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Plant-Parasitic Nematodes Associated with Yam in the Two Agro-Ecological Zones of Ghana

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Abstract
A study was conducted between August 2014 and May 2015 in ten communities of Ghana to identify plant-parasitic nematodes associated with yam (*Dioscorea* spp.), and to assess the knowledge, perceptions and experiences of farmers on occurrence and management of these parasites both on their farms and in storage. Semi-structured questionnaires were designed and administered to 60 randomly selected farmers. Composite rhizosphere soils and tubers were collected from selected farms and nematodes extracted, identified, and enumerated. The study revealed that, although majority of farmers (98.1%) practiced crop rotation, most (83.0%) lacked knowledge on the status of nematodes as parasites on their crops. Symptoms of nematode infestation such as internal rotting and discoloration of vegetative organs were widespread in fields resulting in high yield losses of yams. Nine and three genera of plant-parasitic nematodes were identified from yam rhizosphere soils and harvested yams from fields respectively, and eight genera of nematodes were associated with yams in storage. These were: *Meloidogyne* spp., *Pratylenchus* spp., *Scutellonema* spp., *Tylenchus* spp., *Trichodorus* spp., *Tylenchorhynchus* spp., *Rotylenchus* spp., *Hoplolaimus* spp., and *Helicotylenchus* spp. However, *Rotylenchus* spp. was absent among nematode species isolated from yams in storage. The three nematode genera isolated from yam peels during the rainy season from field samples were: *Pratylenchus*, *Scutellonema* and *Meloidogyne* and each of these recorded a 100% frequency of occurrence. The relative abundance of the three most prevalent nematode genera (*Pratylenchus*, *Scutellonema*) and *Meloidogyne* in soil and yam tuber peels for field samples were 22.9%, 46.3%, 18.8% and 32.4%, 18.2% and 21.2%, respectively. However, relative abundance of these nematodes in the tuber peels varied from 22.3%, 20.8% and 19.2% for *Pratylenchus*, *Scutellonema*, and *Meloidogyne*, respectively.

Keywords: Farmers' perception, Plant-parasitic nematodes, Relative abundance, Survey, Yam.

INTRODUCTION

Yam (*Dioscorea* spp.) is an important crop in West Africa and serves as a food commodity for various individuals (Coursey, 1967). The various species of *Dioscorea* range from 300 to 600, however, majority cannot be taken in by humans as food. Four yam species widely cultivated are, the water yam (*D. alata* L.), yellow yam (*D. cayenensis* Lam.), Chinese yam (*D. esculenta* [Lour.] Burk.) and white yam (*D. rotundata* Poir). Almost 80% of the world's yam production occurs in West Africa (Bridge *et al.,* 2005; Coyne *et al.*, 2006; Nweke and Okoye, 2013). The major yam producing-countries in

West Africa include Nigeria, Ghana, Benin, Cote d'Ivore, and Cameroon (FAO, 2013). Ghana is second to Nigeria, the leader in yam production, and produces about 6.6 million tonnes of yam which accounts for 12.1% of the total yam produced in West Africa and the crop contributes 16% of Ghana's Agricultural gross domestic product (GDP) (FAO, 2013). The Guinea savanna and forest/savanna transitional zones which consists of Northern, Brong Ahafo and Ashanti regions, contributes about 72 % of the total yam produced in Ghana (MoFA-SRID, 2011).

Yam production in Ghana is however, adversely affected by plant-parasitic nematodes which results in yield losses and poor tuber quality (Adegbite *et al.*, 2005; Bridge *et al.,* 2005; Coyne *et al.,* 2006; Humphreys, 2010). About 25% estimated loses of tubers in storage due to nematodes have been reported in Ghana (Kwoseh *et al.,* 2005). Numerous species of nematodes are known to be associated with yam. Severe damages occur in yams attributable to *Scutellonema* spp., *Pratylenchus* spp. and *Meloidogyne* spp. (Osei *et al.,* 2004; Kwoseh *et al*., 2005; Adegbite *et al.* 2006; Adegbite and Agbaje, 2007; Adegbite *et al.,* 2008; Imafidor and Mukoro, 2016). These nematode genera have been reported as the three most prevalent nematodes out of 10 species identified in a survey of yam farms in Ogun and Osun States of Nigeria **(**Adegbite *et al.,* 2008**).** The distribution of nematodes associated with marketed yam in a West-African study by Coyne *et al*. (2006) showed that tubers obtained from Ghana and Mali were the most (7.53%) and least (0.28%) infested with *S. bradys*, respectively. However, galled tubers from *Meloidogyne* spp. infections were (14.4%) and (4.42%) for Mali and Ghana, respectively.

