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REGULAR ARTICLE

STUDIES ON THE OCCURRENCE AND POPULATION DISTRIBUTION OF NEMATODES WITH YAM (*DIOSCOREA ROTUNDATA POIR*) TUBERS IN BENUE STATE, NIGERIA

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ABSTRACT

Yam (*Dioscorea* spp) nematodes have been variously reported to reduce tuber yield and quality worldwide. In the present study, a survey was done to estimate types, frequency and population density of nematodes associated with yam tubers at each of the Local Government headquarters and two villages in Benue state of Nigeria. A total of 250 yam tubers were sampled randomly in the survey markets between April and May, 2017. Each yam sample was processed by peeling the periderm (one-inch-thick) out of which a 10 g sub-sample tuber was separately put in a blender with some quantity of water and macerated at low speed for 15 seconds. Plant-parasitic nematodes were recovered from the yam tubers using a modified extraction tray method. Five nematode species were found in association with yam tubers as follows: *Scutellonema bradys*, *Meloidogyne* spp, *Pratylenchus* spp, *Rotylenchulus* spp and *Tylenchus* spp. *Scutellonema bradys* was the most ubiquitous, occurring at a 100% frequency rating in all the samples while *Meloidogyne* spp, *Pratylenchus* spp, *Rotylenchulus* spp and *Tylenchus* spp. were 29.60%, 16.80%, 8.80% and 4.80% respectively. Though the study revealed that *Rotylenchulus* spp and *Tylenchus* spp. were poor parasites of yam tubers, yet there was a widespread distribution of *Scutellonema bradys*, *Meloidogyne* spp and *Pratylenchus* spp on yam tubers in Benue State of Nigeria, thus control of plant-parasitic nematodes is encouraged for improved tuber quality.

Keywords: Yam nematodes, Markets, Nigeria

INTRODUCTION

Yam (*Dioscorea* spp) is a staple food crop in Nigeria. There are four main varieties widely cultivated in the country [7]. Large production of the yam crop is in West Africa and out of that, Nigeria is the largest producer and Ghana and Cote d'Ivoire follows Nigeria [19]. Among the world's root crops, yam is the second most used one [26]. The rise in yam consumption in the world today is due to its high nutritional value. Yam is rich in many nutrients and also have medicinal properties [18]. The crop is also used for cultural events and the harvest is always celebrated annually by some tribes in Nigeria [24]. The set standard for exportable crops including yam is necessary to be followed by stakeholders in order to raise the quality of yam export to internationally acceptable level. For example, as far back as 2000, Jamaica's yam export industry was valued at 15 million dollars and serves as source of revenue for the 15,000 small farmers [18].

Despite above listed advantages of yam to human health, economic, cultural and social benefits, the damage by agents like plant-parasitic nematodes is a major threat to this crop in all yam producing countries throughout the world [8, 10, 30, 2, 14, 23, 21, 7]. In West Africa, [16] and

in Central America [1] the extent of damage is high. *Meloidogyne* sp. type causes losses after harvest [12] there are different factors enhance the spread of nematodes in Nigeria, like a suitable a host [3].

In a bid for Nigeria Agricultural Quarantine Service (NAQS) to carry out one of her functional objectives which is to facilitate international trade in agricultural products by enforcing compliance with World Trade Organization (WTO), Sanitary and Phytosanitary (SPS) standards, a survey was carried out for yam's associated nematodes in the State with a view to controlling them for safe export and preventing postharvest losses.

MATERIALS AND METHODS

The survey was carried out in Benue State, North Central geopolitical zone of Nigeria between April and May 2017. All the headquarters of Local Government Areas of the State and two prominent villages (Obode Obi Ijegwu Ainu and Daudu) where their production crop is majorly yam were visited for collection of samples of yam tubers. There are twenty-three Local Government Areas in Benue state. In each headquarters of Local Government Areas and two major yam producing villages, ten yam tubers were

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sampled from an open market. This made a total of two hundred and fifty (250 tubers) samples in the entire state. Samples (yam tubers) from each market were pooled and sealed in plastic bags and protected from the sun [26]. The samples were properly labelled and taken to Nematology Research Laboratory of the Nigeria Agricultural Quarantine Service (NAQS), Moor Plantation, Ibadan-Nigeria for analysis and identification of plant parasitic nematodes. The coverage of the state surveyed is shown in fig. 1 while The Geographic Information System (GIS) was used to indicate coordinate of each market where nematodes on the sampled yams were intercepted (fig. 2).

