SURVEY OF PLANT PARASITIC NEMATODES IN YAM GROWING BELT OF LAPAI AND PAIKORO LOCAL GOVERNMENT AREAS OF NIGER STATE, NIGERIA.

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SUMMARY

A survey of plant parasitic nematodes associated with yam was conducted in the yam growing fields of Lapai and Paikoro Local Government Areas of Niger State in 2019. A total of 30 soil samples were collected from both locations. Nematodes were extracted from soil by decanting and sieving method. Nematodes were identified using morphological and morphometric features. *Scutellonema Rotylenchus*, *Meloidogyne* and *Tylenchus* were the most common of the plant parasitic nematodes associated with yam. *Scutellonema bradys*, *Tylenchus* spp. and *Meloidogyne incognita* were present in all the fields. Kawu village in Lapai local government area had the highest number of *Scutellonema bradys* (281) as compared to Paikoro village in Paikoro Local Government area with the lowest number of *Scutellonema bradys* (80). From the survey, *Scutellonema bradys* is common to all the fields in both Local Government Areas. Nematode management strategy should be factored into yam production program in the study areas to avoid nematode disease outbreak.

Keywords: Yam, plant-parasitic nematodes, *Scutellonema brady*, *Tylenchus spp* and *Meloidogyne incognita*

YAM, *Dioscorea* species belongs to the family *Dioscoreaceae*. It is a monocotyledonous plant which originated from West Africa. Six hundred species of yam are particularly grown in tropical countries of West Africa with Nigeria ranked as the largest producer followed by Ghana and Cote d'Ivoire (Hinmikaiye *et al*., 2015). Yam is the second most important tuber crop in the World after cassava and contributes more than 300 dietary calories per day for 70 million people in the yam zone (Hinmikaiye *et al*., 2015). Among the species of yam are *Dioscorea cayenensis, Dioscorea*

alata, *Dioscorea esculenta*, *Dioscorea composita*, *Dioscorea dumetorum*, *Dioscorea rotundata* and *Dioscorea bulbifera* (Ana *et al.*, 2016).

Yam provides a valuable source of carbohydrates for more than 65 million people from an estimated annual production of 44 million metric tonnes (FAO, 2016). More than 90% of the total world yam output is produced in West Africa primarily by smallholder farmers (FAO, 2016). The yam tubers provide a substantial intake of vitamins (thiamine and vitamin C), iron, potassium and protein needed by the body system. The African countries production is 65.7 million tons which is equivalent to 96.4% of the world output (Kingsley *et al.*, 2017). Many of the *Dioscorea* species have high content of steroidal saponins which make them suitable for industrial applications, corticosteroids precursors and anti-cancer bioactive compounds (Athira *et al.*, 2017). Yams constitute an important subsistence food crop and component of the farming system. The yam tuber can be put to other uses such as cash/export crop; livestock feed and cultural values (Nwankwo *et al.*, 2018).

Yam is used in the same manner as potato in the western world. The most common use is as a boiled yam which may also be baked, fried, roasted or mashed to suit regional tastes and customs (Puja and Satinder, 2010).

In Nigeria, the cooked yam is pounded and kneaded into a sticky mass that is then eaten as small balls of dough often dipped into stew. It can also be processed into various staple, intermediate and end product forms which are used for direct consumption by animals, used as the basic ingredient for snacks or made into flour for making instant puree (Anjorin *et al.*, 2014).

Plant-parasitic nematodes damage is a factor in tuber quality reduction and yield loss in yam in the field. Plant-parasitic nematodes associated with yam cultivation have been reported from various yam producing areas of the world (Adegbite *et al.*, 2005) which are the yam nematode

Scutellonema bradys, the root-knot nematode *Meloidogyne* spp. and the lesion nematode *Pratylenchus* spp., which are all field pests. However, plant parasitic nematodes associated with yam in Niger State, North Central Nigeria have not been fully investigated.