A previous survey in Ghana on farmers' knowledge relating to nematodes and their control, revealed a general lack of information on the causal agent of the soft-rot disease of yam (Osei *et al*., 2004). Farmers in two communities (Techiman and Ejura) consisting of 40% and 10% of the respondents, respectively out of the six communities surveyed knew nematodes as causal agents of soft rot. Understanding the diversity, current distribution, and population densities of plant-parasitic nematodes is very essential for the implementation of nematode management strategies. In Ghana, information on the various nematode types associated with yams both in the soil and storage is of utmost concern. Our objectives were to assess yam farmers' knowledge, perceptions, and experiences of plant-parasitic nematode occurrence and their management, and to identify plant-parasitic nematodes associated with yam in the Forest/savanna transitional and Guinea savanna agro-ecological zones of Ghana.

MATERIALS AND METHODS

Selection of sites for questionnaire survey and collection of soil and tuber samples

Ten communities were purposefully selected from the two leading yam producing ecological zones in Ghana. These communities were: Choo, Shebo, Kpachi, Kaswurape, and Kanshegu in the Guinea savanna zone and Promposo, Ayayo, Atrensu, Afrefreso, and Nokwarease in the Forest/ savanna transitional zone (Table 1).

Table 1: Agro-ecological zones, communities and their Global Positioning System (GPS) coordinates selected for the questionnaire survey and soil and tuber sample collections

Agro-ecological zones	Community	*Global Positioning System* (GPS) coordinates	No of respondents
Guinea savanna	Choo	N 09° 19' 44.1" W 000° 00′ 09.7′′	6
	Shebo	N 09° 55′ 12.6′′ W 000° 23′ 00.5′′	6
	Kpachi	N 09° 25′ 44.1′′ W 000° 58′ 37.4′′	**6**
	Kaswurape	N 08° 41′ 39.0′′ W 000° 32′ 44.9′′	6
	Kanshegu	N 09° 34′ 31.5′′ W 000° 49′ 17.0′′	6
Forest/savanna transitional	Promposo	N 07° 40′ 42.4′′ W 002° 39′ 52.0′′	6
	Ayayo	N 07° 36′ 45.1′′ W 002° 08′ 08.0′′	6
	Atrensu	N 07° 37′ 55.5′′ W002° 03′ 04.0′′	6
	Afrefreso	N 07° 40′ 34.5′′ W 001° 02′ 01.5′′	6
	Nokwarease	N 07° 21' 24.4" W 001° 18' 19.7"	6

Questionnaire survey to assess farmers' knowledge, perceptions, and experiences with management of plant-parasitic nematodes

Semi-structured questionnaires were administered in August, 2014 to obtain baseline data concerning farmers' knowledge, perceptions, and experiences on occurrence and management of plant-parasitic nematodes on their farms. Six yam farmers were randomly selected from each study area and interviewed. Pictures of nematode infested tubers showing symptoms were included to facilitate farmer's responses.

Collection of rhizosphere soil and yam tuber samples

Rhizosphere soils and yam tubers were collected in August, 2014 from farms within the selected communities that had their plants showing symptoms of nematode parasitism. Composite soil samples were taken from the rhizosphere region of yam plants on each farm, together with yam tubers. The soil samples were taken from depths of 0 cm to 15 cm from 10 randomly selected sites using a 5 cm diameter soil core and bulked. The soil core and footwear were cleaned after sampling from each farm, to avoid cross-contamination of soil samples and spread of nematodes between farms. The GPS coordinates of each farm were captured with a handheld GPS device (Garmin eTrex 20, Switzerland). Yam tuber samples were also collected from storage in February, 2015 across the ten communities.

