Identification and Abundance of Plant-parasitic Nematodes Associated with Amenity Trees in the University of Port Harcourt, Rivers State, Nigeria

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ABSTRACT: Plant-parasitic nematodes contribute to unnoticeable damages which lead to gradual decline in the values and eventually death of amenity trees. Identification of these nematode pests is vital for their effective management. Reconnaissance survey was carried out to identify amenity tree species present in the University of Port Harcourt (UNIPORT). Composite bulked soil and root samples (126) were collected from amenity trees in UNIPORT and nematode pests were extracted from samples using modified Baerman method. The nematode pests were identified and their populations determined using standard procedures. Relative importance value (RIV) and diversity indices were calculated with appropriate software. Data were processed using descriptive statistics and with analysis of variance. 38 tree species were identified in UNIPORT belonging to 20 families. Terminalia mantaly, Cocos nucifera and Terminalia catappa with RIVs of 15.1, 9.35, and 9.12 respectively were the three most important amenity trees in UNIPORT. Fifteen nematode pest genera; Helicotylenchus, Aporcelaimus, Tylenchulus, Meloidogyne, Scutelonomia, Pratylenchus, Tylenchus, Rotylenchoides, Criconema, Hemicycliophora, Trichodorus, Mesodorylaimus, Heterodera, Paratylenchus and Longidorus were associated with 21 of the amenity trees. The three most important nematode pest genera were Helicotylenchus, Tylenchulus and Aporcelaimus with RIVs of 42%, 16% and 5.34%, respectively. Helicotylenchus (RIV 45.41%) and Tylenchulus (RIV 30%) were the most important plant-parasitic nematode genera in the soil and roots of amenity trees, respectively. Helicotylenchus, Tylenchulus and Aporcelaimus were the three most important plant-parasitic nematode genera associated with amenity trees in UNIPORT.

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Trees that are not grown or managed for their value as timber, but they also provide other benefits or values are amenity trees (Kraxner et al., 2003; Haysom and Murphy, 2003; Cullen, 2007). Some examples of amenity trees include urban trees found in parks and other open space, or lining the sides of streets, railways, rivers and canals, and in gardens (Olujobi, 2016). Amenity value of trees means how highly the trees are regarded by the community as part of the local landscape. Agbelade et al. (2016) reported the environmental benefits derived from amenity trees to include; purification of air, wind break, provision of shade, beautification, income generation from sales of firewood, provision of relaxation parks and gardens. A tree provides many benefits for the urban dwellers, such as environmental, economical and socio-cultural (Kraxner et al., 2003; Jim and Chen, 2009; Onyekwelu and Olaniyi, 2012). The presence of tree is considered essential in improving the quality of life and well-being of city dwellers. In cities, trees have been considered to fulfil a primarily ornamental purpose; however, they also perform other important functions, such as their use for recreation (Gunderson et al., 2006), their role as a link between man and nature (Aldous, 2007), and their contribution to the general well-being of residents in the cities (Dwyer et al., 2000). In West Africa, parks and recreation centres planted with various amenity trees serve as small business centres, community meeting place, religious worship centres and shades for groves in some urban and peri-urban centres (Fuwape and Onyekwelu, 2011). Trees have the potential to create different kinds of social spaces (William, 2004). Trees are culturally and spiritually important in many societies (Omura, 2004; Hall et al., 2011). Individuals and organizations maintain large tree registries (Van Pelt, 2001) and government agencies maintain parks and reserves dedicated to the sustainability of exceptionally large trees (James et al., 2012). There are several pests affecting the growth and development...
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of trees, it varies from fungal, bacterial, nematode pest infections and at times severe insect damages (Khan, 2012). Some tree species are more susceptible to infestation than others. *Gmelina* is an example of a tree species susceptible to insect attack and diseases from different pathogens which might limit expansion (Dvorak, 2004). However, least consideration has been given to nematode pests of trees because the damage cause by them seems indistinctive and not easily recognised (Khan, 2012). Globally, plant-parasitic nematodes (PPNs) have been reported as one of the major biotic bances to the growth and development of trees (Hagan, 2005; El-Sherbiny, 2011; Manju and Subramanians, 2015). They are commonly associated with rhizospheres of many species of plants. Plant-parasitic nematodes have caused severe damages on plants where they attack the plants and alter the whole functioning of the plants. The symptoms observe varies with tree species and these symptoms include loss of vigour, small and distorted root systems, root galls and decay of feeder roots and sometimes death (Khan, 2012). One difficulty in assessing nematode impact is that damage resulting from nematode infection is often less obvious than that caused by many other pests or diseases. Losses that result from nematode attack may not necessarily be as a consequence of direct cell death, necrosis or ‘diseased’ tissue. However, they may be derived from other more insidious aspects, such as interference with the root system, reducing their efficiency in terms of access and uptake of nutrients and water. To the unaware, nematode-affected plants present typical drought and nutrient stress symptoms, which are easily and often misdiagnosed (Nicol *et al.*, 2011). Detection of pathogens such as nematodes is often difficult because, pathogens often have lag times of several years between infection and the trees developing external or visible symptoms (Brasier, 2008). As a result of this, nematode identification and population determination is important for the healthy growth of trees. The identification of new or potentially harmful species of nematodes is important to their effective management (Zafar, 1998). This study was to identify and determine the abundance of plant-parasitic nematodes associated with amenity trees in University of Port Harcourt, Rivers State, Nigeria

