Soil and Roots nematodes of Banana(*Musasapientum* L.)in Otuoke Community, Bayelsa State, Nigeria

Abstract

Banana(*Musasapientum* L.)cultivation in rural communities creates job opportunities and generates income. Soil nematodes, a major pest, can lead to yield loss and financial loss. To ensure sustainable production and food security, it's crucial to survey potential threats and identify incumbent nematode species. Identifying these species can help develop effective pest management strategies. A survey was carried out to determine the potential nematode species of threat to banana production in Otuoke community, Bayelsa State. The random sampling technique was employed and soil and roots from two banana mono-cultured vegetations were tested. The modified sieve platetechnique was used for nematode extraction and nematode pictorial key was employed for nematode identification to genera level. A total of 438 nematodes representing 8 genera were identified, among which 51.4% occurred in farm 1 and 48.6%were reported from farm 2.Nematodes of significant economic interest reported in this survey were*Meloidogyne* species(23.1%), *Pratylenchus* species(18.5%), *Ditylenchus* species(15.3%),*Helicotylenchus* species (10.0%), *Hemicyclophora* species (9.8%),*Rotylenchus* species(9.1%),*Radopholus* species (8.4%)and *Paratylenchus* species (5.7%). The occurrence of nematodes against farm types displayed disparities which was indicative that nematodes survival strategy depends on the prevailing field conditions. The study revealed that nematodes compose a prominent pest group infesting banana in Otuoke and should be checked to ameliorate food security.

Keywords:Banana, Food security, Nematodes species, Otuoke

1.0 Introduction

Banana is likely among the ancient vegetable food crop known to the Ijaws, especially in Otuoke, Ogbia kingdom.The crop is locally produced and is consumed across the West African region. In Nigeria, majority of the total banana production comes from the southernpart, particularly the South-Southregion [1,2]. Otuoke have recorded the highest production for the crop[3] and is regarded as banana kingdom.Banana farming in the rural setting generate income and job opportunities for a particular group in the communities, aiding their well-being and reducing crime rate[4].The significance of banana in Otuoke is such that it couldadequately remedy the looming hunger in the land if properly cared for anditsits pest eliminated.It also

playssignificant role in improving the overall local economy of the rural residents.Considering the value and prospects of banana as a sustainable factor for economic development of the rural residents in Otuoke, it became necessary that potential threat to its production be surveyed to create awareness and enable sustainable production and enhance food security.

Among the variety of potential threats to banana production, soil nematodes have been rated higher above insect pests[5]. Soil nematodes compose a significant pest group of vegetable food crops [6] and can facilitate yield loss in banana.*Radopholus* species have been implicated on lesion formation in banana which many a times could result to root enlargement and necrosis [7,8]. Banana cultivated in soil infested with *Meloidogyne* and *Radopholus* species have reportedly showed higher value of dry roots and leaves of economic concern [9,10,7]. Akinyemi[11] reported that nematodes inhibits the water absorbing ability of banana roots and slow down photosynthesis which prompt low yield in the crop.The infestationsof phyto-parasitic nematodes on banana,if not checked, may result to huge financial loss to the farmer and drastically reduce supply in the market and adversely affect intended consumers.

Data on the detrimental effects of nematodes on crops in Otuoke community, Ogbia kingdom is lacking. Hence, the farmers haverepeatedly fall prey of nematode invasion and suffer reduction on farm produce. However, to achieve sustainable production of crops including banana production, a reliable pest management option is required. Nevertheless, identification of incumbent nematode species could aid a good pest management option for the parasites and other related pest infesting banana in the area.Therefore, this study is aimed at surveying soil and root of banana in other to identify the nematode species and create awareness of its threatinOtuoke and guide farmers on cropping system for sustainable banana production.

2.0 Materials and Methods

2.1 Study Area

This survey was carried out in Otuoke, a community thatis the heart of oil exploration activities inOgbia Kingdom, Bayelsa State and is located 21kilometres away from Yenagoa, the capital city of the state. The residents of Otuoke are banana and plantain famers[12]. The vegetations of the area are typical of tropical rain forest. Its' Coordinates is 4°41′22.417″N 7°17′43.470″E [3].

2.2 Collection of plantain soil and roots

Sixty soil samples, each from two banana mono-cultured farms designated farm1 and farm 2, were randomly collected from rhizosphere at depth 0-15 cm using an improvised soil augur. In each banana farm, fifty stands were also selected and the roots removed concurrently with the soil samples with the aid of knife and hand trowel.

