



Original article

## Identification of parasitic nematodes of *Musa paradisiaca* L. (plantain) in Otuoke, Bayelsa State, Nigeria

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Submitted: November, 2023; Accepted: December, 2023; Published: December, 2023

### ABSTRACT

Plantain, *Musa paradisiaca* L., is a popular food in West African sub-regions, including Nigeria, and a primary source of livelihood for a greater percentage of the people in Otuoke community. Aside being food, the crop *Musa paradisiaca* L. has traditionally been used as medicine. Its growth is hampered by soil nematodes. A survey to identify the endemic nematode pest parasitizing plantain in Bayelsa State was conducted in Otuoke, one of the plantains producing community in the state. Soil samples were randomly collected from the root rhizosphere of a plantain mono-cultured farm of three hundred stands by the use of hand trowel. Roots were also collected at the same time with soil using kitchen knife and nematodes were extracted using the modified sieve plate technique and were identified to genera level by means of nematode key. A total of 384 nematodes from 9 genera were recovered. Among the 384 nematodes reported in this survey, 274 (71.4%) occurred in soil and root tissues had 110 (28.6%). The occurrence of nematodes in soil and roots in this survey could be attributed to nematode site of feeding preference. This observation suggests that high concentration of nutrient around the root rhizosphere can discourage nematodes from root burrowing. The study opined that nematodes of agronomical importance are present in Otuoke and awareness should be created to minimized damage severity on indigenous crops.

**Keywords:** Identification, *Musa paradisiaca*, parasites, Plantain, Root rhizosphere

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## INTRODUCTION

Plantain, *Musa paradisiaca L.*, is an edible food consumed all over West African sub region including Nigeria. The crop plantain is ranked second among the locally produced food in Nigeria [1,2]. In Nigeria, the Southern region has recorded the highest production of all time with Otuoke among the largely producing area for the crop. Plantain meal is the most cherished by the people of Otuoke. Its business is very lucrative and constitutes a primary source of livelihood of a greater percentage of the people living in Otuoke, Ogbia Local Government Area, Bayelsa State. Plantain production has proven a viable alternative for imported food and achievable solution to food insecurity and malnourishment among the inhabitants of Otuoke and the entire Southern Nigeria. In addition, the crop *Musa paradisiaca L.* has traditionally been used as medicine for bacterial-inflicted infections in human [3]. The leaves are practicable cure to problems emanating from insect bites and skin irritations [4]. Growth and yield of plantain had been hampered by the presence of nematodes in the soil. Considering the relevance of plantain in the study area, it became necessary to investigate and identify the nematode species implicated in its poor growth, performance and reduction in yield quality.

Control for nematodes has proven challenging in the rural setting due to inadequate identification. However, proper identification of endemic nematodes constraining plantain production could aid a viable management strategy and facilitate *Musa paradisiacal L.* yield in the area. Nematodes are soil emanating parasites of agronomical importance [5]. Inaccurate assessment and

identification of nematodes species affecting plantain facilitate poor performance of the crop and prompt low supply which could result to food insecurity. However, there can never be a good management strategy for nematodes without proper identification of the endemic species. The exploration of phyto-parasitic nematodes implicated in plantain crop is encouraged by its potential to address significant agricultural challenges and fortify food security. This is because it will ultimately enhance plantain production and mitigate food insecurity. Phyto-parasitic nematodes parasitized the root tissues of plantain in soil and activate poor yield [6]. Olayemi [7] reported that soil-borne nematodes are typical parasites affecting plantain and banana in West African sub-region. However, information on the nematode species of specificity on plantains' poor performance in Otuoke will be of utmost importance in establishing control measure for yield improvement. Therefore, this study is aimed at identifying the nematode species of endemicity implicated in plantain crop in Otuoke.

