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Full Length Research Paper

Survey of plant-parasitic nematodes associated with yams in Edo, Ekiti and Oyo states of Nigeria

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A survey was conducted to determine the types, frequency and population of plant parasitic nematodes associated with the soils and roots of Yam (*Dioscorea* spp.) in all Local Government Areas of Edo, Ekiti and Oyo States of Nigeria using random sampling for soil and root and using pie pan modification of Baerman funnel for plant parasitic nematode extraction. Twelve, eleven and ten genera of plant parasitic nematodes were encountered in the three States respectively, while ten genera each were identified from root samples from the three States. Plant-parasitic nematodes recovered included *Meloidogyne* spp., *Pratylenchus* spp., *Scutellonema* spp., *Radopholus* spp., *Aphelenchoides* spp., *Trichodorus* spp., *Rotylenchus* spp., *Helicotylenchus* spp., *Aphelenchus* spp., *Longidorus* spp., *Xiphinema* spp and *Rotylenchulus* spp. *Pratylenchus* spp., *Scutellonema* spp., and *Meloidogyne* spp were most widely distributed with frequency rating of 70, 60 and 55% respectively in soil samples from Edo State and in the root samples the three genera predominated with 75, 60 and 60% frequency rating respectively. *Scutellonema* spp., *Meloidogyne* spp., and *Pratylenchus* spp were most widely distributed with a frequency rating of 75, 70 and 60% respectively in soil samples from Ekiti State and in the root samples the three genera predominated with 70, 65 and 50% frequency rating respectively while *Meloidogyne* spp., *Scutellonema* spp., and *Pratylenchus* spp were mostly widely distributed with a frequency rating of 70, 65 and 62.7% respectively in soil samples from Oyo State and in the root samples the three genera predominated with 65, 60 and 60% frequency rating respectively.

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

INTRODUCTION

Yams (*Dioscorea* spp.) constitute one of the most important food crops in the tropics and most important group of staple foods especially in the yam zone (25^0N and 25^0S) of West Africa (Coursey, 1967). There are between 300 and 600 species of *Dioscorea*, of which only a few are edible. The four most commonly cultivated are the water yam (*D. alata* L.), yellow yam (*D. cayenensis* Lam.), Chinese yam (*D. esculenta* [Lour.] Burk.) and the white yam (*D. rotundata* Poir). *D. cayenensis* and *D. rotundata* are indigenous to West Africa, *D. alata* and *D. esculenta* are native to Asia. *D. rotundata* is the most important species of yams in Africa; followed by *D. cayenensis*. The bulk of global yam production is concentrated in West Africa, with Nigeria producing the largest proportion followed by Ghana and Cote d'Ivoire (FAO-STAT 2004). Yam is the second most important root and tuber crop in the World after cassava in terms of production, and contributes more than 200 dietary calories per day for 60 million people in the yam zone (Nweke et al., 1991). In Nigeria, yam production is undertaken mainly in the South-eastern zone, the South-Western zone, the

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area south of River Benue and east of River Niger, which stretches from the humid forest to the subhumid guinea savannah ecological zones (Nweke et al., 1991) where the soil fertility and rainfall permit their production. Yams require rainfall ranging between 1168.4 and 2500 mm per annum. Yam productions are expanding annually but realized yields are usually considerably lower than potential yields.

Plant- parasitic nematodes damage is an important factor in tuber quality reduction and yield loss in yam in the field and in storage. A large number of plant- parasitic nematodes associated with yam cultivation have been reported from various yam producing areas of the world (Ayala and Acosta, 1971; Bridge, 1972; Thompson et al., 1973; Adesiyan and Odihirin, 1977; Caveness, 1982; Hahn et al., 1989; Green and Florini, 1996; Agbaje et al., 2002; 2003; Adegbite et al., 2005).

These are the yam nematode *Scutellonema bradys*, the root-knot nematode *Meloidogyne* spp. and the lesion nematode *Pratylenchus* spp., which are all field and post-harvest pests (Caveness, 1982; Hahn et al., 1989; Agbaje et al., 2002; 2003; Adegbite et al., 2005). However, plant parasitic nematodes associated with yam in South Western Nigeria, particularly in Edo, Ekiti and Oyo States have not been fully investigated. This survey was conducted to update available information on nematodes of yam in South Western Nigeria and determine the types, population levels and frequency of occurrence of plant parasitic nematodes associated with yam in the three states.

