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Occurrence and Distribution of Plant Parasitic Nematodes Associated with Recreational Turf Soils of Federal University Otuoke, Niger Delta Region of Nigeria

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Abstract

Plant-parasitic nematodes pose a hidden threat to turfgrass health by damaging root systems and weakening sports playing surfaces. This study assessed the presence, relative abundance, and vertical distribution of phytoparasitic nematodes associated with turfgrass at the Federal University Otuoke football field in Bayelsa State, Nigeria. Soil samples were collected from the field, and nematodes were extracted using the modified Baermann tray technique and examined microscopically for identification to the genus level. A total of 188 phytoparasitic nematodes belonging to six genera were recovered. *Meloidogyne* spp. was the most prevalent group, accounting for 29.8% (56 individuals) of the total assemblage, followed by *Longidorus* spp. (17.6%, 33), *Tylenchus* spp. (17.0%, 32), *Heterodera* spp. (13.3%, 25), *Pratylenchus* spp. (12.2%, 23), and *Radopholus* spp. (10.1%, 19). Analysis of vertical distribution across soil core depths showed that nematode population density increased with depth: 18.6% (35) in the 0–10 cm depth, 29.3% (55) in the 11–20 cm depth, and 52.1% (98) in the 21–30 cm depth. All six genera were present in the 21–30 cm soil layer, indicating that deeper soil serves as a primary reservoir for phytoparasitic nematodes at this site. The findings confirm that the football field turf supports a diverse nematode community dominated by root-knot nematodes (*Meloidogyne* spp.), providing essential baseline data to inform future turf diagnosis, health monitoring, and management strategies in Nigeria.

Keywords: Phytoparasitic Nematodes, Turfgrass, *Meloidogyne spp*., Vertical Distribution, Soil Core Depth, Baermann Tray Method, Federal University Otuoke.Adaptation Strategies, Agricultural, Climate Change.

Introduction

Turf grasses are widely used on football fields and other recreational landscapes, because of its ability to improve ground cover, reduce erosion, and provide a durable playing surface. In football fields, turf quality is specifically important because the grass is subjected to repeated trampling, mowing, watering, compaction, and other maintenance practices that can weaken the root zone over time. When turf becomes unhealthy, the playing surface may deteriorate, and the grass may recover slowly after stress (Dong et al., 2022; Shahoveisi & Waldo, 2024; Mwamula & Lee, 2021). One hidden cause of turf decline is infections by plant-parasitic nematodes. Plant parasitic nematodes are soil born parasites, infecting plant roots in soil. The feeding behavior of plant parasitic nematodes is damaging to root tissues and interferes root conduction processes in the plant. According to Mwamula and Lee (2021), plant-parasitic nematodes can cause both direct and indirect damage to turfgrass, leading to chlorosis, stunted growth and poor turf recovery. Because these symptoms are often similar to those caused by drought, poor soil fertility, or compaction, nematode problems may go unnoticed unless laboratory diagnosis is carried out (Luc et al., 2005; Nicol et al., 2011; Crow, 2023).

Various species of plant parasitic nematodes are commonly reported in turfgrass fields. This is evidence that turf grass can support nematode diversity in the ecosystem. Nematode survey in places like China, Korea, Australia, and the United States have reported the presence of phytoparasitic nematodes including genera like *Helicotylenchus*, *Tylenchorhynchus*, *Mesocriconema*, *Meloidogyne*, *Pratylenchus*, *Hoplolaimus*, and *Paratrichodorus* as problems of turf soils (Stirling et al., 2021). Dong et al. (2022) recorded 41 species of nematodes belonging to 20 genera, while Shahoveisi and Waldo (2024) identified 13 plant-parasitic nematode taxa from golf courses and athletic fields in Maryland. The results from Zeng et al. (2012), Vandenbossche et al. (2012), and Stirling et al. (2021) reported that turfgrass-associated nematodes are diverse and can occur at levels capable of causing turf injury. Nzeako et al. (2016) reported higher prevalence of *Pratylenchus* species in secondary school football fields in Port Harcourt, Nigeria. Root-knot nematodes, *Meloidogyne* species are among the most economically important plant-parasitic nematodes worldwide and have been reported from golf courses and sports fields in several countries (Sasser & Carter, 1985; Taylor & Sasser, 1978; Azevedo de Oliveira et al., 2018). These species have been reported as pests and parasites of ornamentals in Otuoke (Ezenwaka & Ekine, 2024). Their ability to induce root galls and disrupt root function makes them a particular concern in intensively managed turf systems where rapid recovery from wear is essential (Ye et al., 2015; Tredway et al., 2017). The abundance and composition of nematode communities in turfgrass are affected by turf species, soil type, climate, moisture, and management intensity (Groover, 2020; Dong et al., 2022).