Extraction and identification of nematodes

Rhizosphere soils

Nematodes were extracted from the soil using the sieve and sucrose centrifugation method (Jenkins, 1964). Each soil sample was thoroughly mixed and a 200 cm^3 sub-sample was used for the extraction, identification, and quantification of the nematodes. The soil was placed in a bucket of running water until the soil

was covered by at least two times its volume. The solution was then mixed vigorously until the soil was sufficiently dispersed and settled for three minutes. The liquid supernatant was then poured through a 200-mesh sieve nested upon a 400-mesh sieve. The 400-mesh sieve was washed thoroughly with water until as much clay and other fine particles were washed out of the sieve. The remaining sample with the nematodes was then transferred into a 50 ml centrifuge tube. Centrifugation was carried out at 1700 rpm for five minutes in a MR 23i benchtop centrifuge (Jouan – Thermo Scientific, U.S.A.). The supernatant was discarded and successive samples centrifuged until a final pellet obtained from the collective population of nematodes. The tubes were filled with sucrose solution at room temperature and stirred with a spatula to break up the pellet. The sample was centrifuged to 1000 rpm for 1 min and the supernatant poured through the 400-mesh sieve, and transferred into labeled vials up to the 10 ml mark using a fine spray water bottle.

Yam tubers

Nematodes were extracted from infested yam tuber peels, using modified Baermann funnel method (Whitehead and Hemming, 1965). The tubers were peeled and the peels chopped, and 10 g sub-samples of peels weighed for nematode extraction. The peels were blended for two to five second bursts, and transferred to a glass funnel lined with a two ply tissue paper placed on a wire mesh. The experimental set-up was left for 48 hrs and the water (containing nematodes) was eluted separately into 250 ml beakers. Two ml of each suspension were transferred to counting dishes for enumeration. Nematodes selected for identification were mounted in a drop of water on a microscopic slide and placed on a hot plate at 60°C for few seconds, which enabled nematodes to straighten out. The nematodes were examined directly under a compound light microscope (Exacta-OptechBiostar B5P, Germany). Nematodes were identified to the genus or species level based on their morphological features (Siddiqi, 1989; Luc *et al.,* 1990; Siddiqi, 2000), and the University of Nebraska Lincoln nematode identification website and enumerated.

Data analysis

Population density (PD) of nematodes in 200 cm^3 of soil and 10 g yam peels, frequency of occurrence (FO), and relative abundance (RA) were calculated according to Norton (1978) as follows: PD = (average number of nematodes per 200 cm^3 of soil, and 10 g yam peels), FO = (number of fields containing a particular genus or species /total number of fields sampled), RA = (number of individuals of a nematode genus or species / the total number of nematodes identified and counted from 200 cm^3 soil or 10 g yam peels) ×100. Differences in the mean plant-parasitic nematode populations from soil and yam tubers obtained in the rainy season, and yam tuber in storage, were assessed using analysis of variance (ANOVA) and Tukey test ($P \leq 0.05$) in the General Statistic (GenStat) software 11.1 (VSN International Ltd.).

RESULTS

Farmers' knowledge and perceptions of plant-parasitic nematodes occurrence and their control

Responses from the questionnaire survey in relation to farmers' knowledge and perceptions of plant-parasitic nematodes occurrence and their control are presented (Table 2). Most of yam farmers were males (93.3%) with no formal education (70.4%). The rest had formal education up to Junior High School (JHS) level (22.2%), Senior High School (3.7%) and tertiary (3.7%). Most of the farmers (51.8%) had between 11 and 15 years of farming experience in yam production, only 3.7% had less than five years of yam production experience. Majority (57.7%) of yam farmers in these two zones were smallholders with lands ranging between 2 - 3 acres. Varieties commonly grown by farmers in

Table 2: Farmers' knowledge, perceptions, and experiences of plant-parasitic nematodes on their farms