2.3 Parasitological analysis of soil and root samples

The modified sieve plate technique as described in [13]was adopted for nematode extraction.A portion of the soil samples was taken from each sample bag rapped in filter paper. A 100ml of running water was measured into a small plastic plate and a sieve was placed on the plastic plate and tied with a rubber band. The soil wrapped in filter paper was placed on sieve supported on the extraction plates. Water was added to the plats ensuring that the sieve and soil in filter paper are touching the tap water in the extraction plates. The extraction set-up was left undisturbed in the laboratory for 72 hours. The soil was removed and the nematode suspension emptied into

specimen bottles, fixed with 10% alcohol and viewed after it had settled, for nematodes counting and identification.

The roots of banana were washed in running water and chopped into smaller parts using a kitchen knife and macerated in a clean blender. A 10ml of water was added to the blender and blended for 15 seconds. Fifty samples were made out and the extraction procedure as for the soil was also employed for the roots.

2.4 Nematode identification: Nematodesidentification was done using pictorial keys according to Siddiqi [14], while the viewing was done with the light microscope.

2.5 Data analysis

Results of this survey were presented by simple percentages and significance of endemic species was analyzed in SPSS version 22 using Analysis of Variance.

3.0 Results

3.1. **Nematode populations in soil and roots of banana in Otuoke.**

Soil and roots sampling in this study revealed the occurrence of a total of 438nematodes from 8 genera. Soil view from farm 1 displayed130 (29.7%) nematodes and soil from farm 2 had 144 (32.8%). The root samples had 164 nematodes in which 95 (21.7%) of the overall occurrence were extracted from farm 1, and farm 2 reported 69 representing 15.8% of the total populations of nematodes in the study (Table 1).

Table 1. Nematode populations in soil and roots of banana in Otuoke.

	Farm 1	**Farm 2**

Nematode	Soil (%)	Root (%)	Total (%)	Soil (%)	Root (%)	Total (%)	Overall Total (%)
Rotylenchus	13(10.0)	6 (6.3)	19 (8.4)	15(10.4)	6 (8.7)	21(9.9)	40(9.1)
Helicotylenchus	25(19.2)	4 (4.2)	29(12.9)	13 (9.0)	2 (2.9)	15 (7.0)	44(10.0)
Meloidogyne	41(31.5)	24(25.3)	65(28.9)	21(14.6)	15(21.7)	36(16.9)	101(23.1)
Pratylenchus	4 (3.1)	26(27.4)	30(13.3)	31(21.5)	20(29.0)	51(23.9)	81(18.5)
Ditylenchus	3 (2.3)	18(18.9)	21(9.3)	34(23.6)	12(17.4)	46(21.6)	67(15.3)
Radopholus	11 (8.5)	17(17.9)	28(12.4)	9 (6.3)	0.0	9 (4.2)	37(8.4)
Paratylenchus	14(10.8)	0.0	14 (6.2)	0.0	11(15.9)	11 (5.2)	25(5.7)
Hemicyclophora	19(14.6)	0.0	19 (8.4)	21(14.6)	3 (4.3)	24(11.3)	43(9.8)
Total	**130(29.7)**	**95(21.7)**	**225(51.4)**	**144(32.8)**	**69(15.8)**	**213(48.6)**	438(100)

3.2 Species diversity of nematodes of banana in Otuoke

The nematodes species recovered from banana in Otuoke were*Rotylenchus, Helicotylenchus, Meloidogyne, Pratylenchus, Ditylenchus, Radopholus, Paratylenchus and*Hemicyclophora species.*Meloidogyne* species 101(23.1%) stood out as a significant threat pest to banana in Otuoke, closely followed by *Pratylenchus* species 81(18.5%).*Ditylenchus* species had 67(15.3%) occurrence, while the populations of *Radopholus* species 37(8.4%) was negligible. The least occurred nematode in this study was *Paratylenchus* species 25(5.7%) (Table 1, Fig.1).