The aim of this study was to determine the plant-parasitic nematodes associated with yam in Lapai and Paikoro LGAs of Niger State.

MATERIALS AND METHODS

The Study Area

The study was conducted in the two zonal districts of Niger State, namely, Zone A and Zone B latitude 6.62700 ¡E and longitude 9.43103 ºN respectively. One Local Government Area were selected in each of the Zonal Districts and five area each from the local government for the study area, namely in Zone A Lapai/ Dangana, Takalafiya, Ganamadi, Kawu and Saminaka. In zone B, Paiko/ Koneyi, Lugowru, Gbaita, Yandat and Paiko towns. The determination of plant-parasitic nematodes was carried out in two Local Government Areas (LGAs) of Niger State spreading across two Zonal Districts in Niger State in December 2019. Soil samples were collected at different points in each of the selected LGAs of Niger State where yam production has been cultivated to identify the different types of nematodes present in the soil, and also to determine their relative abundance. Soil samples were collected from the two Zonal Districts in Niger State using a soil corer in a randomized manner. From each of the LGA, five farms were selected each and three soil samples from different locations were collected within the farms making a total of fifteen soil samples each from the two LGAs of the two zonal districts.

The soil samples collected were taken at a depth of 1 - 30 cm at the base of each plant in order to cover as much of the rhizosphere as possible using soil auger. Samples (soil) from each farm where pooled and sealed in plastic bags and protected from the sun. The samples were properly labeled and taken to Nematology Unit, Department of Crop Protection, Faculty of Agriculture, Ahmadu

Bello University, Zaria, Nigeria for extraction, identification and quantification of plant parasitic nematodes.

Extraction of nematodes from soil samples

Plant parasitic nematodes were extracted from the soil using the sieving and decanting method (Coyne *et al.* 2011), the method was effective for all types of nematodes and also good for extracting large and slow moving nematodes, a bucket, smooth and coarse mesh sieve, tissue paper and enough water was used. The bucket was filled with 6 litres of water, a line was marked inside of the bucket with a waterproof pen for consistent water volume, then a wet soil was measured using a beaker and then pour into the bucket and then mixed thoroughly using hand to allow larger particles to dissolve. Afterwards, three-quarter of the upper water level was poured off through the nested 2 mm sieve to catch debris for disposal in a slow manner and tapped the underside of the bottom to help water flow through the sieve. Bucket was refill to the marked line and repeats the process again. The debris was washed off from the 2 mm sieves into a labelled beaker. By ensuring the sieve are properly cleared by washing gently from the behind. The beakers were then left for 2-3 hours for nematodes to settle at the bottom, then view under the microscope for identification, twelve different genera were identified when viewed under stereomicroscope; these were *Scutellonema, Tylenchus, Meloidogyne, Hemicylophora, Heterodera, Rotylenchus, Xiphinema, Longidorus Hoplolaimus, Trichodorus, Aphelenchus and Pratylenchus.*

RESULTS

The result of the survey of parasitic nematodes associated with yam fields in Lapai and Paikoro Local Government Niger State is summarized in the Tables 1 and 2, respectively. The results indicated that twelve nematode genera were associated with yam fields in the two LGAs in Niger State with variation in number of occurrence. Nematode species of the *Scutellonema* genus had the highest number of occurrence and were widely distributed in yam fields of both LGAs.