MATERIALS AND METHODS

The survey was carried out in Edo, Ekiti and Oyo States in South Western Nigeria between January and June 2006. All the Local Government Areas of the three States were visited for collection of soil and root samples of yam which consists of 20, 18 and 33 Local Government Areas respectively. In each of the Local Government Areas, farms in three towns were randomly selected for sampling making a total of 60, 54 and 99 farms sampled in Edo, Ekiti and Oyo 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 15-30cm with garden trowels. Samples (soil and root) 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, 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 samples was mixed thoroughly and plant parasitic nematodes were extracted from 200ml sub-sample. The set up was left undisturbed for 24 h before decanting the suspension into a beaker. Ten extraction trays were set up per sample. Plant parasitic nematodes in each suspension were killed by adding an equal volume of hot water to the nematodes suspension and each sample was then adjusted to a desired volume. The suspension was thoroughly mixed using a magnetic stirrer and 5ml 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 30seconds. Samples were then processed and identified in the same way as for the soil samples. Percentage frequency was determined using the formula n/N x 100.

Where n = the number of times an individual nematode occurred in all the samples and N is the sample size (60 for Edo State, 54 for Ekiti State and 99 for Oyo State). Also the percentage nematode population was determined using In/TN x 100%.

Where In = the individual nematode population in all the samples while TN is the total population of all the nematodes extracted in all the samples.

RESULTS

Twelve and ten genera of plant parasitic nematodes were encountered in soil and root samples collected from Edo State respectively. In the soil, plant parasitic nematodes identified were *Pratylenchus* spp., *Scutellonema* spp., *Meloidogyne* spp., *Aphelenchoides* spp., *Helicotylenchus* spp., *Rotylenchus* spp., *Radopholus* spp., *Trichodorus* spp., *Aphelenchus* spp., *Rotylenchulus* spp., *Longidorus* spp., and *Xiphinema* spp. *Pratylenchus* species was the most frequently occurring species in the soil (70%) where the population was 15500/200 ml soil which was followed by *Scutellonema* species with 60% frequency rating and a population of 12355/200 ml soil while *Meloidogyne* species had frequency rating of 57% and a population of 11542/200 ml soil. *Longidorus* and *Xiphinema* species had the lowest frequency rating of 16.5% while *Rotylenchulus* species had the lowest population of 1245/ 200 ml soil (Table 1). In the root sample similar trends were observed in which *Pratylenchus* spp was the most frequently encountered species (75%) and a population of 8500/10 g root, followed by *Scutellonema* and *Meloidogyne* species with 60% frequency ratings respectively (Table 2).

Eleven and ten genera of plant parasitic nematodes were encountered in soil and root samples collected from Ekiti State respectively. In the soil, plant parasitic nematodes identified were *Scutellonema* spp., *Meloidogyne* spp., *Pratylenchus* spp., *Trichodorus* spp., *Aphelenchus* spp., *Helicotylenchus* spp., *Radopholus* spp., *Longidorus* spp., *Xiphinema* spp., *Rotylenchulus* spp and *Aphelenchoides* spp. *Scutellonema* spp was the most frequently occurring species in the soil (76%) where the population was 19550/200 ml soil which was followed by *Meloidogyne* spp with 70% frequency rating and a population of 17655/200 ml soil while the third frequently occurring species was *Pratylenchus* with frequency rating of 63% and a population of 15887/200 ml soil. *Xiphinema* spp had the lowest frequency rating of 21% while *Aphelenchus* spp had the lowest population of 1845/200 ml soil (Table 3).

In the root, similar trends were observed in which *Scu-*

Table 1. Plant Parasitic Nematodes extracted from soils around the roots of Yam in Edo State

Nematode Genera	Frequency of Occurrence	% Frequency Rating*	Nematode Population/200 ml soil	% Nematode Population **
Pratylenchus spp	42	70	15500±175.6	18.2
Scutellonema spp	36	60	12355±163.5	14.5
Meloidogyne spp	34	57	11542±160.8	13.5
Aphelenchoides spp	30	50	8690±120.5	10.2
Rotylenchus spp	20	33	6538±100.2	7.7
Radopholus spp	18	30	6015±95.5	7.1
Helicotylenchus spp	15	25	5835±87.6	6.8
Aphelenchus spp	15	25	5835±87.6	6.8
Trichodorus spp	13	22	4567±71.6	5.3
Xiphinema spp	9	15	3695±73.8	4.3
Longidorus spp	9	15	3468±72.5	4.1
Rotylenchulus spp	6	10	1245±68.9	1.5

* n/N x 100 (n = number of times individual nematodes occurred and N = Sample size (60).
** In/N x 100 (n = Individual nematode in all the samples and TN = Total Population of all the nematodes extracted in all the samples).

