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Assessment of nematode pests of ornamental plants in Federal University Otuoke, Bayelsa State, Nigeria.

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Abstract

A survey at Federal University Otuoke, Bayelsa State in Nigeria assessed nematode infestation of ornamental plants, highlighting their significance in human existence, medicine, and air purification. Identification of the ornamental plants was done prior to sampling. Soil and roots samples were collected simultaneously using soil auger and kitchen knife at 0-20 cm core depth. Nematode extraction was done using a modified sieve plate method, and identification was done using a pictorial key. The study found an overall abundance of 2,149 nematodes, with 12 genera identified. Genera of eminent species noticed in this survey were *Aphelenchoides*, *Ditylenchus*, *Gracilachus*, *Helicotylenchus*, *Heterodera* species, *Longidorus*, *Meloidogyne*, *Nacobbus*, *Pratylenchus*, *Rotylenchulus*, *Tylenchus* and *Xiphinema* species. Nematode richness of 942 (43.8%) and 1,207 (56.2%) were recorded at the East and West campuses respectively. Copious number was recorded for *Heterodera* species (13.3%) and *Pratylenchus* species (26.1%) in soil at West and East campuses respectively; while in the root tissues of the ornamental plants, *Helicotylenchus* species (26.9%) and *Ditylenchus* species (27.8%) were predominant at respective campuses. The most susceptible ornamental plants were *Chrysothemis pulchella* (Sunset bells) (19.0%) and *Codiaeum variegatum* (Croton) (14.6%) at East and West campuses respectively. The study found that the susceptibility level of each ornamental plant significantly influenced nematode richness within the campus ($P < 0.05$). However, nematode occurrence between the campuses investigated was not significant ($P > 0.05$). The survey concluded that phyto-parasitic nematodes are factual pests that can impede quality production and supply of ornamentals plants in Otuoke if not checked. However, attention on nematode pest of ornamentals in Otuoke will guarantee market for gardeners, preserve nature's beauty, and provide residents with clean air for healthy living. The study recommends gardeners use composited poultry droppings as manure to outweigh the effects of nematode infestation.

Keywords: Assessment, nematodes, ornamental plants, Otuoke, Phyto-parasites, University.

INTRODUCTION

Ornamentals are raised in different parts of the world for a variety of intent peculiar to the region where they are cultivated. In some parts of the world, ornamentals are raised as decoration and medicine (Nwanze & Ojeniyi, 2018; Howland & Quintanilla, 2023) while some cultivate them as atmospheric cleaning agents (El-Tanbouly *et al.*, 2021). The varieties of purposes for which ornamentals are raised have made the ornamental gardens weighty globally.

In pollution prone areas of the Niger Delta, like Otuoke, the growing of ornamental plants is fast becoming a tenet. It is believed here that the presence of plants, including ornamental species, can guarantee pollutant-free air for breathing. This is because these plants can naturally

separate carbon (iv) oxide into Oxygen (Agyekum, 2010; Nwanze & Ojeniyi, 2018; El-Tanbouly *et al.*, 2021) and ensure suitable air for the continuity of life. The relevance attached to ornamentals within Otuoke has prompted a good market for gardeners within the region. Ornamental gardens have formed major source of income for majority of the Otuoke residents and that has shaped their way of life. Aside of the economic importance and air purification, ornamental plants play a crucial role in enhancing beautification of landscapes in Federal University Otuoke. Yet, the sustainability of these important crop plants species is threatened by nematode infestations.

Plant feeding nematodes disrupt the beauty of nature by depleting plant quality (Nzeako *et al*., 2016; Ekine *et al*., 2018; Ekine & Ezenwaka, 2023) including vegetables and ornamentals and put human at risk of their expectations. Infested ornamentals may appear rough and unpleasant at sight, hence, jeopardise attempt to maintain the beauty of nature. Their infestations on ornamental plants increases the chances of opportunistic fungal and bacterial infections which intensifies damage status (Nzeako *et al*., 2016; Howland & Quintanilla, 2023) and starve man of good air while presenting landscape with a poor look. The local farmers and gardeners in Otuoke have frequently fallen victim of the mischief imposed by these nematodes. This is because they lack the basic knowledge of the ability of nematodes to cause harm and yield quality prediction, both of which have facilitated the spread of the parasitic worms and endangered biodiversity.