## MATERIALS AND METHODS

### Study area

This survey was carried out in Otuoke community, Bayelsa State. Otuoke is located in the heart of the oil-rich Niger-Delta Region of Bayelsa State, 21 kilometers away from Yenagoa, Bayelsa State capital. Otuoke is a suburb in Ogbia Local Government Area where most of its inhabitants are fishermen and plantain famers. The vegetation around the general area consisted mostly of primary vegetation of tall trees underlain by an undergrowth of shrubs, grasses and other

forms of secondary vegetal growth in places where the primary forest has been cleared for farming. The rainy (wet) season runs from April to October, whereas, the dry season starts in November and ends in March. The average monthly temperature is high throughout the year. There is a large daily influx of people and a complex socio-economic system in the study area due to the current development projects and the presence of educational and medical facilities. It's Coordinates: 4°42'23.418"N 6°19'44.472"E [8].

### **Collection of plantain roots and soil samples**

Fifty plantain stands were randomly selected and sampled in a plantain mono-cultured farm of three hundred plantain stands. Soil samples (200g per plantain stand) of the randomly selected plantain stands were collected from the root rhizosphere of the plantain with an improvised soil auger. The soil samples were packed into black water-proof bag and labelled against each plantain stand and was transferred to the Biology laboratory of Federal University Otuoke, Bayelsa State, for analysis and detection of the presence of parasitic nematodes. At the same time, roots from the plantain stands where soil were collected were carefully removed using a sterilized kitchen knife and labelled appropriately before conveying to the laboratory for nematodes extraction.

### **Parasitological analysis of soil and root samples**

The modified Baermann technique as described in [9] was adopted for nematode extraction in this study.

A portion of the soil (10g) samples was taken from each sample bag and wrapped in filter paper. A 200ml of tap water was measured into a small plastic plate (10 cm by 15cm) and a net was placed on the plastic plate and band with a rubber band. The soil wrapped in filter paper was placed on net supported on the extraction plates. Water was added to the plates ensuring that the net and soil in filter paper were touching the tap water in the extraction plates. The nematodes migrated through the filter paper into the water in the extraction plates. The set-up was left undisturbed in the laboratory for 48 hours. The soil was discarded and the nematode suspension emptied into specimen bottles, fixed with 5% formalin and viewed after it had settled for nematodes counting and identification.

The roots of plantain were washed in tap water, chopped with 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.

**Nematode identification:** Nematode pictorial keys according to Siddiqi [10] were used for identification while the viewing was done with the light microscope.

### **Data analysis**

Results in this survey were presented by simple percentages and significance of occurrence of endemic species was analyzed with SPSS (Version 23) using Analysis of Variance.

## RESULTS

### Abundance of Plant Parasitic Nematodes of Plantain in Otuoke

The study recorded nematode abundance of 384 species from 9 genera. The nematodes so extracted in soil around the roots of plantain were *Ditylenchus* spp. (7.7%), *Helicotylenchus* spp. (11.7%), *Hemicyclophora* spp. (5.8%), *Heterodera* spp. (16.4%), *Meloidogyne* spp. (15.7%), *Paratylenchus* spp. (4.7%) and *Pratylenchus* spp. (8.8%) (Table 1).

From the root tissue of plantain, a total of 110 nematodes from six genera were extracted. The most prevalence been *Radopholus* spp. (35.5%), closely followed by *Meloidogyne* spp. (24.5%) and *Pratylenchus* spp. (17.3%). However, *Ditylenchus* spp., *Rotylenchus* spp. and *Hemicyclophora* spp. had 10.0%, 9.0% and 3.6% respectively. Nematode actual population in soil and root tissue was statistically significant ( $p < 0.05$ ) (Table 1).