MATERIALS AND METHODS

Research Site: The survey for plant-parasitic nematodes of amenity trees was carried out within the three parks (Choba, Delta and University) of the University of Port Harcourt (UNIPORT), Rivers State, Nigeria. The survey was carried out in July to August 2019. University of Port Harcourt is located at coordinates 4° 52' 30” and 4° 55' 40” N, 6° 54' 40” and 6° 55' 49” E with an elevation of 18 m above sea level, temperature of 28-33°C and with rainfall ranging from 2000-2680 mm per annum (Eludoyin *et al.*, 2015). The sampling location cut across all the major roads, pathways and buildings in the university.

Research Design and Reconnaissance of Amenity Trees: Identification of amenity trees and their population in UNIPORT was carried out in a reconnaissance survey under the supervision of a plant taxonomist in June, 2019. The three parks of UNIPORT were surveyed using random sampling design method for the collection of roots and soil samples of amenity trees (Adesoye, 2011). Coordinates of locations where trees were found were taken using E-trex Garmin Geo Positioning System (GPS).

Collection of Soil and Root Samples: Twenty-one (21) tree species were selected based on their relative importance values for collection of soil and root samples from the outcome of the reconnaissance survey. The trees were randomly selected and samples were collected from five stands of each tree species. Soil and root samples were collected from both the soil and roots of the selected amenity trees to facilitate the extraction and identification of plant-parasitic nematodes present using standard procedures. Soil of 500 cm³ were collected from the rhizospheres of each tree using hand trowel to a depth of 30 cm and bagged into a well labelled polythene bag. The roots were also collected from the same tree species using knife and added to the polythene bag. The bulked soil samples were taken to the laboratory for extraction. Soil and root samples were collected from all the selected 21 amenity trees. A total of 126 composite root and soil samples were collected across the University.

Extraction Procedure for Plant-parasitic Nematodes: The extraction of the plant-parasitic nematodes from the soil samples was done using the extraction tray method (Whitehead and Hemming, 1965; Coyne *et al.*, 2007) at the Crop Protection Laboratory, Department of Crop and Soil Science, University of Port Harcourt. Each bulked soil sample was placed in a dish and sieved to remove debris from it and then it was evenly mixed. 200 cm³ soil sample was poured on a facial tissue in a plastic sieve on an extraction tray and water was added by the side. The extraction set-up was allowed for 48 hours after which the sieve was removed and the water was poured into a beaker. The suspension was kept for a day and allowed to settle. The suspension was later decanted and the suspension containing nematodes were poured into a sample bottle and preserved in the refrigerator prior to identification and counting. The bottles containing nematode suspension were later sent to the Nematology Research
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Laboratory, International Institutes for Tropical Agriculture (IITA), Ibadan, Oyo State for identification and counting.