In the laboratory, every yam tuber collected was freed of soil, washed under a gentle stream of cool tap water and mopped dry. Each yam was processed by peeling the periderm (one-inch-thick) with a knife and cut transversely with scissors into about 1-2 cm pieces, mixed carefully and 10 g sub-sample was weighed out of the bulk sample per tuber and assayed for nematode using the Whitehead and Hemming [31] and identified [15, 17, 22] as described previously [4].

RESULTS

Nematode species isolated from yam tubers

Five species of parasitic nematodes were identified and recorded in association with yam tubers from Benue state of Nigeria. They include; *Scutellonema bradys*, *Meloidogyne* spp, *Pratylenchus* spp, *Rotylenchulus* spp and *Tylenchus* spp. (Plate 1(a-e)). The occurrence and widespread distribution of these nematode species on yam tubers in Benue State surveyed is described in table 2 while the occurrence and widespread distribution of these nematode species on yam tubers recovered from each market surveyed in Benue State of Nigeria is described in Tables 3 and 4.

Population density of nematode species associated with yam tubers

The population densities are described in table 2 and 3. *Scutellonema bradys* (71.81 %) and *Rotylenchulus* spp and *Tylenchus* spp were recorded in relatively low from the tuber samples.

Frequency of occurrence of nematodes from yam tubers samples

Scutellonema bradys (100 %), *Meloidogyne* spp (29.60 %), *Pratylenchus* spp (16.80 %), *Rotylenchulus* spp (8.80 %) and *Tylenchus* spp (4.80 %) were recorded (fig. 3).

DISCUSSION

The survey revealed a large diversity and population of Plant-Parasitic Nematodes (PPN) found in association with the yam tubers in Benue state of Nigeria. The result agree with earlier reports by [24] in which seven species of plant-parasitic nematodes associated with yam tubers from various countries were identified. The nematode species that were reported as important pest of yam tubers include; *Scutellonema*, *Meloidogyne*, *Pratylenchus*, *Paratrichodorus*, *Rotylenchulus*, *Radopholus* and *Aphelenchoides*.

Nematodes like *Scutellonema bradys*, *Meloidogyne* spp and *Pratylenchus* spp attack yam in many countries [24]. Estimates of the damaging potentials for *Pratylenchus coffeae* indicate that where the number of individuals in soil exceeds 600 per plant of *Dioscorea rotundata* [13]. Yields of yams severely infested with *M. arenaria* can be reduced by 24-80 % in Chlna [20] while population of *M. incognita* as low as 100 juveniles per plant are said to reduce tuber yields of *D. rotundata* in India [25].



