



POPULATION DISTRIBUTION OF PLANT-PARASITIC NEMATODES ASSOCIATED WITH JATROPHA AND TEAK PLANTATIONS IN THE UNIVERSITY OF ILORIN, NIGERIA

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ABSTRACTS: Nematode population distribution study was conducted to determine the different nematodes genera associated with the soil and roots of Jatropha and Teak plantations at University of Ilorin for a period of 18months. Total of 8 composite soil samples were collected from fields of Jatropha and Teak Plantations. Random sampling from each grid section and a random point was selected from teak and Jatropha plantation, and a soil sample was collected using soil auger. Samples were collected at a depth of 0-20 cm (top soil) and 20-40 cm (subsoil) to form a composite sample, (4 from Jatropha and 4 from Teak plantations. Samples were labelled, stored in polythene bags and transported to the laboratory for analysis. Results revealed *Meloidogyne incognita*, *Helicotylenchus* spp., *Tylenchusspp.*, *Pratylenchus* spp., *Criconemella* spp. and *Hoplolaimus* spp. were encountered. The percentage predominance of *Meloidogyne* spp. was 45.73 % in the surveyed fields, followed by *Helicotylenchus* spp., (34.32%), the least was *Criconema* spp. with percentage predominance of 2.5%. The highest population of *Helicotylenchus* spp., *Meloidogyne* spp., and *Pratylenchus* per 10g of root in the field were recorded. The study indicates that *Meloidogyne* spp., and *Helicotylenchus* spp., were widely spread in all examined crops and locations of the plantations.

Keyword: Nematode, population, Temperature, *Helicotylenchus* spp., *Meloidogyne* spp.,

INTRODUCTION

The existence of plant-parasitic nematodes and their importance as pests of agricultural crops have since been established in the developed world (Kayani *et. al.*, 2012). The injury and crop losses caused by the root-knot nematodes, the sugar beet nematodes and the golden nematode have been apparent for many years because these parasites are constraining factors in economic crop production in some areas (Borgonieet *al.*, 2011). It is now becoming obvious, especially in perennial ornamentals and fruit and nuts crops, that greater injury may be caused by nematodes whose presence and damage is less easily measured (Wheeler *et. al.*, 2000).

Since nematodes cause serious damage to citrus, peaches, walnuts, cherries, almonds, and many other horticultural important trees, it is not unexpected that they also damage forest trees, yet nematode diseases of forest trees remain virtually unknown (Barbosa *et al.*, 2004). Disregard of rhizosphere ecology by forest scientists probably accounts for past failures to recognize nematodes as important soil and site factors in forestry. Root losses due to nematodes on forest trees have generally gone unnoticed. In fact, forest soils are probably the least known portion of the forest environment (Khan *et al.*, 2006). High organic content, adequate moisture and moderate temperature of forest soils with diversified flora represent conducive condition for nematode survival in forest habitats (Mujeebur, 2012). The fact that the research is laborious and time consuming has probably caused many investigators to avoid this area. Nevertheless, information concerning host-parasite relations of nematodes and tree roots is essential to provide a basis for recognition and diagnosis of diseases. Until such information is available, accurate estimates of yield losses of trees due to nematodes will be lacking.

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Limited investigations so far conducted have revealed infestation of important forest trees such as acacia, sal, teak, pine and sandal wood with *Helicotylenchus*, *Tylenchorhynchus*, *Hemicriconemoides*, *Macroposthonia*, *Pratylenchus*, *Meloidogyne*, *Xiphinema*, *Trichodorus*, and *Paratrichodorus* etc. Nematode damage to forest trees usually appears as a slow decline of growth which gradually gets aggravated leading to tree death within 5 to 10 years (Mujeebur, 2012). The global wood harvest accounted for 3.4 billion cubic meters in 2004, 52% of this is used as fuel (Lee, 2008). The legal or illegal export/import of unprocessed timber and wood especially from risk prone countries has posed a serious quarantine risk of spread of this nematode to countries having favourable climate for the nematode and its insect vector (Khan and Jairajpuri, 2012).

Since nematodes are generally soil inhabitants and attack underground parts of plant, the damage caused by them cannot be diagnosed by symptoms alone, general symptoms mostly resemble with those of several other biotic agents or some nutrient deficiency (Khan, 2008). However, in nurseries, the infected seedlings could be identified on the basis of vigour, small, distorted root system, root galls and general decay of feeder roots. In addition to causing direct damages, nematode may also act as vector for plant viruses and facilitates infection by fungi and bacteria (Taylor and Brown, 1997).