The extraction of the plant-parasitic nematodes from the roots samples was done with the extraction tray method (Whitehead Hemming, 1965; Coyne et al., 2007). Roots collected from each sample were properly rinsed with water to get rid of debris. The roots were chopped into small parts of 1-2 cm and from each bulked sample, 10 grams of the chopped roots of each sample was weighed out using an electronic weighing scale. The chopped roots were poured on the facial tissue inside the sieve and water was added by the side. The extraction set-up was allowed for 48 hours after which the sieve was removed and the water was poured into a beaker.

The suspension was allowed to settle for one to two hours, after which it was decanted and the suspension containing the nematodes was poured into a sample bottle and preserved in the refrigerator prior to identification and counting. Identification and population count of plant-parasitic nematodes were done at IITA Nematology Research Laboratory, Ibadan, Oyo State, Nigeria. Eppendorf pipette was used to take one milliliter of nematode suspension from 10 ml sample bottle and this was subsequently released into a counting slide.

The counting slide was placed under a Wild Leitz GMBH compound microscope and identification keys of Mai et al., (1996), Mekete et al., (2012) and Nematode Diagnostic Compendium at the IITA Nematology Research Laboratory were used to identify nematode pests to genera level. The identified nematodes were counted with the aid of a multiple tally counter. Each count for each nematode species was extrapolated to the volume of the sample bottle to determine the population count.

**Data Processing and Analyses:** Descriptive statistics were used to process data on frequency of occurrence of amenity trees and nematodes with these formulas (Norton, 1978):

\[
AFO = \frac{\text{No of occurrence of species}}{\text{Number of samples collected}}
\]

\[
RFO = \frac{\text{Frequency of a species}}{\text{Frequency of all species}}
\]

**Nematode Abundance and Relative Importance Value:** Nematode abundance and relative importance value of plant-parasitic nematode species were determined using the methods of Kent and Coker (1996) and Shukla and Chandel (2014) with modifications.

\[
AB = \frac{T_i}{T_s}
\]

\[
RD = \frac{\text{Density of individual species}}{\text{Total density of all species}} \times \frac{100}{1}
\]

\[
RIV (%) = \frac{RD + RF}{2}
\]

Where \( AFO = \) absolute frequency of occurrence; \( RFO = \) relative frequency of occurrence; \( AB = \) Abundance, \( Ti = \) total number of individual species in all samples, \( Ts = \) total number of samples in which the species occurred; \( RD = \) relative density, \( RF = \) relative frequency, \( RIV = \) relative importance value

**Determination of Community Structure and Diversity of Nematode Communities:** The Paleontological Statistical Tool (PAST) of Hammer et al. (2001) was used to determine the diversity of nematode communities. Some indices calculated were:

\( a \) Genera (G) or Species Richness (S): This is the simple count of different species per organism.

\( b \) Shannon – Wiener index \((H): (H) = -\Sigma (pi)ln(p)\)

\( c \) Evenness index \((J) = \frac{H}{\ln S}\) Where, \( S \) Number of species enumerated in the community.

\( d \) Dominance index \( = \sum (ni/n)^2\)

Data from nematode counts were transformed using Log10 \((x+1)\), then analyzed with analysis of variance (ANOVA) and means were separated using Fisher’s Least Significant Difference at probability of 5% with Statistical Analysis System (SAS, 2007) package.