Given the importance of ornamental plants, prompt action is required to ensure pest-and disease-free green plants and secure clean air for sustenance in the Niger Delta as air pollution from oil exploration and gas flaring intensifies. Hence, this study is targeted towards providing insight on nematodes of ornamental plants in Otuoke and suggesting possible preventive measures.

MATERIALS AND METHODS

Study Area: This research was conducted at the West and East campuses of Federal University Otuoke (FUO), Bayelsa State, Nigeria. The Federal University is situated in the centre of Otuoke town, an oil-rich community in the Ogbia Local Government Area of Bayelsa State, South of Nigeria. It lies on Latitude 4°42′23.418″N and Longitude 6°19′44.472″E. It is among the nine (9) new Federal Universities established by the Nigerian government in February 2011. Otuoke community is 21 kilometres away from Yenagoa, Bayelsa State capital. The inhabitants are fishermen and garden keepers (Smith, 2010). 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.

Identification of the Ornamental plants in the study area: Prior to sampling, leaf samples from the ornamental plants at the East and West campuses of Federal University Otuoke, Bayelsa, were gathered for accurate scientific identification by a taxonomist at the Department of Biology, Federal University Otuoke, Bayelsa State, Nigeria.

Sample collection: Soil samples were collected around the root region of eight randomly selected ornamentals used for the beautification of the premises of senior staff club (East campus, FUO). The soil was collected at 0-20 cm core depth using a hand trowel. The samples were packed into appropriately labelled waterproof bags and taken to laboratory of Biology Department, Federal University Otuoke, Bayelsa State, for nematode bioassay. At the West campus, the soil samples were collected at the premises of the Post-graduate school. All the samples were collected once per week between February through May, 2023 between 6:30 am – 7:30 am.

At the same time, using a sterilized knife and hand trowel, root samples from each stand of ornamentals where soil was collected were carefully removed and appropriately labelled.

Laboratory bioassay of soil and root samples of ornamentals in Otuoke: The modified sieve plate technique, according to Ekine *et al*. (2020), was adopted for nematode extraction. Soil from each sampling bag was properly examined and debris removed. A 5g of soil sample each was wrapped in tissue paper, placed on a plastic plate with net, band with a rubber band. Water was added to the plates ensuring that the net and soil in tissue paper are touching the water in the extraction plates but not submerged. The extraction procedure was left undisturbed in the laboratory for two days. After discarding the soil, the nematode suspension was emptied into specimen

bottles, fixed with 5% formalin and viewed after it had settled for nematodes counting and identification.

The roots were cleaned in running water, chopped with kitchen knife and macerated in a clean blender. A 10ml of water was added to the blender and ran for 15 seconds. Samples were made out against each plant from where roots were collected and the extraction procedure as for the soil was also employed for the roots.

Nematode identification: Nematode pictorial keys according Mekete *et al*. (2012) was used for for identification while the viewing was done with x10 and x40 objectives of the light microscope.

Data analysis: Results of this survey were presented in simple percentages and significance of endemic species was analyzed in SPSS version 23 using Analysis of Variance.

RESULTS

Overall nematode abundance in ornamentals in Federal University Otuoke (FUO), Bayelsa State, Nigeria

In this survey, soil and root samples of ornamentals within the Federal University Otuoke recorded nematode richness of 942 (43.8%) and 1,207 (56.2%) at the East and West campuses respectively, with an overall abundance of 2,149. However, nematode occurrence between the campuses was not significant *(P* > 0.05) (Table 1).

Table 1: Overall nematode abundance in ornamentals in Federal University Otuoke (FUO), Bayelsa State, Nigeria

Campuses	**Nematode abundance (**%)
East	942 (43.8)
West	1,207 (56.2)
Total	2,149

Nematodes of ornamentals from Senior staff clubs in East campus, Federal University Otuoke

Soil and root samples of the ornamental plants from the senior staff club, East campus of the Federal University Otuoke presented nematode richness of 942, among which 68.7% were seen in soil around the root region and the root tissue had 31.3% with the highest nematode accumulation occurring on *Ixora chinensis* (Chinese ixora) (22.1%) and *Chrysothemis pulchella* (Sunset bells) (29.5%) for soil and roots respectively. The most susceptible ornamental plant in the East campus was *Chrysothemis pulchella* (Sunset bells) (19.0%). No nematode was recorded in the root tissue of *Codiaeum variegatum* (Croton) plant. However, nematode load on the ornamental plants was significant (*P* < 0.05). Nematode pests of economic importance encountered in this East campus were *Meloidogyne* species, *Pratylenchus* species, *Heterodera* species, *Xiphinema* species, *Nacobbus* species, *Helicotylenchus* species, *Tylenchus* species, *Ditylenchus* species and *Rotylenchulus* species (Table 2).