The need to maximize the yield of Teak and Jatropha bearing in mind the damages nematodes pose on Teak and Jatropha of which on a steady rate leads to inevitable death of both trees makes the study a necessity. Also the identification of Nematode infecting Teak and Jatropha will enable us to develop appropriate management measures. The objectives of study therefore were to identify the different nematode genera that infest *Tectonagrandis* and *Jatropha curcas*, and study their population variation over a period of 18 months, and to study if climatic changes and the type of crop grown has any effect on their reproduction and population growth.

MATERIALS AND METHODS

Site Description

The sites of experiment were the Teak and Jatropha Plantations were located is at the teaching and research farm of the University of Ilorin permanent site within the Southern Guinea Savannah Ecological Zone (9°29' N, 4°35' E) of Nigeria.

Sampling Materials and Sampling Method:

Measuring tape, ranging pole, ropes, soil auger, plastic bags, paper tape, water proof maker, cutlass, and thermometer. The method of sampling was Random sampling method. At the Jatropha farm and teak plantation farm, 400 by 200 m of land was measured using the measuring tape and was divided into four equal parts respectively. Each plot was labelled A, B, C, D for Jatropha and E, F, G and H for Teak. Five Jatropha and teak plants were marked at random on each plot and soil surrounding these plants were excavated to a depth of 15-20 cm using the soil auger and the soil samples were placed into plastic bag; these soil samples make up the sub-soils which was later mixed together to make the core samples, giving a total of four (4) core soil samples for Jatropha and four (4) core samples for teak plantation altogether making eight (8) core samples. The soil samples were stored in the plastic bags and labelled for proper identification. Root samples were also collected per marked plants using the cutlass and also mixed together giving four (4) core root samples for Jatropha plantation and four (4) core samples for teak plantation making eight (8) altogether. Soil temperature reading was taken up by the thermometer during the survey while collecting soil samples at a depth of 15-20 cm below the ground. The root sample were also stored in the plastic bags and labelled for proper identification.

Nematode Extraction from Soil

The modified Baerman's extraction technique was used. The plastic sieve was placed in the plastic tray and double ply serviette paper placed inside the sieve then 100 ml of soil sample was measured using the measuring flask and poured inside the sieve. Clean water was poured into the tray rising above the soil level and left undisturbed for 48 h. This is to encourage nematodes to swim out into tray. After 48 h, the sieve was gently lifted and the extract was poured into the vial bottles and was labelled after which it was taken to International Institute of Tropical Agriculture (IITA) Ibadan, Oyo State Nigeria for identification and counting.

Nematode Extraction from Root

The plastic sieve was placed in the plastic tray and the extraction paper was placed inside it, then the root sample was macerated using an electric blender and then poured into the sieve; clean water was poured into the tray rising above

the sample level and it was left undisturbed for 48h after which the sieve was gently lifted and the extract poured into the vial bottles, labelled and was taken to IITA for identification and counting.

Data Analysis

Separation of means was done using the Tukey's Honestly Significant Difference at 5% level of significance. All statistical Analysis was done using the International Business Machine (IBM) SPSS statistics version 21. Correlations between soil temperature and soil and root populations of the five nematode species monitored over 18 months were performed using correlation analysis.

Nematode prevalence was calculated as a percentage ((Number of samples containing a species / number of samples collected) * 100).

RESULTS

Results presented in Table 1 indicate the populations of nematode over a Soil temperature reading was taken up by the thermometer during the survey while collecting soil samples at a depth of 15-20cm below the ground for the period of 18 months. The population of the isolated nematodes greatly differed at all examined months. Highest population of *Helicotylenchus* spp., *Meloidogyne* spp., and *Pratylenchus* 10g of root in the surveyed field were recorded in the month of June to August, while that of *Helicotylenchus* spp., drastically reduced in the month of December, *Meloidogyne* spp., was lowest from December to March and *Pratylenchus* in month of January. Meanwhile the highest population of *Criconebella* spp., was encountered in the month of April, while that of *Scutellonema* spp., was recorded in the month of December.