**RESULTS AND DISCUSSION**

**Relative Importance Values of Amenity Tree Species in the University of Port Harcourt:** Thirty-eight (38) amenity tree species were identified belonging to 20 families from the reconnaissance survey (Table 1). The major families of trees encountered were Moraceae, Fabaceae, and Areaceae. The five most important tree species in UNIPORT were Terminalia mantaly, Cocos nucifera, Terminalia catappa Azadirachta indica and Polyalthia longifolia with the relative importance values (RIV) of 15.1%, 9.35%, 9.12%, 8.18%, and 4.57%, respectively. The least prominent amenity trees encountered in UNIPORT were Ficus exasperata and Syziguim malaccense with the same RIV of 0.42% (Table 1).
Diversity of Amenity Tree Species in the University of Port Harcourt: The results for diversity of amenity tree species in UNIPORT is presented in Figure 1. The diversity indices such as Dominance, Shannon Wiener and Evenness were calculated. Dominance value for amenity tree species for taxa of 38 tree species is 8.51, Shannon Wiener index was 2.69 and the value for Evenness was 0.39.

Relative importance values of plant-parasitic and diversity of plant-parasitic nematodes associated with soil of amenity trees at the University of Port Harcourt: Helicotylenchus multicinctus with the RIV of 45.41% was the most important nematode pest genus associated with the soil of the amenity trees (Table 2). This was followed by Tylenchulus spp. with RIV of 14.67%. The least important nematode pest genera were Trichodorus spp, Mesodorylaimus spp. and Paratylenchus spp., all having the same RIV of 1.37%. Figure 2 shows results for the diversity of plant-parasitic nematodes associated with the soil of amenity trees. Fifteen nematode pest genera were encountered in the soil. The Dominance index for the nematode pests was 0.33, Shannon Wiener index of 1.73 and Evenness value of 0.38.

Relative importance values and diversity indices of plant-parasitic nematodes found in the roots of amenity trees at the University of Port Harcourt: Tylenchulus spp. had the highest RIV of 30%, then Helicotylenchus multicinctus with RIV of 18.33%, followed by Aporcelaimus species (RIV 12.22%)

Table 1: Occurrence and relative importance values of amenity tree species in the University of Port Harcourt

| Tree species       | Family   | Frequency of occurrence | Relative frequency of occurrence (%) | RIV (%) |
|--------------------|----------|-------------------------|--------------------------------------|--------|
| Delonix regia      | Fabaceae | 7                       | 5.22                                 | 4.23   |
| Peltophorum pterocarpum | Fabaceae | 5                       | 3.73                                 | 3.18   |
| Ilora ereptans      | Euphorbiaceae | 5                       | 3.73                                 | 2.88   |
| Persia Americana   | Lauraceae | 1                       | 0.75                                 | 0.53   |
| Polyathia longifolia | Annonaceae | 6                       | 4.48                                 | 4.57   |
| Gmelina arborea     | Lamiaceae | 3                       | 2.24                                 | 1.68   |
| Terminalia mantalya | Combretaceae | 11                      | 8.21                                 | 15.1   |
| Adoxodora indica   | Meliaceae | 4                       | 2.99                                 | 8.18   |
| Terminalia catappa  | Combretaceae | 14                      | 10.45                                | 9.12   |
| Ficus exasperate    | Moraceae | 1                       | 0.75                                 | 0.42   |
| Ficus benjamina     | Moraceae | 3                       | 2.24                                 | 1.73   |
| Ficus elastic       | Moraceae | 3                       | 2.24                                 | 1.47   |
| Syzigium malaccense | Myrtaceae | 1                       | 0.75                                 | 0.42   |
| Arenga pinnata      | Palmae | 3                       | 2.24                                 | 2.64   |
| Rosystonea regia    | Arecaaceae | 2                       | 1.49                                 | 1.51   |
| Syagrus romanzeoffiana | Arecaaceae | 2                       | 1.49                                 | 0.90   |
| Cassarina equisetifolia | Casuarinaceae | 1                       | 0.75                                 | 0.47   |
| Pterocarpus santalinoides | Fabaceae | 2                       | 1.49                                 | 0.80   |
| Cocos nucifera      | Palmae | 7                       | 5.22                                 | 9.35   |
| Mangifera indica    | Anacardiaceae | 6                       | 4.48                                 | 3.91   |
| Tectona grandis     | Lamiaceae | 2                       | 1.49                                 | 0.80   |
| Lagerstroemia indica | Lythraceae | 3                       | 2.24                                 | 1.68   |
| Anacardium occidentalis | Anacardiaceae | 2                       | 1.49                                 | 1.10   |
| Dacyryodes edulis   | Burseaceae | 2                       | 1.49                                 | 0.90   |
| Elaeis guineensis   | Arecaaceae | 2                       | 1.49                                 | 4.09   |