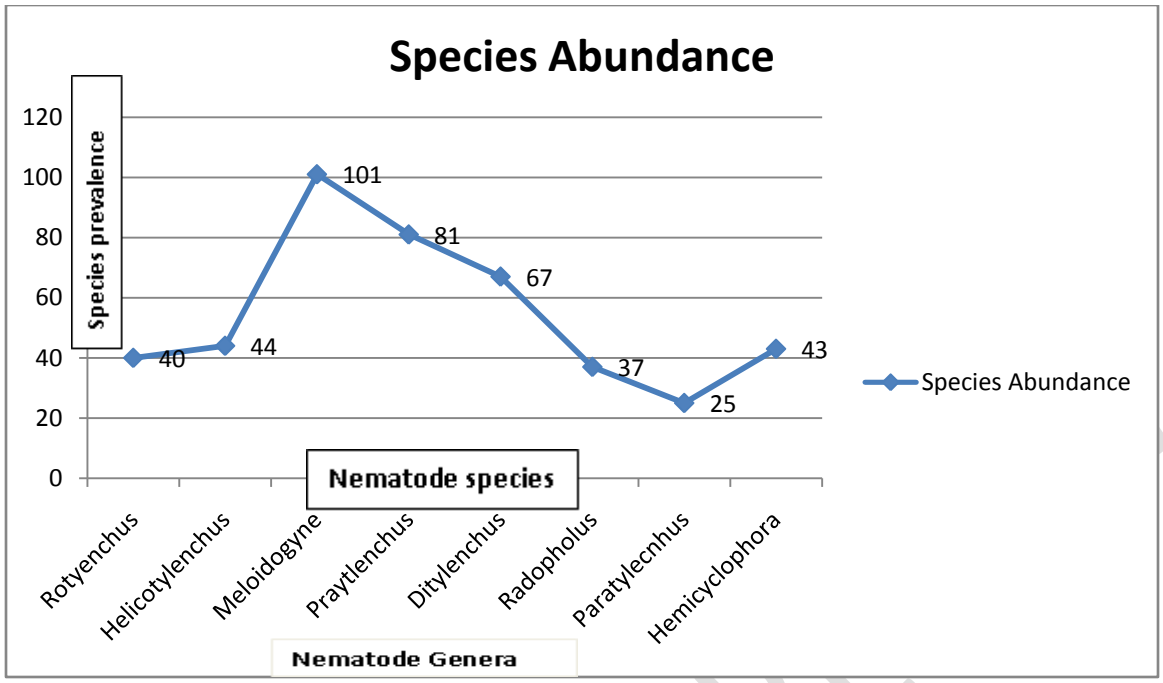

Fig. 1: Species diversity of nematodes of banana in Otuoke

3.3 Variability of nematodes occurrence in farm 1 and 2.

Nematodes species occurred in variable population in the two banana farms sampled. Farm 1 recorded 225(51.4%) nematodes and farm 2 had 213(48.6%) nematodes (Table 1).*Meloidogyne* species 101 (23.1%) occurred most in farm 1 65(28.9%), while farm 2 recorded 36(16.9%) occurrence. The actual occurrence of *Pratylenchus* species was 81 (18.5%), appearing in both farm 1 (13.3 %) and farm 2 (23.9%) but displayinghigher number in farm 2. *Ditylenchus* species 67 (15.3%) was 9.3% and 21.6% in farm 1 and 2 respectively. However, the populations of *Radopholus* species 37 (8.4%) was negligible having 12.4% and 4.2% in farm 1 and farm 2 respectively, although the least occurred nematode in this study was *Paratylenchus* species 25 (5.7%) having 6.2% and 5.2% in farm 1 and farm 2 respectively(Fig. 2).