Table 1: Nematode population by month

Month	<i>Helicotylenchus</i>	<i>Meloidogyne</i>	<i>Criconebella</i>	<i>Pratylenchus</i>	<i>Scutellonema</i>
Mar	7.06cdef	1.13h	1.56b	4.50bcde	0.5abc
Apr	8.75bcdef	9.19abcd	0.00b	5.81bcde	2.19abc
May	2.81ef	6.00bcdefgh	0.00b	1.25cde	0.63abc
Jun	13.44abcd	10.44abc	0.63b	2.19cde	0.00c
Jul	20.13a	11.38ab	0.00b	7.25abcd	0.00c
Aug	9.69abcde	2.94efgh	0.00b	1.25cde	0.00c
Sep	3.06ef	4.56cdefgh	0.00b	7.81abc	1.56abc
Oct	5.63def	7.5bcdefg	0.00b	4.50bcde	0.00c
Nov	3.44ef	3.13defgh	0.00b	2.00cde	0.00c
Dec	0.61f	2.19fgh	0.00b	0.94de	2.63a
Jan	2.44ef	1.25h	0.00b	0.31e	0.94abc
Feb	3.44ef	0.63h	0.63b	1.88cde	0.31bc
Mar	4.38ef	1.44gh	0.88b	2.69bcde	1.88abc
Apr	5.13def	4.94cdefgh	7.94a	2.88bcde	0.00c
May	7.13cdef	7.85bcdef	0.00b	6.00abcde	1.69ac
Jun	3.88ef	12.0ab	0.25b	9.25ab	1.25abc
Jul	14.25abc	11.34ab	0.50b	6.38a-e	2.44ab
Aug	15.94ab	14.06a	0.00b	12.69a	0.00c
SEM	2.4	1.8	0.8	1.9	0.6

Mean values followed by the same letter(s) are not significantly different at P=0.05 according to the Tukey's Honestly Significant Difference

Table 2 showed the population of nematodes by crop type. There was significant difference between the population of nematode and the type of crop grown. Generally, there was increase in the population number of *Helicotylenchus* spp., in the Jatropha plant compared with those in teak, with the highest population recorded in the Jatropha plant labelled H and the lowest in teak labelled C, the same also goes for the population of *Pratylenchus* spp.,

with the highest population recorded in Jatropha H and the least in teak labelled D, also highest population of *Scutellonema* spp., was recorded in Jatropha plant labelled G. On the other hand, maximum population of *Meloidogynespp.*, was observed in teak labelled A and minimum population in Jatropha labelled F, as well as the highest population of *Criconema* spp., evident in teak labelled B.

Table 2; Population of nematodes by crop type

CROP	<i>Helicotylenchus</i>	<i>Meloidogyne</i>	<i>Criconemella</i>	<i>Pratylenchus</i>	<i>Scutellonema</i>
Teak A	8.89abc	11.1a	1.00ab	3.00cd	1.25abc
Teak B	3.50de	4.60bc	2.61a	3.28bcd	0.14c
Teak C	2.25e	4.67bc	0.81b	2.39cd	1.22abc
Teak D	5.00cde	4.67bc	0.00b	1.39d	0.00c
Jatropha E	6.08cde	8.14ab	0.11b	3.67bcd	1.64ab
Jatropha F	7.36bcd	4.25c	0.97ab	5.97abc	0.28c
Jatropha G	11.72ab	4.31c	0.00b	6.97ab	2.03a
Jatropha H	13.5a	6.69bc	0.00b	8.69a	0.56bc
SEM	1.7	1.2	0.5	1.3	0.4

Mean values followed by the same letter(s) are not significantly different at P=0.05 according to the Tukey's Honestly Significant Difference

Table 3 shows the population of nematode by source and the percent predominance over a period of 18months. Significant difference was evident between populations of nematodes present in the root of crops and those in soil except in *Criconemaspp.*, and *Scutellonema* spp. There were increased population number of *Helicotylychusspp.*, *Meloidogyne* spp., and *Pratylenchusspp.*, in root of crop compared with those in soil. *Meloidogyne* spp., were found to be predominant in the crop as they accounted for up to 45.73% of the overall nematode population, this was followed by *Helicotylenchusspp* (34.32), *Pratylenchus* spp., (12.16%), *Scutellonemaspp.*, (5.29%) and *Criconema* spp., (2.50%)

Table 3: Population of nematodes by source and percent predominance in crop

SOURCE	<i>Helicotylenchus</i>	<i>Meloidogyne</i>	<i>Criconema</i>	<i>Pratylenchus</i>	<i>Scutellonema</i>
ROOT	7.31a ± 0.5	11.65a ± 0.8	0.56a ± 0.1	4.69a ± 0.42	1.47a ± 0.2
SOIL	4.80b ± 0.4	2.93b ± 0.3	0.82a ± 0.3	4.15a ± 0.51	0.31b ± 0.1
PREDOMINANCE (%)	34.32	45.73	2.50	12.16	5.29

Mean values followed by the same letter(s) are not significantly different at P=0.05 according to the Tukey's Honestly Significant Difference

Table 4 shows the correlation between nematode population in soil and temperature over the period of 18months. The difference of soil temperature on *Helicotylenchus* spp., and *Scutellonemaspp.*, populations was insignificant in locations examined. A positive correlation between soil temperature *Meloidogynespp.*, and *Criconema* spp., populations in soil was evident in locations examined. There was a negative correlation between soil temperature and population of *Pratylenchusspp.*, in soil.