Variables	Percentage of growers (%)
Gender	
Males	93.3
Females	6.7
Educational levels of growers	
None	70.4
Primary	22.2
Secondary	3.7
Tertiary	3.7
Period of Cultivation	
1-5 years	3.7
6-10 years	27.8
11-15 years	51.8
>15 years	16.7
Source of yam for planting	
Previous harvest	72.5
Friends/ Neighbours	5.1
Varied sources	22.4
Length of cultivation	
1-3 years	7.4
4-6 years	37
7-10 years	46.3
> 10 years	9.3
Crops intercropped with yam	
Cassava	34
Pigeon pea	22
Cowpea	11
Maize	7
Groundnut	6
Millet	5
Others	15
Period of crop rotation	
1 – 2 years	15.1
3 – 5 years	83
> 5 years	1.9
Growers perception on spread of nematode diseases	
Infected seed yam	37
Infected soil	31.5
Insects	16.7
Excessive heat	14.8

the two ecological zones included 'Pona' (60%), 'Lareboko' (28%), 'Afeshei' (5%), 'Fuseinbilla' (4%) and 'Lillea' (3%). Many (72.5%) farmers sourced their planting materials from their own farms of previous harvest, while others (5.1%) got theirs from family members. Some farmers had continuously cultivated their fields for 7 – 10 years (46.3%) intercropping with cassava (34%), pigeon pea (22%), cowpea (11%), maize (7%), groundnut (6%), millet (5%), guinea corn (5%), pepper (4%), okra (3%), and tomato (3%). Almost all farmers (98.1%) practiced crop rotation for periods of 1 – 2 years (15.1%), 3 – 5 years (83.0%) and more than 5 years (1.9%). All the farmers indicated that all the varieties showed symptoms similar to the pictures of nematode infested tubers shown them during the interview at varying levels. They perceived 'Lareboko' to be the most highly susceptible (26.7%) to nematode parasitism followed by 'Pona' (20.0%), 'Afishei' (16.7%), 'Fusheinbilla' (11.7%), 'Asobayere' (12.9%) and 'Lillea' (7.4 %). Farmers perceived spread of these symptoms to be by infected seed yam (37%), infected soils (31.5%), insects (16.7%), and excessive heat (14.8%). Farmers (16.7%), in both ecological zones believed that, nematodes could be managed through crop rotation, land rotation, and destruction of infected tubers. Most of the farmers cultivated yam mainly for food (56.7%), income generation (28.3%) and asset acquisition (15.0%). Many respondents (23.3%) attributed yam yield loses to diseases and pests prevalent in their fields.

Genera of plant-parasitic nematodes on yam in ten communities sampled during rainy season

When nematodes were extracted from the soil and yam tubers in the field, nine genera *Helicotylenchus, Hoplolaimus, Meloidogyne, Pratylenchus, Rotylenchulus*, *Scutellonema, Trichodorus*, *Tylenchorhynchus* and *Tylenchus* were consistently found associated with the crop from soil samples, and *Pratylenchus*, *Scutellonema* and *Meloidogyne* were

recovered from yam tubers as well (Table 3).

The Guinea savanna zone recorded a higher nematode density (6,184) out of 11,125 individual nematodes identified in 200 cm^3 of soil. Atrenso (forest/savanna transitional zone), had the highest nematode densities of *Helicotylenchus* spp. (245), *Tylenchus* spp. (195), *Trichodorus* spp. (186), and *Tylenchorhynchus* spp. (122), while Kanshegu (Guinea savanna zone), had the highest densities of *Pratylenchus* spp. (362), *Scutellonema bradys* (354), and *Rotylenchulus* spp. (134). Kanshegu had the highest nematode population densities for *Meloidogyne* spp. (108) and *Scutellonema bradys* (98) in 10 g of yam peels, whereas Atrenso had the highest nematode density for *Pratylenchus* spp. (119). *Hoplolaimus* spp. was found only in the Guinea savanna zone and differed from the other populations significantly (Fig. 1).