Turfgrass growing in warm, humid environments may support nematode survival and reproduction for most of the year, typical of the Niger delta region. However, fields subjected to frequent use and repeated stress may be more vulnerable to root damage caused by nematodes. Because of these variations, local surveys are necessary to determine the nematode group present in a particular site and to provide baseline information for future management. (Dong et al., 2022; Stirling et al., 2021; Ye et al., 2015). In Nigeria, there is limited published information on phytoparasitic nematodes associated with turf grass in community or university football fields such as the one located within the East Campus of Federal University Otuoke.

This makes it difficult to know whether nematodes are contributing to turf decline in the area. This study is significant because it may help to identify the nematode fauna present, determine distribution pattern which may be critical in turf management decisions. Dong et al., 2022; Zeng et al. (2012) reported the necessity of community specified surveys which are needed to determine the nematode species of importance and peculiarity in specific area to provide the required information to improve nematode management.

Turfgrass decline on football fields is often attributed to visible stress factors such as drought, low fertility, or compaction, while plant-parasitic nematodes are rarely considered. This can lead to misdiagnosis and delayed management, even when nematode populations are present in damaging numbers. Since no detailed survey has been documented for Federal University Otuoke football field, there is need to assess the phytoparasitic nematodes associated with the turf grass there. Therefore, this study is aimed at assessing plant parasitic nematodes associated with turf grass in Federal University Otuoke football field.

Materials and Methods

Study Area

The study was carried out in Otuoke. However, soil samples were collected at the football field, East Campus, Federal University Otuoke, Otuoke, Ogbia local government Bayelsa State, Nigeria (Lat. 04°47'42.9" N, long. 006°19'34.8" E). The field is used for football and other recreational purposes and is covered by turf grass. The area is characterized by high rainfall, high humidity and sandy-loam soil, conditions that are favorable for nematode survival and multiplication.

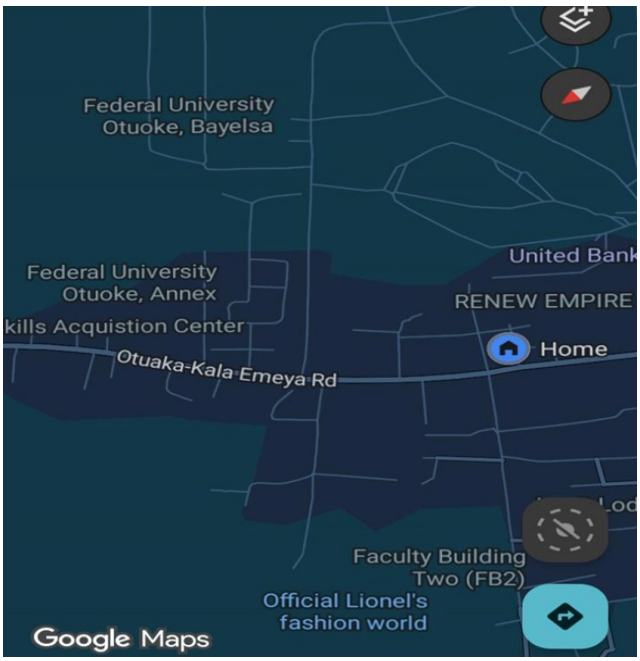


Figure 1: Map of the study area

Sample Collection

Sample collection was conducted between March and August 2026, corresponding to the rainy season peak in the study area. Soil samples were collected randomly from selected points within the University

football field, using a hand trowel. Thirteen (13) bulk samples were collected at a soil core depth of 0-10cm, thirteen (13) bulk samples at 11-20cm and fourteen (14) bulk samples at 21-30cm, making a total of 40 bulk samples. Each bulk sample was divided into 40 portions to obtain subsamples, yielding 40 subsamples at 0-10cm, 40 subsamples at 11-20cm, and 40 subsamples at 21-30cm, for a total of 120 subsamples in the study. For each depth, the subsamples were thoroughly mixed in the laboratory to form composite samples and processed within 24 hours of collection.