Table 4: Pearson's correlation between nematode population and temperature

	<i>Helicotylenchus</i>	<i>Meloidogyne</i>	<i>Criconema</i>	<i>Pratylenchus</i>	<i>Scutellonema</i>
TEMP	0.37	0.064*	0.097**	-0.023	0.863

*Correlation is significant at the 0.05 level (2-tailed)

**Correlation is significant at the 0.01 level (2-tailed)

DISCUSSION

One of the most evident characteristics of nematode populations in the soil is their tendency to fluctuate. This study present evidence of seasonal fluctuations in nematode numbers and species. As the number of

Helicotylenchus spp., *Meloidogyne* spp., and *Pratylenchus* spp., were highest during the rainy season (June to August) and lowest in the late winter (December to March), rising again during the rains. In contrast, species of *Scutellonema* were encountered during the winter month (December) and *Criconea* spp., attained their maximum population in April. Also, there was significant seasonal fluctuation in population number of the nematode species in the type of crop grown. *Helicotylenchus* spp., *Pratylenchus* spp., and *Scutellonema* spp., obtained their maximum number in the Jatropha plant while *Meloidogyne* spp., and *Criconea* spp., highest population number were observed in teak.

The seasonal variations were attributed to temperature, moisture, type of crop grown and their soil type. This summation is at par with Bakr *et al.*, (2011), who stated that biological populations such as plant parasitic nematodes are affected by different factors such as location, soil type, irrigation system, soil moisture, kind of cultivated crops and agricultural practices.

Higher soil temperature cause desiccation and dryness of soil because the necessary thin film of water needed for movement are low and nematode are subjected to increased stress, during which the nematodes consume a considerable amount of energy stored and reduce their population density (Gaur, 1994). These results are in confirmation with Siddiqui (2007) who observed that higher soil moisture is favourable for nematode multiplication.

The present survey showed positive correlation between the difference of soil temperature and soil populations of *Meloidogyne* spp., and *Criconea* spp., while a negative correlation was obtained in species of *Pratylenchus*. Soil temperature in the selected locations is different, which could affect the population density of the tested nematodes (Youssef & Aboul-Eid, 1996). Also, *Meloidogyne* spp. has been shown to reproduce well at temperatures as high as 35°C (Dropkin, 2003).

There were increased population number of *Helicotylenchus* spp., *Meloidogyne* spp., and *Scutellonema* spp., in root of crops compared with those in soil. The increased number of *Meloidogyne* spp., found in the root samples compared to the soil samples was expected as the natural behaviour of these sedentary endoparasites which stay immobile at the feeding sites upon reaching the infective J2 stage (Williamson & Kumar 2006).

Meloidogyne spp., were found to be predominant in the crop as they accounted for up to 45.73% of the overall nematode population, this was followed by *Helicotylenchus* spp. (34.32%) semi-endoparasite, *Pratylenchus* spp. Migratory endoparasite, (12.16%), *Scutellonema* spp., (5.29%) and *Criconea* spp., (2.50%). This result was echoed by Ibrahim *et al.*, (2000) who stated that the highest distribution and infection of *Meloidogyne* spp., occurred in sandy soil especially in the new reclaimed lands and also depended on the kind of cultivated crops and temperature.

In summary, five nematode genera namely *Helicotylenchus*, *Meloidogyne*, *Criconea*, *Pratylenchus* and *Scutellonema* were isolated from both soil and roots of teak and jatropha plants from four sampling plots in University of Ilorin plantation. *Meloidogyne* spp., were the most commonly encountered species of plant parasitic nematodes and also have the potential of causing damage in the surveyed area as evidenced from their high population and predominance values. However, *Helicotylenchus* spp., was found in all samples with high population. The variations in species distributions may be attributed to soil characteristics, crop type and climate of this particular study area.

The results of this survey would help in choosing planting systems in the selected locations and avoid planting the susceptible hosts. In addition, these results should be taken into consideration during planning of effective nematode management strategies especially, during the rains when soil moisture is high.

CONCLUSION

The findings of the experiment indicates that *Meloidogyne* spp., and *Helicotylenchus* spp., were widely spread in all examined crops and locations of the plantations and nematode management strategies must become a part of production practices planning program.

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