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SURVEY OF PLANT-PARASITIC NEMATODES ASSOCIATED WITH YAMS IN OGUN AND OSUN STATES OF NIGERIA

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Abstract: A survey was conducted to determine the types, frequency and population of plant parasitic nematodes associated with the soils and roots of Yam (*Dioscorea* species) in all the Local Government Areas of Ogun and Osun States of Nigeria using random sampling soil and root and pie pan modification of Baerman funnel for plant parasitic nematode extraction. Ten and nine genera of plant parasitic nematodes were encountered both from the soils and root samples from the two States. Plant parasitic nematodes recovered included *Scutellonema* spp., *Meloidogyne* spp., *Pratylenchus* spp., *Trichodorus* spp., *Helicotylenchus* spp., *Radopholus* spp., *Longidorus* spp., *Xiphinema* spp., *Rotylenchulus* spp and *Aphelenchoides* species. *Scutellonema* spp., *Meloidogyne* spp., and *Pratylenchus* spp were most widely distributed with frequency ratings of 70, 65 and 60% respectively in soil samples from Ogun State and in the root samples the three genera predominated with 60, 55 and 45% frequency ratings respectively. *Meloidogyne* spp., *Scutellonema* spp., and *Pratylenchus* spp were most widely distributed with frequency ratings of 65, 45 and 35% respectively in soil samples from Osun State and in the root samples the three genera predominated with 55, 35 and 35% frequency ratings respectively.

Key words: Yam (*Dioscorea* spp.), types, frequency, population of plant-parasitic nematodes, *Scutellonema* spp., *Meloidogyne* spp., *and Pratylenchus* spp.

INTRODUCTION

Yams (*Dioscorea* spp.) are probably one of the oldest food crops known to man. Their large-scale cultivation as food crops is restricted largely to three main areas of the world: West Africa, the Pacific area (including Japan), and the Caribbean, but

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is also of importance in parts of eastern African and tropical America. The majority of yams are produced in West Africa, where they are steeped in cultural history and referred as a cultural symbol of fertility. The bulk of global yam production is concentrated in West Africa, with Nigeria producing the largest proportion followed by Ghana and Cote d'Ivoire (FAOSTAT 2004). In Nigeria, yam production is undertaken mainly in the South-Eastern zone, the South-Western zone, the area south of River Benue and east of River Niger, which stretches from the humid forest to the sub-humid guinea savannah ecological zones (Nweke *et al*. 1991) where the soil fertility and rainfall permit its production. Plant-parasitic nematodes damage is an important factor in tuber quality reduction and yield loss in yam in the field and in storage. Many different nematode species have been found and reported associated with yam cultivation from various yam-producing areas of the world (Ayala and Acosta 1971; Bridge 1972; Adesiyan and Odihirin 1977; Caveness 1982; Hahn *et al*. 1989; Adegbite *et al*. 2005, 2006; Adegbite and Agbaje 2007). The nematodes of particular importance are endoparasites of roots and tubers. Those known to cause serious damage by mainly reducing tuber yield and quality are *Scutellonema bradys, Pratylenchus coffeae, Pratylenchus sudanensis and Meloidogyne* spp. which have been reported from some parts of yam-producing areas of Southwestern Nigeria (Adegbite *et al*. 2006; Adegbite and Agbaje 2007), some of these nematodes have been found either in or on yam roots and tubers, while other in the yam rhizosphere. However, plant parasitic nematodes associated with yam in Southwestern Nigeria, particularly in Ogun and Osun States have not been fully investigated and documented. This survey was conducted to update available information on plant parasitic nematodes of yam in Ogun and Osun states, determine the types, population levels and frequency of occurrence.