### Species diversity and Abundance of plantain nematodes in relation to site of occurrence

Overall nematode diversity showed that *Radopholus* spp. (23.2%) was the most prevalent, occurring in both soil (18.2%) and roots tissues (35.5%) of plantain. The actual incidence of *Meloidogyne* spp. was 13.0%, followed by *Heterodera* spp. (11.7%) occurring only in soil. *Pratylenchus* spp. (11.2%) occurred in soil (8.8%) and root tissues (17.3%) of plantain. Total abundance for *Ditylenchus* spp. was 8.3%. However, the percentage in soil and root was 7.7% and 10.0% respectively. *Paratylenchus* spp. 3.4%, recorded the least appearance found only in soil. Nematode dynamics for *Hemicyclophora* spp. (5.2%) showed 5.8% in soil and 3.6% in roots of plantain. *Helicotylenchus* spp. (8.3%) appeared only in soil. *Rotylenchus* spp. was 10.4%, having 10.9% in soil and 9.0% in roots (Table 1, Fig. 1).

**Table 1: Abundance of Plant Parasitic Nematodes of Plantain in soil and roots**

Nematode genera	Soil	Roots	Total
	No. (%)	No. (%)	No. (%)
<i>Ditylenchus</i>	21 (7.7)	11 (10.0)	32 (8.3)
<i>Helicotylenchus</i>	32 (11.7)	0	32 (8.3)
<i>Hemicyclophora</i>	16 (5.8)	4 (3.6)	20 (5.2)
<i>Heterodera</i>	45 (16.4)	0	45 (11.7)
<i>Meloidogyne</i>	43 (15.7)	27 (24.5)	50 (13.0)
<i>Paratylenchus</i>	13 (4.7)	0	13 (3.4)
<i>Pratylenchus</i>	24 (8.8)	19 (17.3)	43 (11.2)
<i>Radopholus</i>	50 (18.2)	39 (35.5)	89 (23.2)
<i>Rotylenchus</i>	30 (10.9)	10 (9.0)	40 (10.4)
<b>Total</b>	<b>274 (71.4)</b>	<b>110 (28.6)</b>	<b>384 (100)</b>

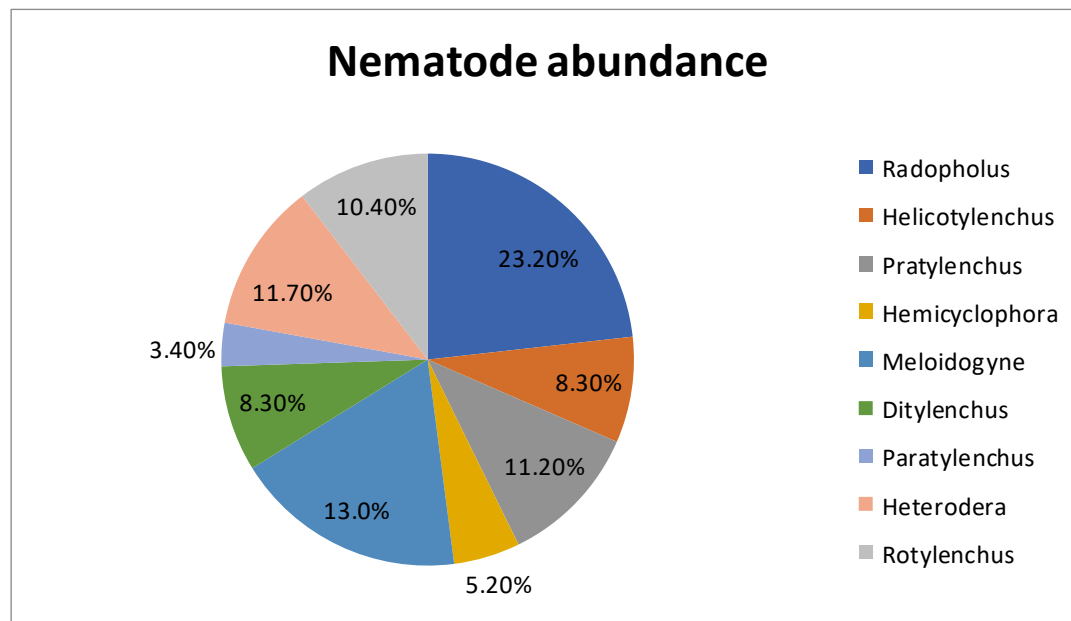


Fig. 1: Overall diversity of plantain nematodes in Otuoke.