RIV= Relative importance value

Table 1 Cont'd.: Occurrence and relative importance values of amenity tree species in the University of Port Harcourt

| Tree species       | Family   | Frequency of occurrence | Relative frequency of occurrence (%) | RIV (%) |
|--------------------|----------|-------------------------|--------------------------------------|--------|
| Ambodia gadis      | Apocynaceae | 2                       | 1.49                                 | 0.80   |
| Alkotonia boonei    | Apocynaceae | 2                       | 1.49                                 | 0.85   |
| Musanga cecropioidea | Urticaceae | 2                       | 1.49                                 | 0.80   |
| Milicia exels       | Moraceae | 2                       | 1.49                                 | 0.90   |
| Trecula Africana    | Moraceae | 2                       | 1.49                                 | 0.80   |
| Spondias cytherea   | Anacardiaceae | 1                       | 0.75                                 | 0.47   |
| Chrysophyllum albicum | Sapotaceae | 4                       | 2.99                                 | 1.95   |
| Terminalia ivorenisis | Combretaceae | 2                       | 1.49                                 | 0.80   |
| Senna fistula       | Fabaceae | 3                       | 2.24                                 | 1.63   |
| Pinus caribaea      | Pinaceae | 6                       | 4.48                                 | 4.21   |
| Eucalyptus camadulensis | Myrtaceae | 4                       | 2.99                                 | 2.10   |
| Samanea saman       | Fabaceae | 2                       | 1.49                                 | 0.80   |
| Citrus sinensis     | Rutaceae | 4                       | 2.99                                 | 2.05   |

Total (134) 100.0 100.0

RIV= Relative importance value
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The least prominent nematode pests were *Rotylenchoides* spp., *Cricocema* spp., *Hemiciophora* spp., *Trichodorosp* spp. and *Longidorus* spp. with equal RIV of 6.11%. Figure 3 shows results for the diversity of nematode pests associated with roots of amenity trees. Dominance value for nematode pests was 0.22, Shannon Wiener of 1.80 and the value for Evenness was 0.76.

Mean relative importance values and diversity indices of plant-parasitic nematodes associated with amenity trees at University of Port Harcourt: Table 4 shows the results for occurrence and relative importance values of plant-parasitic nematodes found in roots of amenity trees. *Helicotylenchus multicinctus* had the highest RIV of 42% and *Tylenchulus* spp. with the RIV of 16%. Mean diversity indices of plant-parasitic nematodes associated with amenity tree species at the University of Port Harcourt is presented in Figure 4. The average Dominance index for nematode pests of amenity trees in UNIPORT was 0.29, whereas the Shannon Wiener index was 1.83 and the Evenness index was 0.41.

### Table 2: Relative importance values of plant-parasitic nematodes found in the soil of amenity trees at the University of Port Harcourt