Nematode Extraction Procedure

In the laboratory, soil samples were processed using the modified Baermann tray extraction method as described by Ezenwaka and Ekine (2024). A total of 120 subsamples (40 from each depth) were each wrapped in tissue paper supported by a sieve. The sieve was placed in a plastic bowl containing clean tap water such that the bottom of the sieve was in contact with the water; the soil was kept moist but not submerged. The setup was left undisturbed for 48 hours at room temperature. This soaking process allowed nematodes to migrate from the soil into the water suspension. After the 48 hours, the soil was discarded and the water was carefully decanted into labeled specimen bottles for examination. To preserved the nematodes, 3 drops of 20% formalin was added to each specimen bottle. The preserved samples were stored until examination under a microscope was completed.

Microscopic Examination and Identification of Nematodes

The water suspension from each sample was examined under a compound microscope. Nematodes were observed and identified based on morphological features such as body shape, stylet structure, esophageal region, and tail shape. Identification was carried out as far as possible to genus level using standard taxonomic keys (Mai & Lyon, 1986) and descriptions recorded in and Mekete et al. (2012). Both juvenile and adult nematodes were counted and recorded.

Data analysis

The data obtained in this study were presented in percentages using the formula: $\frac{n}{N} \times 100$. Where n= number of individuals of a nematode genus, and N= total number of nematodes recovered. Differences in nematode prevalence and assemblage among soil depths were tested for significance using Analysis of Variance (ANOVA) in SPSS version 23.0, with significance set at
$p < 0.05$.

Results

Phytoparasitic Nematodes Associated with Turf Grass

A total of six nematode genera were recovered from soil around the root region of the turf grass within the football field in Federal University Otuoke. The phytoparasitic nematodes identified in were *Pratylenchus* spp., *Radopholus* spp., *Meloidogyne* spp., *Longidorus* spp., *Tylenchus* spp., and *Heterodera* spp. The most prevalent phytoparasitic nematode encountered in this study was *Meloidogyne* spp. with 56 individuals (29.8 %), followed by *Longidorus* spp. with 33 individuals (17.6%) and *Tylenchus* spp. with 32 individuals (17.0%). The least encountered was, *Radopholus* spp. with 19 individuals (10.1 %) compared to *Heterodera* spp. with 25 individuals (13.3%) and *Pratylenchus* spp. with 23 individuals (12.2 %).

Table 1: Prevalence of phytoparasitic nematodes in association with Federal University Otuoke football field.

Phyto-parasitic nematode	Assemblage	% Prevalence	Pv
***Meloidogyne* species**	56	29.8	
***Longidorus* species**	33	17.6	
***Tylenchus* species**	32	17.0	
***Heterodera* species**	25	13.3	
***Radopholus* species**	19	10.1	
***Pratylenchus* species**	23	12.2	
Total	188	100	.023

Vertical distribution of phytoparasitc nematodes across soil core depth in Federal University Otuoke football field

The 188 phytoparasitic nematodes observed in this study was unevenly distributed in soil core depth. Among the 6 nematode genera reported in this study, only 5 were seen occurring within 0-10 cm core depth, 5 genera were noticed within 11-20 cm depth and depth 21-30 had 6 nematode genera with a total assemblage of assemblage of 98 (52.1 %). Nevertheless, *Tylenchus* species were missing in 0-10 cm depth, *Pratylenchus* species not found in 11-20 core depth. However, all the phytoparasitic nematode species reported in this study registered their presence in 21-30 cm core depth. The results revealed that 21-30 core depth had the highest prevalence of nematodes, 52.1 %. However, the prevalence of phytoparasitic nematodes in 0-10 cm and 11-20 depth was 18.6 % and 29.3 % respectively.