MATERIALS AND METHODS

The survey was carried out in the major yam producing areas of Ogun and Osun States of Southwestern Nigeria between October 2006 and March 2007. All the local Government Areas of the two States were visited for collection of soil and root samples of yam, which consists of twenty and thirty Local Government Areas, respectively. In each of the Local Government Area, farms towns with signs of nematode infestation were randomly selected for sampling making a total of sixty and ninety farms sampled in Ogun and Osun States, respectively. In each farm, 10 plants were randomly selected for sampling. Soil samples from around the roots of each plant were collected using a soil auger along the four cardinal directions at the base of each plant in order to cover as much of the rhizosphere as possible. Soil samples were collected to a depth of 15–30 cm with garden trowels. Samples (soil and roots) from each farm were pooled and sealed in plastic bags and protected from the sun (Ricka and Barker 1992). The samples were properly labeled and taken to Plant Protection Laboratory of the Institute of Agricultural Research and Training, Obafemi Awolowo University, Moor Plantation, Ibadan–Nigeria for analysis and for identification of plant parasitic nematodes.

Plant parasitic nematodes were extracted from the soil using the pie-pan modification of the Baerman Funnel method (Southey 1986). Each composite soil sample was mixed thoroughly and plant parasitic nematodes were extracted from 200 ml sub-sample. The sediment was left undisturbed for 24 hours before decanting the

suspension into a beaker. Ten extraction trays were set up per sample. Adding an equal volume of hot water to the nematode suspension killed plant parasitic nematodes and each sample was then adjusted to a desired volume. The suspension was thoroughly mixed using a magnetic stirrer and 5 ml aliquot was drawn from each suspension into a Doncaster counting dish for identification and quantification of the extracted nematodes. Temporary mounts of nematodes were prepared prior to nematode identification. Identification of plant parasitic nematodes to the generic level was done using the Lucid-key of Bell (2004). In case of the root samples 10g/ composite root samples were cut into pieces and macerated with an electric blender for 30 seconds. Samples were then processed and identified in the same way as the soil samples. Percentage frequency was determined using the formula n/N x 100, where n = frequency an individual nematode occurrence in all samples and N is the sample size (60 for Ogun State and 90 for Osun State). Also the percentage nematode population was determined using In/TN x 100%, where In = the individual nematode population in all samples while TN is the total population of all the nematodes extracted from all samples.

RESULTS

Ten genera of plant parasitic nematodes were encountered in soil and root samples collected from Ogun State, respectively. In the soil, plant parasitic nematodes identified were as *Scutellonema* spp., *Meloidogyne* spp., *Pratylenchus* spp., *Trichodorus* spp., *Helicotylenchus* spp., *Radopholus* spp., *Longidorus* spp., *Xiphinema* spp., *Rotylenchulus* spp., and *Aphelenchoides* spp. *Scutellonema* species was the most frequently occurring species in the soil (70%) where the population was 18550/200 ml soil, this was followed by *Meloidogyne* species with 65% frequency rating and a population of 16555/200 ml soil while *Pratylenchus* species had frequency rating of 60% and a population of 12887/200 ml soil. *Longidorus* and *Xiphinema* species had the lowest frequency rating of 19 and 21%, respectively while *Longidorus* species had the lowest population of 5467/200 ml soil (Table 1). In the root samples similar trends were observed in which *Scutellonema* species was the most frequently encountered species (60%) with a population of 6500/10 grams of roots, followed by *Meloidogyne* species and *Pratylenchus* species with 55 and 45%, frequency ratings respectively (Table 2).