Table 2: Nematodes of ornamentals from senior staff clubs in East campus, FUO

	Ornamentals								
Nematodes	***Hibiscus rosa-sinensis*** **(Chinese Hibiscus)** **(%)**	***Chrysothemis pulchella*** **(Sunset bells)** **(%)**	***Caesalpinia pulcherrima*** **(Pride of Barbados)** **(%)**	***Ixora chinensis*** **(Chinese ixora)** **(%)**	***Euonymus japonicas*** **(Japanese euonymus)** **(%)**	***Gardenia jasminoides*** **(Cape jasmine)** **(%)**	***Terminalia catappa*** **(Tropical almond)** **(%)**	***Codiaeum variegatum*** **(Croton)** **(%)**	**Total** **(%)**
Soil									
Nacobbus	8(14.8)	0	9(16.6)	21(38.8)	0	0	2 (3.7)	14(26.0)	**54 (8.3)**
Xiphinema	17(28.8)	6 (10.2)	5 (8.5)	0	21(35.6)	3 (5.0)	0	7 (11.9)	**59 (9.1)**
Meloidogyne	24(25.8)	12 (12.9)	4 (4.3)	17(18.3)	7 (5.5)	15 (16.1)	1 (1.1)	13(14.0)	**93(14.4)**
Helicotylenchus	4(3.6)	31 (27.7)	0	21(18.8)	6 (5.4)	21 (18.8)	7 (6.3)	22(19.6)	**112(17.3)**
Pratylenchus	25(14.8)	14 (8.3)	3 (1.8)	31(18.3)	27(16.0)	19 (11.2)	14 (8.3)	36(21.3)	**169(26.1)**
Heterodera	1(1.0)	7 (7.6)	11(12.0)	39(42.4)	11(12.0)	20(4.7)	3 (3.3)	0	**92(14.2)**
Tylenchus	0	22 (32.4)	9 (13.2)	14(20.6)	5 (7.4)	7 (10.3)	11 (16.2)	0	**68(10.5)**
Total	**79**	**92**	**41**	**143**	**77**	**85**	**38**	**92**	**647**
	(12.2)	**(14.2)**	**(6.3)**	**(22.1)**	**(12.0)**	**(13.1)**	**(5.9)**	**(14.2)**	**(68.7)**
Root									**Total**
Meloidogyne	21(34.4)	11(18.0)	4 (6.6)	15(24.6)	4 (6.6)	6(9.8)	0	0	**61 (20.7)**
Rotylenchulus	9 (23.6)	18 (47.4)	5 (13.2)	1 (2.6)	2 (5.3)	3 (7.9)	0	0	**38 (12.9)**
Tylenchus	2 (2.9)	18 (26.0)	25(36.2)	6 (8.7)	13(18.8)	4 (5.8)	1(1.4)	0	**69 (23.4)**
Ditylenchus	6 (7.3)	31 (36.4)	3 (3.7)	11(13.4)	6 (7.6)	25(36.5)	0	0	**82 (27.8)**
Pratylenchus	11(24.4)	9 (20.0)	21(46.6)	4 (8.8)	0	0	0	0	**45 (15.2)**
Total	**49**	**87**	**37**	**33**	**46**	**42**	**1**	**0**	**295**
	(16.6)	**(29.5)**	**(12.5)**	**(11.2)**	**(15.6)**	**(15.2)**	**(0.3)**	**(0)**	**(31.3)**
Grand total	**128 (13.6)**	**179** **(19.0)**	**78** **(8.3)**	**176 (18.7)**	**123 (13.1)**	**127** **(13.5)**	**39** **(4.1)**	**92** **(9.7)**	**942 (43.8%)**