Table 2: Vertical distribution of phytoparasitic nematodes across soil core depth in Federal University Otuoke football field

Nematode species	Soil core depth				
	0-10 cm (%)	**11-20 cm (%)**	**21-30 cm (%)**	**Total (%)**	**pv**
***Meloidogyne* spp.**	14 (40)	18 (32.7)	24 (24.5)	56 (29.8)	
***Longidorus* spp.**	2 (5.7)	10 (18.2)	21 (21.4)	33 (17.6)	
***Tylenchus* spp.**	0	16 (29.1)	16 (16.3)	32 (17.0)	
***Heterodera* spp.**	11(31.4)	5 (9.1)	9 (9.2)	25 (13.3)	
***Pratylenchus* spp.**	6 (17.1)	0	17 (17.3)	23 (12.2)	
***Radopholus* spp.**	2 (5.7)	6 (11.0)	11 (11.2)	19 (10.1)	
Total	**35 (100)**	**55 (100)**	**98 (100)**	**100**	**.000**

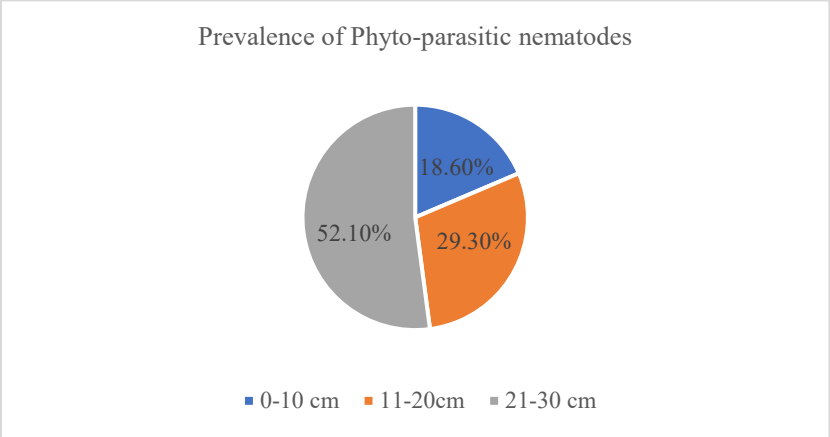


Figure 1: Total prevalence of phytoparasitic nematodes in relation to soil core depth

Discussion

The assessment of plant parasitic nematodes of specific plants such as ornamentals, food crops and grasses are significant. This is because it may provide evidence on the specific nematode species prevalence in the area. This study seeks to test the nematode species possibly associated with soil within the university football field in federal university Otuoke. The study recorded nematode prevalence of 188 from six genera from the turfgrass soil at the Federal University Otuoke football field. Nematodes prevalence as observed in this study, is indicative that the football field soil supports a diverse assemblage of plant-parasitic nematodes. Similar diversity has been reported in surveys of turfgrass systems in different parts of the world, where several plant-parasitic nematode genera were reportedly found to occur together in the same managed turf environment (Dong et al., 2022; Mwamula & Lee, 2021; Zeng et al., 2012).

The high assemblage of *Meloidogyne* species in the study is noteworthy. The nematode genus accounted for 29.8% of all nematodes recovered and was the most abundant genus at each of the three soil depths. Root-knot nematodes in the genus *Meloidogyne* are among the most important plant-parasitic nematodes because they invade roots and induce the formation of feeding sites and root galls. The injuries induce by *Meloidogyne* species may interfere with water and nutrient absorption and may result in weak, sparse, or discolored turf. The predominance of *Meloidogyne* in this study is consistent with reports that root-knot nematodes are important pests of turfgrass and can affect the quality and recovery of managed sports surfaces (Azevedo de Oliveira et al., 2018; Ye et al., 2015). The high occurrence of *Meloidogyne* spp. may be related to the availability of suitable grass roots which supported rapid propagation of the nematode genus. Nematode, like other biota in soil thrive under favorable host (Ekine et al., 2020; Gboeloh et al., 2019). Turfgrass fields are regularly maintained and contain a relatively continuous root system, which can provide a constant food source for root-feeding nematodes.

Longidorus species were the second most abundant group, accounting for 17.6% of the total nematodes. Their presence in the football-field soil suggests that the turfgrass root zone provides conditions suitable for their survival. This result agrees with Dong et al. (2022) and Zeng et al., 2012) who reported dagger and needle-like parasitic nematodes including *Longidorids* species in turfgrass environments.