| Plant-parasitic Nematodes | Frequency | Relative frequency (%) | *RIV (%) |
|---------------------------|-----------|------------------------|----------|
| *Helicotylenchus* spp.    | 18        | 36                     | 45.41    |
| *Aporcelaimus* spp.       | 3         | 6                      | 4.48     |
| *Tylenchulus* spp.        | 8         | 16                     | 14.67    |
| *Meloidogyne* spp.        | 3         | 6                      | 5.22     |
| *Scutelonema* spp.        | 2         | 4                      | 3.85     |
| *Pratylenchus* spp.       | 1         | 2                      | 1.74     |
| *Tylenchus* spp.          | 2         | 4                      | 3.11     |
| *Rotylenchoides* spp.     | 2         | 4                      | 3.11     |
| *Cricocema* spp.          | 3         | 6                      | 5.22     |
| *Hemiciophora* spp.       | 2         | 4                      | 4.22     |
| *Trichodorosp* spp.       | 1         | 2                      | 1.37     |
| *Mesodorylaimus* spp.     | 1         | 2                      | 1.37     |
| *Heterodera* spp.         | 1         | 2                      | 2.11     |
| *Paratylenchus* spp.      | 1         | 2                      | 1.37     |
| *Longidorus* spp.         | 2         | 4                      | 2.74     |
| **Total**                 | **50**    | **100**                | **100**  |

*RIV = Relative Importance Value*
Mean population of plant-parasitic nematodes associated with amenity trees in the University of Port Harcourt: Terminalia catappa had the highest mean population of Helicotylenchus spp. Arenga pinnata had the highest mean of population of Aporcelaimus, whereas the highest population of Tylencehus was found on Terminalia catappa (Table 5). The highest population of Meloidogyne was found on Anacardium occidentalis, Roystonea regia had the highest population of Scutellonema, Polyathia longifolia and Persia americana were the only amenity trees with the same population of Pratylenchus.

The highest mean populations of Tylencehus, Rotylenchus, Criconemella, Hemiclyclophora, Trichodorus, Mesodorylaimus, Heterodera, Paratylenchus and Longidorus were found in Cocos nucifera, Mangifera indica, Anacardium occidentalis, Terminalia mantaly, Ficus elastica, Delonix regia, Delonix regia, Hura crepitans and Elaeis guineensis, respectively (Table 5). The highest mean population of plant-parasitic nematodes of 106.67 was obtained from Terminalia catappa, but was not significantly higher than mean population of nematode pests of other amenity trees in UNIPORT (Table 5). The tree species identified in UNIPORT as amenity trees are 38 and classified into twenty families viz; Fabaceae, Euphorbiaceae, Lauraceae, Annonaceae, Combretaceae, Meliaceae, Moraceae, Myrtaceae, Palmae, Arecales, Casuarinaceae, Anacardiaceae, Lamiaeae, Lythraceae, Burseraceae, Apocynaceae, Urticaceae, Sapotaceae, Rutaceae and Pinaceae. Most of the trees belong to the Moraceae family. These prominent trees encountered in this study were in conformity with the reports of other workers as being effective as amenity trees (Babalola and Raji, 2016; Ugbaja, 2018). The cultivation of these encountered trees in UNIPORT could be due to their ability to provide shade, fruits, aesthetic values, increase property values (Hedonic) and their ease of growth (Schroeder, 1989; Panduro and Veie, 2013; Rosato et al., 2017).

Plant-parasitic nematodes found associated with amenity trees across UNIPORT varied in population densities and they are of different genera. The nematodes found affecting amenity trees in UNIPORT are of 15 genera; Helicotylenchus spp., Aporcelaimus spp., Meloidogyne spp., Scutellonema spp., Pratylenchus spp., Tylencehus spp., Rotylenchoides spp., Criconema spp., Hemiclyclophora spp., Trichodorus spp., Mesodorylaimus spp., Heterodera spp., Paratylenchus spp., Longidorus spp. and Tylencehus spp. However, the three major genera are: Helicotylenchus spp., Aporcelaimus spp. and Tylencehus spp.