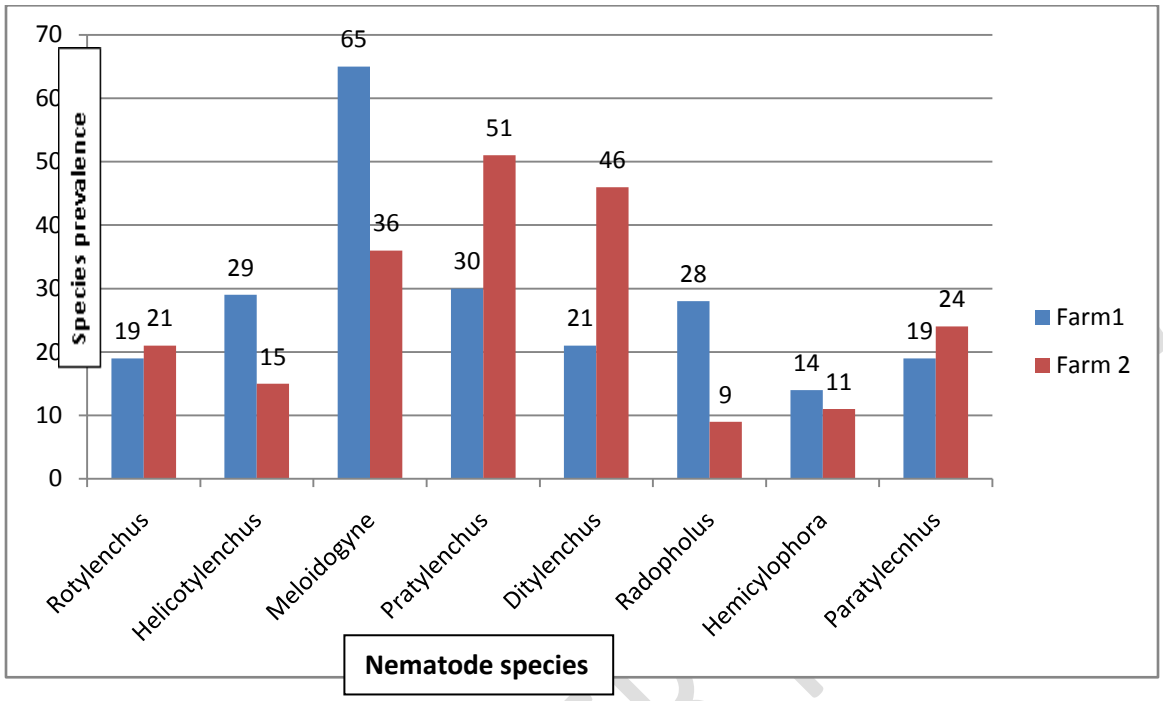

Fig. 2: Variability of nematode occurrence in farm 1 and 2

4.0 Discussion

The study result revealed a total of 438 nematodes representing 8 genera from farm 1 and 2 as pests of banana in Otuoke. This result is indicative that nematodes are potential threats to banana production in the area if not checked.This summation is in conformity with [7,15] which reported that nematodes are typical pests of banana and plantain both in green house and cultivated fields. The presence of nematodes in soil around the roots and inside the root tissues of banana as seen in this study is an evidence that parasitic nematodes compose a serious pest family that could impair banana production and supply in Otuoke. Nematodesassemblage on the root tissue

implies that banana crop in Otuoke are at risk of poor water conduction ability and slow photosynthetic activities which could prompt low yield and limited supply of the crop.

Banana vegetation is usually done on monoculture and last for decays except the farm is abandoned. This practice has increases the vulnerability of the crop to intense infections by phyto-parasitic nematodes. Continuous monoculture favours nematode build up, this is because nematodes build up occur over time and its population increases as long a suitable host is consistent[13].As hunger increases on daily basis in Nigeria, farmers are burdened on getting the fastest remedy for staple food such as rice, to which banana is suitable. Therefore, effortshould be intensify to check nematode infestation and infectivity on banana crop as it can fit in and ameliorate food security. Ogunniyi *et al*. [16] opined that sustainable production forbanana crop in Nigeria can be achieved when measures are in place to check *Meloidogyne* species, an economic pest of banana production.

The study reported higher populations of *Meloidogyne* species (23.1%) above other species and genera. This scenario agreed with [17]who reported high populations of*Meloidogyne* speciesin soil and roots of cassava crop.*Meliodogyne* species has been reported to competently survive in all cultivated fieldsnot minding the prevailing soil conditions[18,13]. In the sequence of occurrence was *Pratylenchus* species (18.5%) following *Meloidogyne* species closely. In banana crops, *Pratylenchus*spp. are frequently observed with species such as *Radopholus*spp. and root-knot nematodes; it is thought that the former serve as a feeding location for the latter's penetration [19]. According to Wang and Hooks [20], the infestation of banana plants with *Pratylenchus*spp.has an adverse effect on plant anchoring, which can cause the plants to uproot or topple and reduce crop yield. The occurrence of *Ditylenchus* species (15.3%) was significantly noticed in this survey; however, the level of economic burden due to its activities on

bananawasnot ascertained. The populations of *Radopholus* species (8.4%), a prominent banana pest as reported by Smith [15],was negligible in this study. This observation can be ascribed to the ability of the genera to outweighcompetitors and establish in the field. However, the assemblage of these nematodes recorded disparities in sampling farms. For instance, the *Meloidogyne* was prevalent in farm 1 and *Pratylenchus* displayed higher number in farm 2. This observation concurs with the postulation that nematodes survival strategyin fieldsdepends on the prevailing conditions in the soil environment[5].

5.0 Conclusion

The study establishedthat banana in Otuoke are susceptible to nematode infestations and its production can be hampered. The study also opined that prevailing field conditions are determinant of nematode survival rate in fields.Therefore, treatment of soil and banana suckers is required to eradicate and prevent nematodes spread.

Competing interests: Authors declare no conflicts of interest exist.

Authors' contributions:

ECO designed the study protocol. Both ECO and EEG performed the sampling and laboratory analyses, analyzed and interpreted the data. EEG managed the literature search and wrote the initial manuscript. All authors read and approved the final manuscript.

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