Rotylenchulus spp. and *Tylenchorhynchus* spp. were also extracted from soil samples of four out of the ten farms sampled. *Pratylenchus* spp. was the most abundant nematode genus found in soil (22.9%) and tubers (46.3%); *Trichodorus* spp., *Rotylenchulus* spp., and *Tylenchorhynchus* spp. had 8.1%, 4.1% and 3.2% relative abundances respectively from soil samples (Table 4). *Meloidogyne* spp., *Scutellonema brady*s, and *Pratylenchus* spp. did not significantly differ from each other (Fig. 1).

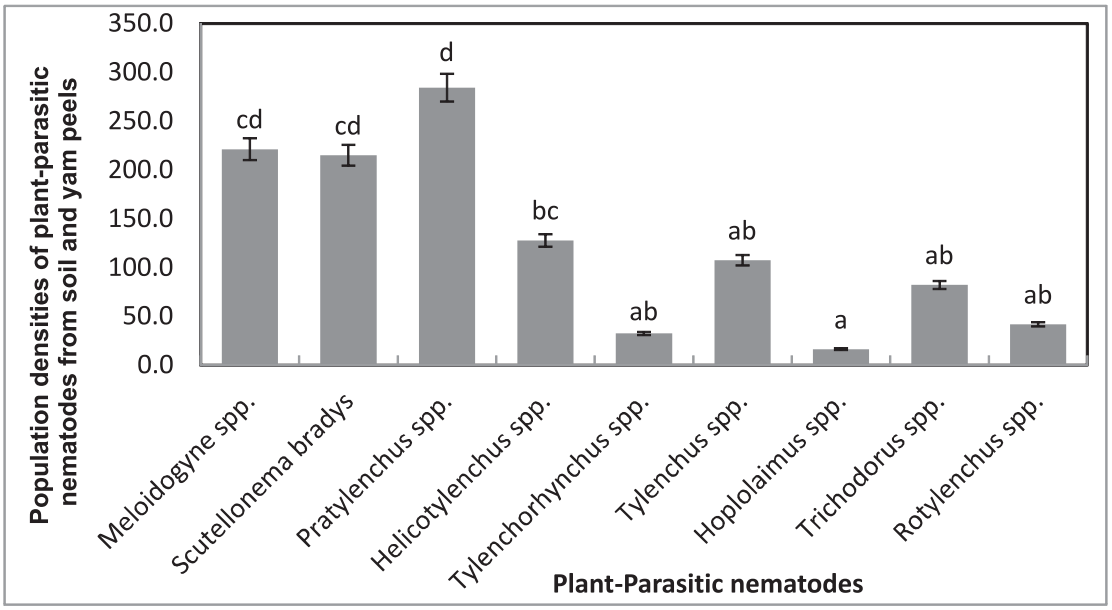

Figure1. Mean population densities of plant-parasitic nematodes isolated from soil and yam tubers obtained during the rainy season. The bars denote standard error while columns followed by the same letters are not different according to the Tukey test ($P \leq 0.05$).

Table 3: Diversity and density of plant-parasitic nematodes (200 cm^3 soil and 10 g yam peels) from ten communities

Nematode	*Pratylencus*			*Scutelonema*			*Meloidogyne*			*Helico*	*Tylen*	*Trich*	*Tylencho*	*Hoplo*	*Roty*	
Community	Soil	Tubers	Total	Soil	Tubers	Total	Soil	Tubers	Total	Soil	Soil	Soil	Soil	Soil	Soil	Total
Choo	192	48	240	318	8	326	178	16	194	125	142	120	0	90	85	2082
Shebo	271	72	343	154	24	178	192	38	230	215	154	153	0	0	48	2072
Kaswurape	156	12	168	274	11	285	145	9	154	96	116	98	0	0	0	1524
Kpachi	242	44	286	195	38	233	112	28	140	56	88	0	0	25	55	1542
Kanshegu	362	85	447	354	98	452	128	108	236	180	148	0	96	48	134	2876
Promposo	266	24	290	54	6	60	184	14	198	186	118	176	0	0	96	1672
Ayayo	40	90	130	10	0	10	406	54	460	15	0	20	0	0	0	1235
Atrensu	340	119	459	273	45	318	134	86	220	245	195	186	122	0	0	2742
Afrefreso	240	18	258	132	8	140	117	6	123	96	65	68	86	0	0	1357
Nokwarease	215	8	223	148	0	148	252	5	257	64	48	0	21	0	0	1389
Total	2324	520	2844	1912	238	2150	1848	364	2212	1278	1074	821	325	163	418	18491