## DISCUSSION

This survey sought to identify endemic nematode species affecting plantain plants in Otuoke and recorded a total of 274 nematodes from 9 genera in the root rhizosphere of the crop. Nematodes' prevalence was relatively not significant in this study compared to 15 genera extracted as pest of cucumber in Abua [11]. The observed difference in nematodes occurrence could be ascribed to the crop under review and the season of survey. However, the result indicates that plantain plants in Otuoke are vulnerable to nematode infection. Nematodes infestation on the root rhizosphere of a sampled crop plants is an indication that nematodes are true pest of the crop under review.

The root tissues of plantain in this study showed a total of 110 (28.6%) nematodes. The most prevalent nematode encountered as pest of plantain roots in this study was *Radopholus* spp. (23.2%).

*Radopholus* spp. appeared as a prominent pest of roots globally and has been reported in Nigeria as significant threat of plantain production [12]. *Radopholus* has been implicated in increased dry root and leaves of plantain which are primary growth parameters of the crop [12]. Next to *Radopholus* as pest of plantain in Otuoke was *Meloidogyne* (13.0%), the root knot nematode. This genus *Meloidogyne* spp. is versatile and survives in every cultivated field not minding crops type in the field [11] and can inflect crops singly [13]. This remark is in conformity with [14] which identified *Meloidogyne* species and *Radopholus* species as the most prevalence nematode causing serious threat to plantain and banana crops.

The abundance and distribution of nematodes across soil and roots was significant. A greater population of nematodes appeared in soil (71.4%) when compared with the actual incidence in roots (28.6%). This scenario may be ascribed to species' site of feeding preference for survival. Orluoma *et al.* [15]

reported high populations of nematodes in soil as against the observation in the root tissues of groundnut. However, nematodes' occurrence in this study was influenced by species' site of feeding peculiarity. The high assemblage of species reported from soil as against the observation in root tissues suggests that the soil environment is more conducive for nematode proliferation and survival than the root tissues. Bridge [16] stated that nutrient around the root rhizosphere of crops including plantain and banana could, many a times, discourage nematodes from burrowing as they could find sufficient nutrient for survival.

Nematode species diversity showed variability in relation to nematodes feeding site of preference. For instance, the populations of *Helicotylenchus* (8.3%), *Heterodera* (11.7%), and *Paratylenchus* (3.4%) were reported in soil 8.3%, 11.7%, and 3.4% respectively and were missing in the root tissues of plantain. However, *Radophulus* (23.2%) was the most prevalent occurrence in soil (18.2%) and roots (23.2%). *Meloidogyne* (13.0%) was also reported in soil (15.7%) and root tissues (24.5%). This scenario could be attributed the species ability to withstand prevailing stress and establish in the environment. It can also be ascribed to nematodes survival strategies and intrinsic properties for overcoming external forces. Ekine [17] reported that nematodes are responsive to changes due to external forces and only species that can adapt rapidly could survive.

The study established that nematodes of agronomical importance are present in Otuoke and awareness should be created to minimized damage severity on indigenous crops including plantain.

However, damage level was not ascertained in this study.

**Declaration:**

**Ethical Approval:** Not applicable

**Conflict of interests:** Authors declare that no conflicts of interest exist.

**Authors' contributions:** ECO designed the study protocol. Both ECO and EEG performed the field samples collection, laboratory analyses, analyzed and interpreted the data. EEG wrote the initial manuscript. All authors read and approved the final manuscript.

**Acknowledgements:** The authors immensely appreciate the farm owner for his consent. The support of Laboratory Technologists in the Department of Biology, Federal University Otuoke, Bayelsa State is sincerely appreciated.