Table 2. Plant Parasitic Nematodes extracted from the roots of Yam in Edo State

Nematode Genera	Frequency of Occurrence	% Frequency Rating *	Nematode Population/10 g root	% Nematode Population **
Pratylenchus spp	45	75	8500±250.5	14.7
Scutellonema spp	36	60	7350±245.8	12.7
Meloidogyne spp	34	60	6990±238.5	12.1
Rotylenchus spp	16	27	6535±230.8	11.3
Radopholus spp	13	22	6285±200.5	10.8
Helicotylenchus spp	12	20	6158±198.8	10.6
Aphelenchus spp	10	17	5215±195.9	9.0
Trichodorus spp	10	17	4815±195.8	8.3
Xiphinema spp	8	13.3	3965±190.9	6.8
Longidorus spp	5	8.3	2156±185.6	3.7

* n/N x 100 (n = number of times individual nematodes occurred and N = Sample size (60).
** In/N x 100 (n = Individual nematode in all the samples and TN = Total Population of all the nematodes extracted in all the samples).

tellonema spp was the most frequently encountered species (70%) and a population of 7450/10 g root, followed by *Meloidogyne* and *Pratylenchus* species with frequency ratings of 65 and 52% respectively (Table 4).

Ten genera of plant parasitic nematodes were encountered in soil and root samples collected from Oyo State respectively. In the soil, plant parasitic nematodes identified were *Meloidogyne* spp., *Scutellonema* spp., *Pratylenchus* spp., *Aphelenchoides* spp., *Trichodorus* spp., *Radopholus* spp., *Helicotylenchus* spp., *Rotylenchus* spp., *Longidorus* spp and *Xiphinema* spp. *Meloidogyne* spp was the most frequently occurring species in the soil (70%) with a population of 20565/ 200 ml soil which was followed *Scutellonema* spp with 65% frequency rating and a population of 17555/200 ml soil while the third frequently occurring species was *Pratylenchus* spp with frequency rating of 62.7% and a population of 16543/200 ml soil. *Longidorus* spp and *Xiphinema* spp had the lowest frequency rating of 15% with populations of 1234/200 ml soil respectively (Table 5). In the root, similar trends were observed in which *Meloidogyne* spp was the most frequently encountered species (65%) and a population of 8765/10 g root, followed by *Scutellonema* spp and *Pratylenchus* spp with frequency ratings of 60% respectively (Table 6).

DISCUSSION

Yams are food crops of major importance in tropical agriculture and they provide the staple food stuff for millions of people in many tropical countries, most notably in West Africa, the Caribbean area and parts of South East Asia.

The intensification of agriculture has led to continuous

Table 3. Plant Parasitic Nematodes extracted from soils around the roots of Yam in Ekiti State

Nematode Genera	Frequency of Occurrence	% Frequency Rating*	Nematode Population/200 ml soil	% Nematode Population**
Scutellonema spp	41	76	19550±234	16.2
Meloidogyne spp	38	70	17655±217	14.6
Pratylenchus spp	34	63	15887±199	13.2
Trichodorus spp	20	37	8765±165	7.3
Aphelenchus spp	24	44	1845±56	1.5
Helicotylenchus spp	32	59	12345±189	10.1
Radopholus spp	15	28	10543±146	9.0
Longidorus spp	10	19	5467±89	4.5
Xiphinema spp	10	21	7654±100	6.4
Rotylenchulus spp	13	24	9876±125	8.2
Aphelenchoides spp	30	56	10897±155	9.0

* n/N x 100 (n = number of times individual nematodes occurred and N = Sample size (54).
** In/N x 100 (n = Individual nematode in all the samples and TN = Total Population of all the nematodes extracted in all the samples).

Table 4. Plant Parasitic Nematodes extracted from the roots of Yam in Ekiti State.

Nematode Genera	Frequency of Occurrence	% Frequency Rating *	Nematode Population/10 g root	% Nematode Population **
Scutellonema spp	38	70	19550±234	16.2
Meloidogyne spp	35	65	17655±217	14.6
Pratylenchus spp	28	52	15887±199	13.2
Trichodorus spp	15	28	8765±165	7.3
Aphelenchus spp	13	24	1845±56	1.5
Helicotylenchus spp	12	22	12345±189	10.1
Radopholus spp	10	19	10543±146	9.0
Longidorus spp	5	9	5467±89	4.5
Xiphinema spp	5	9	7654±100	6.4
Rotylenchulus spp	13	24	9876±125	8.2

* n/N x100 (n = number of times individual nematodes occurred and N = Sample size (54).
** In/N X 100 (n = Individual nematode in all the samples and TN = Total Population of all the nematodes extracted in all the samples).