Nine genera of plant parasitic nematodes were encountered each in soil and root samples collected from Osun State. In the soil, plant parasitic nematodes identified were *Meloidogyne* spp., *Scutellonema* spp., *Pratylenchus* spp., *Aphelenchoides* spp., *Trichodorus* spp., *Radopholus* spp., *Helicotylenchus* spp., *Rotylenchus* spp., and *Longidorus* species. The most frequently occurring species in the soil samples from Osun State was *Meloidogyne* species with the frequency rating of 65% and a population of 18565/200 ml soil, this was followed by *Scutellonema* species with frequency rating of 45% and a population of 15635/200 ml soil while *Pratylenchus* species had a frequency rating of 35% with nematode population of 12443/200 ml soil. *Longidorus* and *Rotylenchus* species had the lowest frequency rating of 15 and 10%, respectively with nematode populations of 3296 and 1264/200 ml soil, respectively (Table 3). In the root samples similar trends were observed in which *Meloidogyne* species was the most frequently encountered species with frequency rating of 55% and with a population of 6465/10 grams of roots, this was followed, by *Scutellonema* and *Pratylenchus* species

with frequency rating of 35% and a populations of 4385/10 grams of roots, respectively. *Helicotylenchus*, *Rotylenchus* and *Longidorus* species had the lowest frequency ratings of 20, 15 and 10%, respectively with populations of 1985, 1868 and 1656/10 grams of roots, respectively (Table 4).

Table 1. Plant parasitic nematodes extracted from soil around the roots of Yam in Ogun State.

Genus	Frequency of occurrence	[%] Frequency rating*	Nematode population/ 200 ml soil	[%] Nematode population**
Scutellonema spp.	40	70	18550 ± 23	16.5
Meloidogyne spp.	35	65	16555 ± 21	15.0
Pratylenchus spp.	30	60	12887 ± 19	11.6
Trichodorus spp.	15	37	8765 ± 16	8.0
Helicotylenchus spp.	26	45	11345 ± 18	10.2
Radopholus spp.	15	28	10043 ± 14	9.0
Longidorus spp.	10	19	5467 ± 89	5.0
Xiphinema spp.	10	21	7654 ± 10	7.0
Rotylenchulus spp.	13	24	9876 ± 12	8.7
Aphelenchoides spp.	25	45	10043 ± 15	9.0

*n/N x 100 (n = frequency of individual nematode occurrence and N = sample size (60)

**In/TN x 100 (n = individual nematodes in all samples and TN = Total population of all nematodes extracted from all samples)

Table 2. Plant parasitic nematodes extracted from roots of Yam in Ogun State.

Genus	Frequency of occurrence	[%] Frequency rating*	Nematode population/ 200 ml soil	[%] Nematode population**
Scutellonema spp.	38	60	6500 ± 25	20.4
Meloidogyne spp.	35	55	5650 ± 24	18.0
Pratylenchus spp.	28	45	4590 ± 38	14.3
Trichodorus spp.	15	28	2756 ± 20	9.0
Helicotylenchus spp.	12	22	2458 ± 19	8.0
Radopholus spp.	10	19	2215 ± 96	7.0
Longidorus spp.	5	9	1224 ± 89	3.8
Xiphinema spp.	5	9	1224 ± 19	3.8
Rotylenchulus spp.	13	24	2665 ± 98	8.3
Aphelenchus spp.	13	24	2665 ± 20	8.3

*n/N x 100 (n = frequency of individual nematode occurrence and N = sample size (60)

**In/TN x 100 (n = individual nematodes in all samples and TN = Total population of all nematodes extracted from all samples)

Table 3. Plant parasitic nematodes extracted from soils around the roots of Yam in Osun State

Genus	Frequency of occurrence	[%] Frequency rating*	Nematode population/ 200 ml soil	[%] Nematode population**
Meloidogyne spp.	69	65	18565 ± 45	26.3
Scutellonema spp.	64	45	15635 ± 48	22.2
Pratylenchus spp.	62	35	12443 ± 30	18.0
Aphelenchoides spp.	52	30	6558 ± 66	9.3
Trichodorus spp.	45	28	4556 ± 45	6.3
Radopholus spp.	40	28	4556 ± 45	6.3
Helicotylenchus spp.	35	25	3592 ± 40	5.1
Rotylenchus spp.	30	10	3296 ± 40	4.7
Longidorus spp.	15	15	1264 ± 65	1.8