Helico=*Helicotylenchus* spp., Tylen= *Tylenchus* spp., Trich =*Trichodorus* spp.,
Tylencho=*Tylenchorhynchus* spp., Hoplo = *Hoplolaimus* spp.,
Roty = *Rotylenchus* spp.

Table 4: Frequency of occurrence of plant-parasitic nematodes and their relative abundance in soil and tubers sampled from 10 communities

Nematode genus	Frequency of occurrence [a]		Relative abundance (%)[b]	
	Soil	Tubers	Soil	Tubers
Pratylenchus	10	10	22.9	46.3
Scutellonema	10	10	18.8	32.4
Meloidogyne	10	10	18.2	21.2
Helicotylenchus	10	-	12.6	-
Tylenchus	9	-	10.6	-
Trichodorus	7	-	8.1	-
Rotylenchulus	4	-	4.1	-
Tylenchorhynchus	4	-	3.2	-

[a] Represent number of farms where corresponding genera of nematodes were recovered.
[b] Represent relative abundance (%) of each nematode genus given as $(\frac{n}{N} \times 100)$. n = the number of individuals of nematode genus, N= the total number of nematodes identified and counted from soil.

Plant-parasitic nematodes in yam obtained from storage during the dry season

Eight genera of plant-parasitic nematodes namely *Helicotylenchus*, *Hoplolaimus*, *Meloidogyne*, *Pratylenchus, Scutellonema, Trichodorus*, *Tylenchorhynchus* and *Tylenchus* were consistently found associated with yams in storage. Within the peels of yam tubers, a total of 13,730 individual nematodes were recovered for the two ecological zones. *Pratylenchus* spp.and *Helicotylencus* spp. had the highest (3,065) and least (870) nematode population densities, respectively. Significant differences existed among the mean population densities for the various plant-parasitic nematodes (Fig. 2). Kanshegu and Kpachi villages both in the Guinea savanna ecological zone were the localities with the highest densities (1,961 and 1,655), respectively of plant-parasitic nematodes extracted from stored yam tubers. The least population density of nematodes was in the tubers sampled from Shebo (770). All the various nematodes extracted from the tuber

Table 5: Diversity and density of plant-parasitic nematodes on stored yam (10 g yam peels) from ten communities

Community	*Praty*	*Meloi*	*Scutello*	*Tylencho*	*Hoplo*	*Tricho*	*Helico*	*Tchus*	Total
Kaswurape	185	216	285	86	95	76	81	64	1,088
Shebo	176	112	185	22	42	35	46	152	770
Kpachi	342	283	372	113	147	178	98	122	1,655
Choo	361	282	378	126	131	114	103	142	1,637
Kanshegu	424	384	466	121	127	154	147	138	1,961
Atrensu	265	238	346	98	134	185	62	142	1,470
Ayayo	282	364	194	87	104	123	74	66	1,294
Pramposo	261	254	242	76	108	118	96	123	1,278
Afrefreso	421	278	187	84	126	107	117	111	1,431
Nokwarease	348	232	194	59	120	95	46	52	1,146
Total	3,065	2,643	2,849	872	1,134	1,185	870	1,112	13,730

Praty = *Pratylenchus* spp. Scutelo = *Scutellonema bradys* Meloi =*Meloidogyne* spp. Helico=*Helicotylenchus* spp. Tchus= *Tylenchus* spp. Tricho =*Trichodorus* spp. Tylencho=*Tylenchorhynchus* spp. Hoplo = *Hoplolaimus* spp.