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Table 4: Relative importance values of plant-parasitic nematodes associate with amenity trees at the University of Port Harcourt

| Plant-parasitic Nematodes Genera | Frequency of Occurrence | Relative frequency of Occurrence (%) | RIV (%) |
|---------------------------------|-------------------------|--------------------------------------|---------|
| Helicotylenchus spp.            | 20                      | 33.33                                | 42      |
| Aporcelaimus spp.               | 10                      | 16.67                                | 16      |
| Tylenchus spp.                  | 3                       | 5                                    | 4.5     |
| Meloidogyne spp.                | 2                       | 3.33                                 | 3.34    |
| Pratylenchus spp.               | 2                       | 3.33                                 | 3       |
| Tylenchus spp.                  | 2                       | 3.33                                 | 2.67    |
| Rotylenchoides spp.             | 3                       | 5                                    | 3.83    |
| Criconema spp.                  | 2                       | 3.33                                 | 2.33    |
| Mesodorylaimus spp.             | 1                       | 1.67                                 | 1.17    |
| Heteroderma spp.                | 1                       | 1.67                                 | 1.83    |
| Paratylenchus spp.              | 1                       | 1.67                                 | 1.17    |
| Longidorus spp.                 | 3                       | 5                                    | 3.5     |
| Total                           | 60                      | 100                                  | 100     |

*RIV = Relative Importance Value

These nematodes found on amenity trees are in conformity with nematode pests that have been reported on trees due to their wide host range and mode of feeding (Ruehle, 1967; Ruehle, 1973; Gbadegesin et al., 1992; Gbadegesin et al., 1993; Nyczepir and Becker, 1998). The economically most important nematode pest species belong to the genera *Criconemella*, *Meloidogyne*, *Pratylenchus*, *Longidorus*, *Xiphinema*, *Trichodorus* and *Paratrichodorus*, and are widely distributed on tree crops throughout the world (Nyczepir and Halbrendt, 1993; Nyczepir and Becker, 1998). The traditional nematode genera associated with trees globally such as *Trichodorus*, *Paratrichodorus*, *Longidorus*, *Xiphinema* were found in significant abundance in this survey (Nyczepir and Becker, 1998; Lišková et al., 2007). These nematodes have been implicated in damage to forest trees with slow decline of growth and eventual tree death in 5 to 10 years, especially in young forest plantations (Khan, 2012). Wilt, drying, defoliation of branch or entire tree has been attributed to attack of nematode pests on trees (Khan, 2012). This shows the importance of plant-parasitic nematodes as one of the major constraints to growth of amenity trees. Also, *Aporcelaimus* species of the family Aporcelaimidae and *Mesodorylaimus* species (Dorylaimidae) classified as omnivores and predators (Andrassy, 2000; McSorley, 2012) are just being reported first in the rhizospheres of trees in Nigeria. The presence of these two nematode species has been linked to ecosystems in nearly all stages of succession, but they have their highest population at the later stages of succession especially in soils of old-growth forests (McSorley, 2012). They have strong adaptation to extreme environment, but are limited by soil with low PH, use of inorganic fertilizers and other agrochemicals. The report of these two nematode pest genera is an indication that their host range have increased either due to climate change or favourable environmental conditions. Recently, change in pest status has been linked to climate change in which potential pests of some plants are now becoming key pests (Asimiea et al., 2015).