*n/N x 100 (n = frequency of times individual nematode occurrence and N = sample size (90)

**In/TN x 100 (n = individual nematodes in all samples and TN = Total population of all nematodes extracted from all samples)

Table 4. Plant parasitic nematodes extracted from roots of Yam in Osun State

Genus	Frequency of occurrence	[%] Frequency rating*	Nematode Population/ 200 ml soil	[%] Nematode population**
Meloidogyne spp.	64	55	6465 ± 50	22.3
Scutellonema spp.	59	35	4385 ± 45	15.1
Pratylenchus spp.	59	35	4385 ± 45	15.1
Aphelenchoides spp.	40	30	3883 ± 35	13.4
Trichodorus spp.	32	26	2355 ± 35	8.1
Radopholus spp.	30	22	2056 ± 30	7.1
Helicotylenchus spp.	25	20	1985 ± 28	6.8
Rotylenchus spp.	15	15	1868 ± 22	6.4
Longidorus spp.	10	10	1656 ± 16	5.7

*n/N x 100 (n = frequency of individual nematodes occurred and N = sample size (90)

**In/TN x 100 (n = individual nematodes in all samples and TN = Total population of all nematodes extracted from all samples)

DISCUSSION

This survey has shown that plant parasitic nematode infestation of agricultural fields could constitute an important economic problem in yam production in South-Western Nigeria. Yams which are most intensively cultivated and food crops of major importance in tropical agriculture providing staple food for population in many tropical countries notably West Africa, the Caribbean area and parts of Southeastern

Asia. As the land use is being intensified across the Southwestern Nigeria, the needs for food to feed the population are increasing. The intensification has led to continuous change and lack of stability in the ecosystems making conditions favourable for certain species of plant parasitic nematodes while exerting immerse selection pressure upon others (Wallace 1971; Tiyagi *et al*. 1987). The sustainability of these intensified yam based systems is threatened by the build up of soilborne constraints, particularly plant parasitic nematodes. Ten and nine genera of plant parasitic nematodes occurring in varying densities were identified in the two states involved in the survey both in the soil and root samples. Three genera, *Scutellonema*, *Meloidogyne* and *Pratylenchus* occurred more frequently than the other genera. These findings corroborate the reports of Unny and Jerath (1965), Caveness (1965), Adesiyan and Odihirin (1977), Acosta and Ayala (1975), Coates-Beckford and Braithwaite (1977), Bridge and Page (1984), Adegbite *et al*. (2005) and Adegbite *et al*. (2006), who reported association of these plant parasitic nematodes with yam. The widespread occurrence of these plant parasitic nematodes in the yam based cropping systems indicates that the nematodes are economically important in yam production.

Also the findings of this investigation are similar to an earlier report by Unny and Jerath (1965) who identified eleven genera of plant parasitic nematodes associated with yam in the former Eastern Nigeria. In their study they identified *Scutellonema* species and *Meloidogyne* species as the most important nematodes limiting yam production. Caveness (1965) found twenty-eight plant parasitic nematodes associated with yams in West and Mid-West, East and North of Nigeria and listed four genera, *Scutellonema*, *Pratylenchus*, *Meloidogyne*, and *Rotylenchulus* as being very important. Adesiyan and Odihirin (1977) identified six genera of plant parasitic nematodes in Midwestern State of Nigeria. The species identified were *Scutellonema* spp., *Pratylenchus* spp., *Meloidogyne* spp., *Helicotylenchus* spp., *Criconemoides* spp. and *Xiphinema* spp. Adegbite *et al*. (2006) identified twelve, eleven and ten genera of plant parasitic nematodes in three states (Edo, Ekiti and Oyo States) and listed three genera, *Scutellonema*, *Meloidogyne* and *Pratylenchus* as being very important. Acosta and Ayala (1975), Coates-Beckford and Braithwaite (1977), and Bridge and Page (1984) made similar observations in Puerto-Rico, Trinidad and Papua New Guinea, respectively. While *Scutellonema* species for instance may be higher than *Meloidogyne* species or *Pratylenchus* species in one state, *Meloidogyne* or *Pratylenchus* species may have higher density in another state. This means that nematode genera differ in their response to existing field conditions. These findings corroborate the reports of Schmitt and Norton (1972). Hunt (1993) identified the genus *Aphelenchoides* as plant parasitic nematodes. *Aphelenchoides besseyi*, a foliar nematode, is known to occur in large populations in the foliage and tubers of *D. trifida* in Guadeloupe being associated with drying and blackening of the foliage, and wasting and cracking of tubers with internal decay (Kermarrec and Anais 1973).