Fig. 1: Map of Nigeria showing the surveyed state for yam nematodes

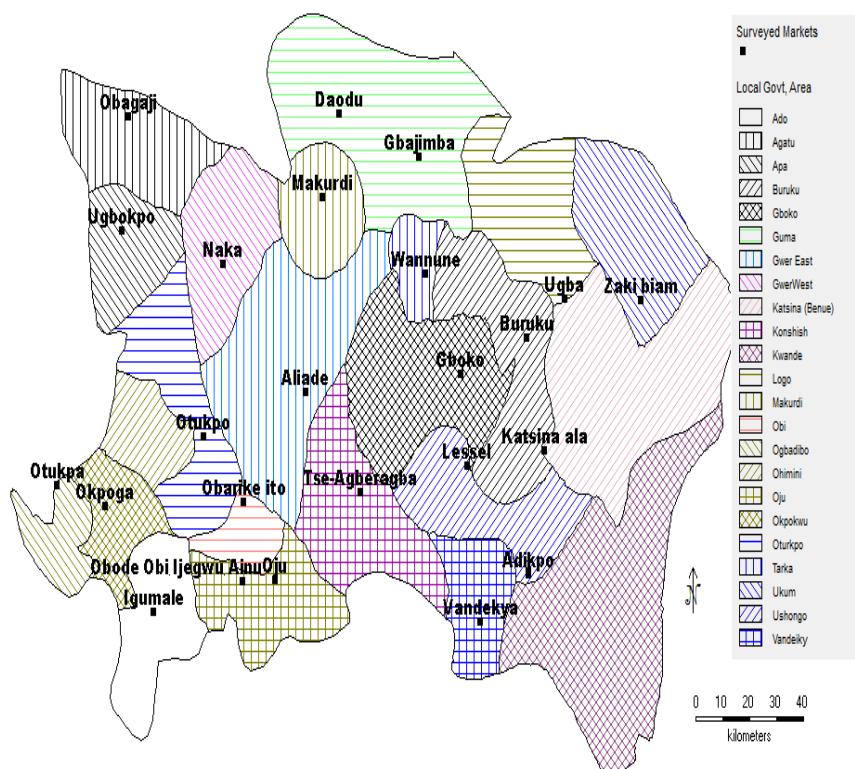


Fig. 2: survey markets in Benue State, Nigeria

In this study, survey was carried out in April when yam tubers must have been harvested and stored for a long period of time which might increase nematode species [30] as temperatures of 24-31 °C can increase yam nematode populations. Other factors that could have contributed to the widespread distribution of these nematodes on yam tubers include planting of nematode infested seed tubers and other environmental factors such as soil type as well as the presence of a suitable alternate host [4].

In Nigeria, yams usually propagate from tubers [10] and thus the risk of dissemination by this means is greater and can act as inoculum [24] for the spread. The type of soil also a determining factor for nematodes [9,28,29]. The cumulative effect of the damage caused by the feeding habit of these nematodes could have a negative impact on the plant vigour thereby constituting serious impediments to the quality and yield of yams which is the ultimate to farmers [5]. Due to the insidious nature of damage caused

by Plant-Parasitic Nematodes (PPN), farmers and marketers are in most cases not aware of them and often times do not control nematodes on the field and store respectively thus quality decline becomes inevitable.

Awareness programmes should therefore be created to sensitize yam marketers on damage potential and the need to embark on effective management strategies on the yams in store in order to maximise market price. It is also imperative that farmers plant resistant varieties and avoid spread of PPN. Efficient regulatory measures and plant quarantine services could also help prevent the spread of such plant-parasitic nematodes from infested to uninfested farmlands.

There is a widespread distribution of plant-parasitic nematodes associated with yam tubers in Benue State of Nigeria, thus nematode control is recommended in order to improve crop quality and yield.



Plate 1: Micrographs of parasitic nematodes found on yam tubers in Benue state of Nigeria during a market survey in 2017 (X60)

Table 1: Occurrence of Nematode species recovered from yam tubers in the Headquarters of each Local Government Area and two prominent villages of the Benue State in Nigeria

Nematode species					
Surveyed market	<i>Scutellonema bradys</i>	<i>Meloidogyne</i> spp	<i>Pratylenchus</i> spp	<i>Rotylenchulus</i> spp	<i>Tylenchus</i> spp
Gboko	+	+	+	+	+
Lessel	+	-	+	-	-
Vandeikya	+	+	-	-	-
Adikpo	+	+	+	-	+
Katsina ala	+	-	+	+	-
Zaki Biam	+	+	+	-	-
Ugba	+	+	-	+	-
Buruku	+	+	+	-	+
Tse-Agberagba	+	+	+	+	-
Aliade	+	+	-	+	-
Naka	+	+	+	+	-
Ugbokpo	+	-	+	+	-
Obagaji	+	+	+	-	-
Idekpa	+	+	+	-	-
Otukpa	+	+	-	+	-
Okpoga	+	+	+	-	+
Otukpo	+	+	+	-	+
Igumale	+	+	+	+	-
Oju	+	+	+	-	-
Obarike Ito	+	+	+	+	-
Makurdi	+	-	+	-	+
Gbajimba	+	+	+	+	-
Obode Obi Ijegwu	+	+	-	+	-
Ainu					
Daudu	+	+	-	+	-
Wannune	+	+	+	+	+

+= Present=- Absent

Table 2: Population density of nematode species recovered from yam tubers in Benue State, Nigeria

Nematode species	Occurrence/250 samples	Frequency occurrence %	Population/10 g tuber	Nematode population %
<i>Scutellonema bradys</i>	250	100	2002	71.81
<i>Meloidogyne</i> spp	74	29.6	487	17.48
<i>Pratylenchus</i> spp	42	16.8	223	8
<i>Rotylenchulus</i> spp	22	8.8	57	2.04
<i>Tylenchus</i> spp	12	4.8	19	0.68
TOTAL			2778	

% Frequency of Occurrence is expressed as a percentage of the total number of samples examined ($n/N \times 100$), Where n = Number of time a nematode occurs and N = the sample size. Sample size (N) = 250

Table 3: Population density of nematode species associated with yam tubers in the survey market of Benue State in Nigeria