Table 5. Plant Parasitic Nematodes extracted from soils around the roots of Yam in Oyo State

Nematode Genera	Frequency of Occurrence	% Frequency Rating *	Nematode Population/200 ml soil	% Nematode Population **
Meloidogyne spp	69	70	20565±156	22
Scutellonema spp	64	65	1755±148	19
Pratylenchus spp	62	62.7	16543±130	18
Aphelenchoides spp	52	52.5	8958±66	10
Trichodorus spp	45	45.5	7335±50	8
Radopholus spp	40	40.4	7056±45	8
Helicotylenchus spp	35	35.4	6592±40	7
Rotylenchus spp	30	30.3	5996±40	6
Longidorus spp	15	15	1234±65	1
Xiphinema spp	15	15	1234±65	1

* n/N x 100 (n = number of times individual nematodes occurred and N = Sample size (99).
** In/N x 100 (n = Individual nematode in all the samples and TN = Total Population of all the nematodes extracted in all the samples).

Table 6. Plant Parasitic Nematodes extracted from the roots of Yam in Oyo State.

Nematode Genera	Frequency of Occurrence	% Frequency Rating *	Nematode Population/10 g root	% Nematode Population **
Meloidogyne spp	64	65	8765±50	25
Scutellonema spp	59	60	6385±45	18.2
Pratylenchus spp	59	60	5836±45	16.3
Aphelenchoides spp	40	40	3283±35	9.3
Trichodorus spp	32	32	2355±35	6.4
Radopholus spp	30	30	2056±30	6
Helicotylenchus spp	25	25	1685±28	5
Rotylenchus spp	15	15	1668±22	5
Longidorus spp	10	10	1556±16	4.4
Xiphinema spp	10	10	1556±16	4.4

* n/N x 100 (n = number of times individual nematodes occurred and N = Sample size(99).
** In/N x 100 (n = Individual nematode in all the samples and TN = Total Population of all the nematodes extracted in all the samples).

change and lack of stability in the ecosystem, making conditions favorable for certain species of plant parasitic nematodes while exerting immense selection pressure upon others (Wallace, 1971; Tiyagi et al., 1987). The sustainability of these intensified yam based systems is threatened by build up of soil borne constraints, particularly plant parasitic nematodes.

Plant parasitic nematodes have been reported to constitute serious impediments to yam production in various parts of the world (Acosta and Ayala, 1975; Bridge, 1972; Thompson et al., 1973; Coates- Beckford and Braithwaite, 1977; Adesiyan and Odihirin, 1977; Caveness, 1982; Hahn et al., 1989; Weber et al., 1995). 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 *Scutello-nema* spp and *Meloidogyne* spp as the most important nematodes limiting yam production. Caveness (1965) found 28 plant parasitic nematodes associated with yams in West and Mid-West, East and North of Nigeria and listed four genera, *Scutellonema* spp., *Pratylenchus* spp., *Meloidogyne* spp and *Rotylenchulus* spp as being very important. Adesiyan and Odihirin (1977) identified six genera of plant parasitic nematodes in Mid-West State of Nigeria. The species identified were *Scutellonema* spp., *Pratylenchus* spp., *Meloidogyn*e spp., *Helicotylenchus* spp., *Criconemoides* spp and *Xiphinema* spp. Acosta and Ayala (1975), Coates-Beckford and Braithwaite (1977) and Bridge and Page (1984) had made similar observations in Puerto-Rico, Trinidad and Papua New Guinea respectively.

Plant-parasitic nematodes damage is an important factor in tuber quality reduction and yield loss in yams both in the field and in storage. Yams are vulnerable to nematode damage as they reduce the yield and quality of the tubers as a result of root gallings, root lesions, dry and soft rots depending on the type of plant parasitic nematodes present.

The presence of plant parasitic nematodes could constitute serious impediments to the growth and yield of yams in Edo, Ekiti and Oyo States.

Enlightenment Programme for the yam farmers should therefore be embarked upon by the State Agricultural Development Programmes in the zone to inform the farmers of the presence of plant parasitic nematodes in their farms and attendant implications.

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