Tylenchus species represented 17.0% of the total nematodes recovered. This group was not detected in the 0–10 cm soil layer but occurred in both the 11–20 cm and 21–30 cm layers. The absence of *Tylenchus* species from the shallowest depth may reflect an uneven distribution of individuals,

differences in soil properties specific in each core depth in soil. This observation implied that nematode distribution may vary considerably over short distances, probably due to differences in soil structure, concentration organic matter and water content. Ekine and Ezenwaka (2024) reported that nematode distribution in soil may be affected by the prevailing circumstance at a time within the distance and space of assessment.

Heterodera species accounted for 13.3% of the total nematode assemblage and were particularly common in the 0–10 cm layer, where they represented 31.4% of the nematodes recovered. Cyst nematodes in the genus *Heterodera* produce durable cysts containing eggs, enabling them to persist in soil when suitable host conditions are absent. The relatively high proportion of *Heterodera* species in the upper soil layer is suggestive of high nutrient concentration. This result agrees with Juvale and Baum (2018) who reported high prevalence of *Heterodera* species in agricultural soil.

Pratylenchus species made up 12.2% of the total population. These nematodes were found in the 0–10 cm and 21–30 cm layers but were not recorded at 11–20 cm. *Pratylenchus* species are migratory endoparasites that enter roots and create feeding lesions as they move through root tissues. Such lesions can weaken roots and may increase the susceptibility of turfgrass to secondary infections. The absence of *Pratylenchus* species at the intermediate depth may be due to spatial variation, differences in root distribution, or the relatively small number of samples analyzed. A larger sampling design would be needed to determine whether this pattern is consistent across the entire field. Elsewhere Nzeako et al. (2016) reported high prevalence of *Pratylenchus* species across soil core depth in football playing fields.

Radopholus species had the lowest assemblage, with 19 individuals representing 10.1% of the total nematodes recovered. Although this was the least abundant genus, its presence is still important because *Radopholus* species are migratory endoparasites capable of causing root lesions and tissue deterioration. However, the higher assemblage nematode genera *like Radopholus, Heterodera, Tylenchus* which are not popular phytoparasitic pathogens of turfgrass depict the versatile and unpredictive nature of the agronomical parasites.

The vertical distribution results showed that the 21–30 cm depth houses the highest nematode assemblage, having 52.1% of the total population. This result disagrees from the common trend that plant-parasitic nematodes are concentrated mainly in the upper rhizosphere in soil. However, nematode distribution is strongly influenced by edaphic properties and nutrient concentration. However, the result agrees with Ekine and Ezenwaka, (2024) who reported that nematode concentration deep done soil is common as a survival strategy for certain species, particularly when prevailing condition at top soil become unfavorable. However, the trend of nematode distribution in this study may be ascribed to period of study. The assemblage of nematodes at surface soil is usually higher during the months of March-May due to high nutrient concentration and tend to decline during months of November-February due to unfavorable conditions that may be pose by excessive sun shine (Ekine & Ezenwaka, 2024). If the substance for plant parasitic nematodes in soil extended deeply or if the surface soil was exposed to unpleasant conditions and disturbance, the deeper layers may have provided a more stable environment for nematode survival. The high nematode abundance recorded at 21–30 cm may also be related to reduced disturbance compared with the soil surface. The upper 0–10 cm layer is more exposed to mowing-related debris, fluctuations of soil features, drying, trampling, and physical disturbance. Deeper soil may retain stability of soil factors for longer periods and offer more stable and consistent conditions for nematode movement and survival. Shahoveisi and Waldo, (2024) and Zeng et al. (2012) reported that nematode abundance and community composition can vary according to soil depth and sampling location. The reports elsewhere, shows considerably different numbers of genera and species

in turfgrass systems, confirming that nematode communities are site-specific (Mwamula & Lee, 2021; Dong et al., 2022; Shahoveisi & Waldo, 2024).

Conclusion

The study established that turfgrass at Federal University Otuoke football field is associated with a variety of phytoparasitic nematode genera. *Meloidogyne* species were the dominant group, while *Radopholus* species were the least abundant. The greatest total assemblage occurred at 21–30 cm depth, where all six genera were detected. The study supports the need for more detailed sampling, species-level identification, and assessment of turfgrass symptoms before specific control measures are recommended.

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