Table 6: Frequency of occurrence of plant-parasitic nematodes and their relative abundance on stored yams from 10 communities

Nematode Genera	Frequency of occurrence	Relative abundance
Pratylenchus	10	22.3
Scutellonema	10	20.8
Meloidogyne	10	19.2
Trichodorus	10	8.6
Hoplolaimus	10	8.3
Tylenchus	10	8.1
Tylenchorhynchus	10	6.4
Helicotylenchulus	10	6.3

peels had a 100% frequency of occurrence (Table 6) across the sampling areas. *Pratylenchus* spp., *Scutellonema* bradys and *Meloidogyne* spp. recorded higher relative abundances of 22.3%, 20.8% and 19.2% respectively, however there were no significant differences among the mean population densities for these nematodes (Fig. 2). *Tylenchorhynchus* spp. and *Helicotylenchus* spp. had the least relative abundances of 6.4% and 6.3%, respectively.

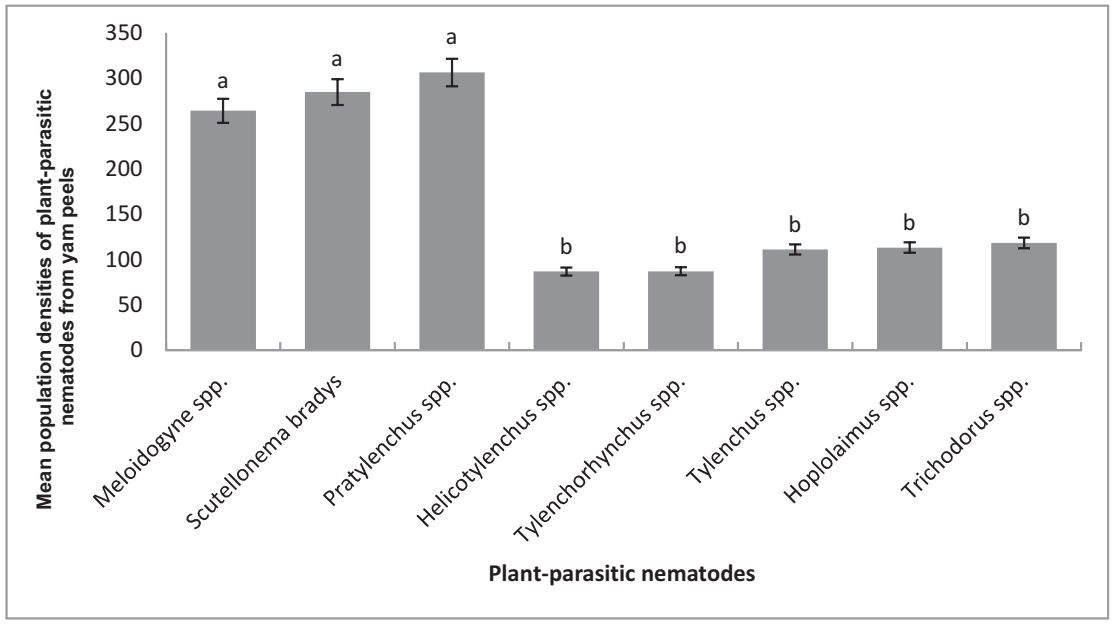

Figure 2: Mean population densities of plant-parasitic nematodes isolated from yam tubers obtained from storage environment. The bars denote standard error while columns followed by the same letters are not different according to the Tukey test ($P \leq 0.05$).

DISCUSSION

The survey results indicated that many of the farmers were males with low level of formal education. This was due to the physical nature of the cultural practices involved in yam production. Also, most people with higher education opted for jobs in the cities and thus, left farming activities in the hands of those with little or no formal education. A similar observation has been reported in Sierra Leone (Sesay, 2013).