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| Tree Species | Heli | Apo | Tyle | Melo | Scat | Praty | Tylenchus | Roty | Crico | Hemi | Trich | Meso | Hetero | Parat | Longi | Mean PPNs |
|--------------|------|-----|------|------|------|-------|-----------|------|-------|------|-------|------|--------|-------|-------|-----------|
| Delonix regia| 0    | 0   | 0    | 0    | 0    | 3.33  | 0         | 0    | 0     | 0    | 3.33  | 10   | 0      | 0     | 16.66| (0.57)    |
| Peltophorum pterocarpum| 23.33| 10  | 0    | 0    | 0    | 3.33  | 0         | 0    | 0     | 0    | 3.33  | 0    | 0      | 0     | 33.33| (1.23)    |
| Hura crepitans| 10   | 0   | 0    | 0    | 0    | 6.67  | 0         | 0    | 0     | 3.33 | 0     | 0    | 0      | 0     | 16.66| (1.23)    |
| Polyalthia longifolia| 0    | 0   | 0    | 0    | 0    | 6.67  | 0         | 0    | 0     | 3.33 | 0     | 0    | 0      | 0     | 10.00| (0.79)    |
| Persia americana| 0    | 0   | 0    | 0    | 0    | 3.33  | 0         | 0    | 0     | 0    | 3.33  | 0    | 0      | 0     | 16.67| (0.88)    |
| Gmelina arborea| 0    | 0   | 0    | 0    | 0    | 0     | 3.33      | 0    | 0     | 0    | 0     | 0    | 3.33   | 0     | 3.33 | (0.35)    |
| Terminalia mantaly| 0    | 0   | 0    | 0    | 0    | 0     | 0         | 0    | 3.33  | 0    | 0     | 0    | 3.33   | 0     | 0    | (0)       |
| Azadirachta indica| 10   | 0   | 3.33 | 0    | 0    | 0     | 0         | 10   | 0     | 0    | 0     | 0    | 0      | 0     | 13.33| (0.88)    |
| Terminalia catappa| 76.67| 0   | 26.67| 0    | 0    | 0     | 0         | 0    | 0     | 0    | 0     | 0    | 0      | 0     | 106.67| (1.27)   |
| Ficus elastica| 6.67 | 0   | 0    | 0    | 0    | 0     | 0         | 0    | 3.33  | 3.33 | 0     | 0    | 0      | 0     | 13.33| (0.84)    |
| Arenga pinnata| 36.67| 6.67| 13.33| 6.67 | 0    | 0     | 0         | 0    | 0     | 0    | 0     | 0    | 0      | 0     | 63.33| (1.31)    |
| Roystonea regia| 10   | 0   | 6.67 | 0    | 10   | 0     | 0         | 0    | 0     | 0    | 0     | 0    | 0      | 0     | 26.67| (0.64)    |
| Cocos nucifera| 0    | 3.33| 0    | 0    | 0    | 6.67  | 0         | 0    | 0     | 0    | 0     | 0    | 0      | 0     | 10.00| (0.79)    |
| Mangifera indica| 3.33 | 0   | 0    | 0    | 0    | 0     | 0         | 10   | 0     | 0    | 0     | 0    | 0      | 0     | 3.33 | (0.35)    |
| Lagerstroemia indica| 3.33 | 0   | 3.33 | 0    | 0    | 0     | 0         | 0    | 0     | 0    | 0     | 0    | 0      | 0     | 6.67 | (0.69)    |
| Anacardium occidentalis| 16.67| 0   | 0    | 10   | 6.67 | 0     | 0         | 13.33| 16.67 | 0   | 0     | 0    | 0      | 0     | 63.33| (1.31)    |
| Elaeis guineensis| 50   | 0   | 6.67 | 3.33 | 0    | 0     | 0         | 3.33 | 0     | 0    | 0     | 0    | 0      | 0     | 6.67 | (0.84)    |
| Chrysophyllum albiflorum| 0    | 0   | 3.33 | 0    | 0    | 0     | 0         | 0    | 3.33  | 0    | 0     | 0    | 0      | 0     | 3.33 | (0.35)    |
| Senna fistula| 0    | 0   | 3.33 | 0    | 0    | 0     | 0         | 0    | 3.33  | 0    | 0     | 0    | 0      | 0     | 3.33 | (0.35)    |
| Pinus caribaea| 3.33 | 0   | 10   | 0    | 0    | 0     | 0         | 0    | 0     | 0    | 0     | 0    | 0      | 0     | 3.33 | (1.54)    |
| Eucalyptus camaldulensis| 3.33 | 0   | 0    | 0    | 0    | 0     | 0         | 0    | 0     | 0    | 0     | 0    | 0      | 0     | 6.67 | (0.44)    |
| LSD (P≤0.05) | 52.85| 7.77| 16.74| 7.76 | 7.49 | 5.87  | 4.64       | 4.15 | 8.81  | 10.79| 2.94  | 2.08 | 6.23   | 2.08  | 2.93 | 74.71 (1.33) |
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