Nematode species											
Survey market	<i>Scutellonema bradys</i>		<i>Meloidogyne</i> spp.		<i>Pratylenchus</i> spp.		<i>Rotylenchulus</i> spp.		<i>Tylenchus</i> spp		Total
	Pop.	% Pop.	Pop.	% Pop.	Pop.	% Pop.	Pop.	% Pop.	Pop.	% Pop.	
Wannune	83	74.77	19	17	5	4.5	2	1.8	2	1.8	111
Gboko	68	61.26	30	27	10	9.01	1	0.9	2	1.8	111
Lessel	93	93	-	-	7	7	-	-	-	-	100
Vandeikya	104	80	26	20	-	-	-	-	-	-	130
Adikpo	74	68.52	23	21	9	8.33	-	-	2	1.85	108
Katsina ala	64	70.33	-	-	22	24.2	5	5.5	-	-	91
Zaki Biam	51	64.56	18	23	10	12.7	-	-	-	-	79
Ugba	91	77.78	20	17	-	-	6	5.1	-	-	117
Buruku	77	63.11	28	23	14	11.5	-	-	3	2.46	122
Tse-Agberagba	69	58.97	34	29	11	9.4	3	2.6	-	-	117
Aliade	70	72.16	21	22	-	-	2	2.1	4	4.12	97
Naka	68	55.28	29	24	21	17.1	5	4.1	-	-	123
Ugbokpo	80	77.67	-	-	16	15.5	7	6.8	-	-	103
Obagaji	85	71.43	13	11	21	17.7	-	-	-	-	119
Idekpa	81	69.23	22	19	14	12	-	-	-	-	117
Otukpa	101	82.11	19	15	-	-	3	2.4	-	-	123
Okpoga	75	68.81	25	23	8	7.34	-	-	1	0.92	109
Otukpo	80	66.12	32	26	6	4.96	-	-	3	2.48	121
Igumale	92	72.44	27	21	5	3.94	3	2.6	-	-	127
Oju	84	76.36	17	15	9	8.18	-	-	-	-	110
Obarike Ito	79	64.75	24	20	10	8.2	9	7.4	-	-	122
Makurdi	90	85.71	-	-	13	12.4	-	-	2	1.9	105
Gbajimba	86	70.49	21	17	12	9.84	3	2.5	-	-	122
Obode Obi Ijegwu	76	81.72	16	17	-	-	1	1.1	-	-	93
Ainu											
Daudu	81	72.97	23	21	-	-	7	6.3	-	-	111

Sample size = 250, Pop. = Population

Table 4: Frequency of occurrence of nematode species associated with yam tubers in the survey market of Benue State in Nigeria

Nematode species Survey market	<i>Scutellonema bradys</i>		Meloid spp		Prat spp.		Roty spp.		<i>Tylenchus</i> spp	
	Freq.	% Freq.	Freq	% Freq.	Freq	% Freq.	Freq	% Freq.	Freq	% Freq.

Wannune	10	100	4	40	1	10	2	20	1	10
Gboko	10	100	3	30	3	30	1	10	1	10
Lessel	10	100	-	-	2	20	-	-	-	-
Vandeikya	10	100	4	40	-	-	-	-	-	-
Adikpo	10	100	3	30	2	20	-	-	1	10
Katsina ala	10	100	-	-	3	30	2	20	-	-
Zaki Biam	10	100	3	30	2	20	-	-	-	-
Ugba	10	100	3	30	-	-	2	20	-	-
Buruku	10	100	4	40	2	20	-	-	2	20
Tse-Agberagba	10	100	4	40	2	20	1	10	-	-
Aliade	10	100	3	30	-	-	1	10	2	20
Naka	10	100	3	30	3	30	2	20	-	-
Ugbokpo	10	100	-	-	3	30	3	30	-	-
Obagaji	10	100	2	20	3	30	-	-	-	-
Idekpa	10	100	4	40	2	20	-	-	-	-
Otukpa	10	100	3	30	-	-	1	10	-	-
Okpoga	10	100	5	50	2	20	-	-	1	10
Otukpo	10	100	5	50	1	10	-	-	2	20
Igumale	10	100	3	30	1	10	1	10	-	-
Oju	10	100	3	30	2	20	-	-	-	-
Obarike Ito	10	100	3	30	2	20	3	30	-	-
Makurdi	10	100	-	-	3	30	-	-	2	20
Gbajimba	10	100	4	40	3	30	2	20	-	-
Obode Obi Ijegwu	10	100	3	30	-	-	1	10	-	-
Ainu										
Daudu	10	100	5	50	-	-	2	20	-	-

Meloid = *Meloidogyne* Prat = *Pratylenchus* Roty = *Rotylenchulus* Freq. = Frequency

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