Nematodes of ornamental plants in Post-graduate school, West campus, FUO

From the ornamental garden of the Post-graduate school, West campus of the Federal University Otuoke; 1,207(56.2%) nematodes were recovered with 28.3 % appearing in roots and 71.7 % seen in the soil. *Codiaeum variegatum* (Croton) (15.5%) was reported most susceptible for soil nematode and the root of *Ixora chinensis* (Chinese ixora) (24.3%) had highest nematode assemblage in roots. The most susceptible ornamental plant in the west campus was *Codiaeum variegatum* (Croton) (14.6%). *Longidorus* species, *Aphelenchoides* species and *Gracilachus* species were peculiar to ornamental plants in the West campus only. *Aphelenchoides* species were seen in the soil and root tissues of ornamentals in the West campus, while *Longidorus* and *Gracilachus* species were present only in the soil around the roots of ornamentals in the West campus, FUO (Table 3).

DISCUSSION

Ornamental plants have been of immense value to man as medicine and air cleanser and for decoration in the physical environment. The overall richness of nematodes of ornamentals in the present survey (2,149) portrays high assemblage. This lofty number in terms of nematode richness as seen in soil region and root tissues of ornamental plants in Otuoke is a mark that phyto-parasitic nematodes are factual pests that can impede quality production and supply of ornamentals in the area if not checked. Ogbuji *et al.* (2017), Emosairue and Iloh (2021) and Howland and Quintanilla (2023) reported that nematodes are prominent pathogens altering yield quality and growth of ornamental plants industry. However, attention on nematode pests of ornamentals in Otuoke will guarantee market for gardeners, uphold the beauty of nature and satisfy inhabitants with safe atmospheric oxygen. It also suggests that nematodes flourish swiftly in favourable situations without compromise. This declaration is in conformance with Ekine and Ezenwaka (2023) which stated that nematodes exhibit excellent propagation on continual availability of preferred host of parasitism.

The actual apportionment of nematodes across the sampled sites saw the West campus (56.2%) with a greater number of nematodes. With the same soil condition, the East campus (43.8%) recorded fewer numbers of nematodes. This remark suggests that the actual appearance of nematodes in the field is manipulated by survival techniques peculiar to specific species not minding the stability of soil properties. This postulation disagrees with earlier position of Orluoma *et al.* (2023) that field-predominant features can out-weigh existing nematode survival mechanisms; thus, predicting community composition in fields. However, the disparity in these opinions can be attributed to nematodes species endemic in the research regions and climatic features of the environments.

The present research reported twelve (12) nematode genera. Copious number was recorded for *Heterodera* species (13.3%) and *Pratylenchus* species (26.1%) in soil samples at West and East campuses respectively. In the root tissues of the ornamental plants, *Helicotylenchus* species (26.9%) and *Ditylenchus* species (27.8%) were predominant at West and East campuses respectively. Other nematode genera of eminent noticed in this survey were *Nacobbus, Longidorus, Aphelenchoides, Gracilachus, Rotylenchulus, Meloidogyne, Tylenchus* and *Xiphinema* species. However, *Trichodorus, Paratylenchus, Radopholus* and *Paratrichodorus* species reported in Howland and Quintanilla, (2023) were not recorded in this study. This observation can be attributed to the incumbent ornamental plants investigated and the prevailing features in the research area.

The most susceptible ornamental plants as seen in Otuoke were *Chrysothemis pulchella* (Sunset bells) (19.0%) and *Codiaeum variegatum* (Croton) (14.6%) at East and West campuses respectively. Following the sequence of vulnerability was *Ixora chinensis* (Chinese ixora) (18.7%) and *Caesalpinia pulcherrima* (Pride of Barbados) (13.9%) at East and West campuses respectively. Nematode richness was influenced by the susceptibility level portrayed by each ornamental plant investigated, and this effect was significant ($P < 0.05$) within campus. However, nematode occurrence between the campuses investigated was not significant ($P > 0.05$). This observation can be attributed to proximity of soil conditions of the investigated campuses.