## REFERENCES

1. Akinyemi, S.O.S., Aiyelaagbe, I.O.O. and Akyeampong, E. (2010). Plantain (*Musa* spp.) Cultivation in Nigeria: a Review of Its Production, Marketing, and Research in the Last Two Decades. *Acta Horticulturae*, 1(879): 211-218.
2. Okoli, C.A. and Eze, C.S. (2012). Morphological diversity of plantain cultivars in Nigeria. *African Journal of Plant Science*, 6 (3): 124-131.
3. Ojo, A. and Adegbola, P. (2020). Economic Analysis of Plantain Production in Nigeria: A Case Study of Ogun State. *Nigerian Journal of Agricultural Economics*, 10 (1):1-14.

4. **Ojo, M.O. and Adebayo-Oyetero, A.O.** (2016). Socio-economic analysis of plantain production in Nigeria: Evidence from Ogun State. *Journal of Agricultural Extension and Rural Development*, **8 (3)**: 57-64.
5. **Ekine, E.G. and Gboeloh, L.B.** (2022). Impact of composited poultry dung on nematodes dynamics and bell pepper performance in Omelema, Rivers State Nigeria. Abstract presented at the 2022 conference of the parasitology and Public society of Nigeria. PPSN/2022/ABS/148, p75.
6. **Bridge, J. and Starr, J.L.** (2007). Plant Nematodes of Agricultural Importance: A Colour Handbook (1st ed.). CRC Press. <https://doi.org/10.1201/b15142>
7. **Olayemi, F.** (2018). Nematode pests of banana and plantain in Nigeria. *Journal of Nematology Research*, **22 (9)**:89-92.
8. **Johnson, M.** (2008). *Otuoke: A Coastal Town in Bayelsa State*. Yenagoa publishers, **78**.
9. **Southey, J.F.** (1986). Laboratory method for work with plant and soil nematodes. Her majesty's Stationery office, London, 201.
10. **Siddiqi, M.R.** (2000). Tylenchida Parasites of Plants and Insects (2nd edition). CAB International Publishing. Wallingford, UK, 833 pp.
11. **Gboeloh, L.B., Elele, K. and Ekine, E.G.** (2019). Plant parasitic nematodes associated with cucumber (*Cucumis sativa*) in Abua/Odual Local Government Area Rivers State. *International Journal of Science, Technology, Engineering, Mathematics and Science Education*, **4(1)**: 23-31.
12. **Imafidor, H.O.** (2007). Estimation of Damage Caused by the Burrowing Nematode, *Radopholus similis* (Cobb, 1893) Thorne, 1949 (*Tylenchidae*) (Guerot, 1970) on *Musa Germplasm* in Green House Studies in Rivers State, Nigeria. *Journal of Applied Sciences and Environmental Management*, **11(4)**: 59-62
13. **Imafidor, H. and Ekine, G.** (2016). A survey of the nematode pests of the crop cassava (*Manihot esculenta*) in Rivers State, Nigeria. *African Journal of Applied Zoology and Environmental Biology*, **18**: 17-18.
14. **Gowen, S.R., Quénéhervé, P. and Fogain, R.** (2005). Nematode parasites of bananas and plantains. Plant Parasitic Nematodes in Subtropical and Tropical Agriculture. *Journal of Nematology*, **2 (9)**: 611-643.
15. **Orluoma, C.A., Ekine, E.G. and Karibi, E.I.** (2023). Populations of phyto-parasitic nematodes on groundnut (*Arachis hypoeal*) cultivated fields in Egbolom, Abual/Odual Local Government Area, Rivers State, Nigeria. *FNAS Journal of Scientific Innovations*, **4(2)**: 19-26.
16. **Bridge, J.** (2000). Nematodes of banana and plantain in Africa: Research trends and management strategies relating to the small-scale farmer, *Acta Horticulturae*, **540**: 391-408
17. **Ekine, E.G.** (2020). *Impact of poultry manure on soil nematode dynamics and yield of bell pepper (Capsicum annum) yield in*

*Abua/Odual Local Government Area, Rivers State, Nigeria.* PhD thesis, Ignatius Ajuru University of Education, Port Harcourt, Rivers State, Nigeria.