Plant-parasitic nematodes are a threat to yam production worldwide (Hahn *et al.,* 1989; Abebe and Geraert, 1995; Weber *et al.,* 1995; Kwoseh *et al*., 2005; Baimey, 2006; Adegbite *et al.,* 2008; Kumar and Singh, 2010). Ten genera of plant-parasitic nematodes were identified in yam communities of Ogun and Osun States in Nigeria (Adegbite *et al*., 2008). In their study, *Scutellonema* spp., *Meloidogyne* spp. and *Pratylenchus* spp. were the most dominant and prevalent nematode species on yam. These nematode genera were also extracted from soil and yam tubers in the current survey. The presence of these plant-parasitic nematodes suggests their importance as pathogens of yams, although their economic importance has usually been undermined. *Pratylenchus* spp. was the most common nematode species in yam tubers sampled in the present study. This nematode was found to have a high frequency of occurrence in samples from all agro ecological zones. *Pratylenchus* spp. was previously identified to have a higher relative abundance in soils in which yam was planted within the Forest/savanna transitional zone of Ghana (Osei *et al.,* 2004). A major distinguishing element of the current study to that of Osei *et al*. (2004) related to the sampling sites surveyed. Our sites were different from those of Osei *et al*. (2004) which were Adidwan, Ejura, and Mampong (Ashanti Region), and Kintampo, Nkoranza, and Techiman (Brong Ahafo Region). Osei *et al*. (2004) identified three major nematodes (*Meloidogyne* spp., *Pratylenchus* spp. and *Scutellonema* spp.) consistently associated with yam tubers, and in the soil rhizosphere from six communities sampled in Ghana. The

highest and least relative abundance of nematodes in the soil were *Pratylenchus* spp. and *Longidorus* spp. respectively. In our study, *Pratylenchus* spp. and *Meloidogyne* spp. had the highest and least nematode densities for soil and tubers sampled from the field, respectively. However, in storage environment the highest and least nematode densities were *Pratylenchus* spp. and *Helicotylenchus* spp., respectively. The high populations of *Pratylenchus* spp. in nearly all the studied areas, makes this nematode a threat to yam production in Ghana. Most farmers interviewed in our study practiced inter-cropping system and the intercrops served as hosts to *Pratylenchus* spp. and *Scutellonema* spp. Mixed cropping systems practiced by many of the farmers might explain the relatively rich nematode genera in soils (Luc *et al.,* 2005). Forty nine percent (49%) of farmers intercropped their yams with cassava, cowpea, and pigeon pea. *Pratylenchus* spp. and *Scutellonema* spp. have been found to be associated with pigeon pea, cowpea, and cassava (Luc *et al*., 2005). Caveness (1982) in a study in Nigeria, identified several plant-parasitic nematodes associated with yams, and *Scutellonema* spp., *Pratylenchus* spp., *Meloidogyne* spp., and *Rotylenchulus* spp. were in higher numbers. Adesiyan and Odihirin (1977) also identified *Scutellonema* spp., *Pratylenchus* spp., *Meloidogyn*e spp., *Helicotylenchus* spp., *Criconemoides* spp and *Xiphinema* spp. as the most important nematode species on yam in Mid-West State of Nigeria.

A study by Kwoseh *et al.* (2005) revealed that stored yam tubers had 83% and 100% prevalence rate of *Scutellonema bradys* in the Forest/savanna transitional zone and the Guinea savanna ecological zones, respectively while that of *Meloidogyne* spp. was 72% and 28.6% in the Forest/savanna transitional zone and the Guinea savanna ecological zones, respectively. Recently, Imafidor and Mukoro (2016) also identified 11 nematode genera associated with white yam (*Dioscorea rotundata*) in Rivers State, Nigeria. Among the nematodes isolated from soil samples, the most frequent nematodes were *Pratylenchus* spp. (90%), *Scutellonema* spp. (76%), and *Meloidogyne* spp. (70%). The least encountered nematode was *Rotylenchulus* spp. (10%).

This study has therefore revealed yam as highly susceptible to various nematode genera and therefore their management is of concern. The biology of the three major plant-parasitic nematode genera, *Pratylenchus*, *Scutellonema* and *Meloidogyne* needs to be explored with a view to managing the pests. Also, pathogenicity studies of these nematodes on yam and identification of tolerant or resistant varieties are vital to increased yam yields in Ghana.

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