In the past, crop damage due to plant parasitic nematodes was often ignored or mistaken for other causes such as depletion in soil fertility and moisture or soil exhaustion. It was because of nematodes' small size and hidden way of life and lack of definite information on their occurrence and pathogenicity. The presence of plant parasitic nematodes could constitute serious impediments to the growth and yield of yams in Ogun and Osun States. The importance of plant parasitic nematodes in yam production cannot be overemphasized, they adversely affect the marketable

value of tubers because of the unappealing, warty appearance, and they are associated with rot of stored yams. Weight differences between healthy and diseased tubers harvested from the field have been estimated to be 20–30% in Cote d'Ivoire (Bridge 1982) and 0–29% in Nigeria (Wood *et al*. 1980). In Nigeria, a combination of root-knot nematodes and *Scutellonema bradys* caused abandonment of large areas of yam farms (Adesiyan and Odihirin 1977). In China, yields of yams have been reduced by 24–28% because of infestation by root knot nematodes (Gao 1992). In India, low population of 100 juveniles/plant of *M. incognita* was observed to reduce tuber yields of *D. rotundata* (Mohandas and Ramakrishnan 1997). Once again enlightenment programme for yam farmers should be embarked upon by the front line extension officers in the State Agricultural Development Programmes in the zones to inform the farmers of the presence of plant parasitic nematodes in their farms and the attendant implications.

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POLISH SUMMARY

LUSTRACJA PASOŻYTNICZYCH DLA ROŚLIN NICIENI ZWIĄZANYCH ZE SŁODKIM ZIEMNIAKIEM W STANACH OGUN I OSUN NIGERII

W celu określenia występowania typów, częstotliwości występowania oraz populacji pasożytniczych dla roślin nicieni związanych z glebą i korzeniami słodkiego ziemianka (gatunku *Dioscorea*) przeprowadzono lustrację wszystkich państwowych lokalizacji w stanach Ogun i Osun, przy wykorzystaniu zmodyfikowanej metody polegającej na użyciu lejka Baermana. W próbkach ziemi i korzeni pochodzących z tych stanów wykryto odpowiednio dziesięć i dziewięć najczęściej spotykanych rodzajów nicieni. Były to gatunki: *Scutellonema* spp., *Meloidogyne* spp., *Pratylenchus* spp., *Trichodorus* spp., *Helicotylenchus* spp., *Radopholus* spp., *Longidorus* spp., *Xiphinema* spp., *Rotylenchulus* spp., i *Aphelenchoides* spp., *Scutellonema* spp., *Meloidogyne* spp., i *Pratylenchus* spp należały do najpospoliciej spotykanych, a częstotliwośc ich występowania w próbach ziemi wynosiła odpowiednio 70, 65 i 60% ze stanu Ogun, natomiast w próbach korzeni znajdowano je w ilości 60, 55 i 45%. W stanie Osun w ziemi najczęściej stwierdzano gatunki *Meloidogyne* – 65%, *Scutellonema* – 45% i *Pratylenchus* – 35%. Natomiast w próbach korzeni częstotliwość ich występowania wynosiła odpowiednio 55, 35 i 35%.