Table 3: Nematodes of ornamental plants in West campus, FUO

Ornamentals / **Nematodes**	***Hibiscus rosa-sinensis*** **(Chinese Hibiscus)** **(%)**	***Chrysothemis pulchella*** **(Sunset bells)** **(%)**	***Caesalpinia pulcherrima*** **(Pride of Barbados)** **(%)**	***Ixora chinensis*** **(Chinese ixora)** **(%)**	***Euonymus japonicas*** **(Japanese euonymus)** **(%)**	***Gardenia jasminoides*** **(Cape jasmine)** **(%)**	***Terminalia catappa*** **(Tropical almond)** **(%)**	***Codiaeum variegatum*** **(Croton)** **(%)**	**Total** **(%)**
Soil									
Longidorus	12 (19.3)	0	7 (11.3)	11(17.7)	0	21 (33.9)	0	11(17.7)	**62 (7.2)**
Ditylenchus	4 (4.3)	5 (6.6)	31(40.8)	21(27.6)	2(2.6)	11 (14.5)	0	2.2.6	**76 (8.8)**
Meloidogyne	4 (3.9)	11(10.8)	16(15.7)	9 (8.8)	8(7.8)	39 (38.2)	1 (0.9)	14(13.7)	**102(11.8)**
Heterodera	41 (35.7)	21(18.3)	4 (3.5)	0	6(5.2)	11 (9.6)	2 (1.7)	30(26.0)	**115(13.3)**
Aphelenchoides	6 (11.1)	15(27.7)	0	13(24.0)	0	3 (5.5)	17 (3.5)	0	**54 (6.2)**
Helicotylenchus	0	16(22.9)	20(28.6)	5 (7.1)	17(24.3)	11 (15.7)	1(1.4)	0	**70 (8.1)**
Gracilachus	6 (3.5)	31(18.0)	25(14.5)	10(5.8)	40(23.3)	0	28(16.3)	32(18.6)	**172(19.9)**
Pratylenchus	11 (17.5)	14(22.2)	19(30.2)	0	4 (6.3)	12 (19.0)	0	3 (4.8)	**63 (7.3)**
Rotylenchulus	10 (11.6)	4 (4.7)	9 (10.5)	0	15(17.4)	21 (24.4)	0	27(31.4)	**86 (9.9)**
Tylenchus	8 (11.3)	7 (10.8)	0	3 (4.6)	11(16.9)	0	21(32.3)	15(23.0)	**65 (7.5)**
Total	**102 (11.8)**	**124 (14.3)**	**131 (15.1)**	**72 (8.3)**	**103 (11.9)**	**129 (14.9)**	**70 (8.1)**	**134 (15.5)**	**865 (71.7%)**
Root									
Ditylenchus	18(30.5)	4 (6.8)	0	0	5(8.5)	0	11(18.6)	21(33.6)	**59 (17.3)**
Rotylenchulus	5 (6.8)	21(28.4)	8 (10.8)	31(41.9)	4 (5.4)	4 (5.4)	0	1(1.4)	**74 (21.6)**
Meloidogyne	13(39.3)	0	6 (18.2)	9 (27.3)	3 (9.0)	0	1 (3.0)	1(3.0)	**33 (9.6)**
Helicotylenchus	0	3 (3.8)	18(19.6)	25(27.2)	31(33.7)	9 (9.8)	0	6 (6.5)	**92 (26.9)**
Pratylenchus	0	2 (3.8)	7 (13.2)	18(33.9)	0	11 (30.8)	4(7.5)	11(20.8)	**53 (15.5)**
Aphelenchoides	3 (9.7)	9 (29.0)	11(35.5)	0	0	0	6 (19.4)	2(6.5)	**31 (9.0)**
Total	**39(11.4)**	**39(11.4)**	**50(14.6)**	**83(24.3)**	**43(12.6)**	**24 (7.0)**	**22(6.4)**	**42(12.3)**	**342(28.3)**
Grand total	**144 (11.9)**	**163 (13.5)**	**168 (13.9)**	**155 (12.8)**	**146 (12.1)**	**153 (12.7)**	**92 (7.6)**	**176 (14.6)**	**1,207 (56.2)**

CONCLUSION AND RECOMMENDATIONS

Considering the high incidence of nematodes in Otuoke, gardeners should adopt the use of composited poultry droppings as manure while raising ornamental plants. Composited poultry filters can boost crop rigidity against nematode penetration and can be employed as a viable option in the management of phyto-parasitic nematodes in field. The attitude of alternating ornamental species in landscape arrangement could reduce infestation load on the plants and improve growth quality. Since nematodes exhibit host peculiarity, alternating resistance species may alter build-up sequence of nematodes of preference of the susceptible ornamental species and improve performance.

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