Scutellonema had the highest number of occurring species in all of the yam fields surveyed in Lapai LGA followed by *Pratylenchus* and *Meloidogyne*. Similarly, Kawu '1' yam field recorded the highest number of occurring nematode species in the *Scutellonema* genus (281), which was highly significantly different from the other yam fields that had species from the same genus. There was no significant difference in number of species of *Scutellonema* in Dangana '2', Dangana '3', Takalafiya '2', Takalafiya '3', Ganamadi '1', Ganamadi '2' Ganamadi '3' (28, 30, 28, 28, 25, 22 and 28). Similarly, Kawu '2' Kawu '3' and Saminaka '1' had no significant difference in the number of nematode species from *Scutellonema* genus (88, 90 and 82) but differed significantly with those from Saminaka '2' Saminaka '3' and Dangana 1 (38, 52 and 128). Also, there was no significant difference in number of *Pratylenchus* spp. in Dangana 1, Dangana 3, Takalafiya '2', Saminaka '2', Saminaka '3' (10, 10, 20, 10 and 20) but differed significantly from Kawu '2' yam field which number of occurrence was 65. There was no significant difference in number of *Meloidogyne* spp. in Dangana '3', Takalafiya '1', Ganamadi '1' yam fields (16, 20 and 15), Ganamadi '2' and Kawu '2' yam fields with the same number of occurrence (28) but, significantly different from Saminaka '1' (34) and Saminaka '2' (25).

Similarly, there was no significant difference in the number of occurrence for *Rotylenchus* spp. in Dangana '1' Dangana '2' Takalafiya '2', Takalafiya '3' Ganamadi '3', Kawu '1', Saminaka '2' (10, 10, 10, 12, 12, 10 and 12). However, the number of species differed significantly from Takalafiya '1' (25) but not in *Tylenchus* spp. for Takalafiya'1', Ganamadi '1', Ganamadi '2', Kawu '2', Kawu '3' with the number of occurrence been (10). The number of species in the *Xiphinema* genus were not significantly different in Takalafiya '3', Ganamadi '1', Kawu '1' and Saminaka '3' (10) yam fields. Takalafiya '3', Ganamadi '3' and Kawu '1' (12, 10 and 10) showed no significant difference in the number of *Hoplolaimus* spp. There was no significant difference in the number of *Trichodorus* spp. recorded in Dangana '1' and Ganamadi '2'(10). But the number differed significantly from yam fields of Kawu '3' and Saminaka '1' (32 and 20), respectively. Nematode species from the *Aphelenchus* genus were only recorded in Dangana '2' and Kawu '1' yam fields (10). Occurrence for *Longidorus* spp. was only recorded in Dangana '3' (10) yam field.

Table 1: Plant - parasitic nematodes associated with yam in Lapai Local Government Areas of Niger State

Lapai L.G.A	Scute (fo)	Praty (fo)	Meloido (fo)	Rotylene (fo)	Tylene (fo)	Xiphine (fo)	Hoplolai (fo)	Trichodo (fo)	Aphelench (fo)	Longido (fo)	Heterode (fo)
Dangana 1	128	10		10				10			
Dangana 2	28			10					10		
Dangana 3	30	10	16							10	
Takalafya 1	42		20	25	10						
Takalafya 2	28	20		10							
Takalafya 3	28			12		10	12				
Ganamadi 1	25		15		10	10					
Ganamadi 2	22				10			10			
Ganamadi 3	28		28	12			10				
Kawu 1	281			10		10			10		
Kawu 2	88	65	28		10			32			
Kawu 3	90				10			20			
Saminaka 1	82		34								
Saminaka 2	38	10	25	12							
Saminaka3	52	20	10			10					

KEYS fo – frequency of occurrence, scute - *Scutellonema,* Praty - *Pratylenchus,* Meloido - *Meloidogyne,* Tylen - *Tylenchus,* Xiphi - *Xiphinema,* Hoplolai - *Hoplolaimus*, Tricho - *Trichodorus*, Aphelenc - *Aphelenchus*, Longi - *Longidorous*, Het – *Heterodera*

Results from Paikoro Local Government showed that there was no significant difference in the number of occurrence for *Scutellonema* spp. (Table 2) in Koneyi 2, Lugowru 2, Lugowru 3, Yandat 3, Paiko Town 2, (48, 44, 42, 44 and 46). However, significant difference in number of occurrence was observed in Gbaita 1 and Paiko Town 1 (64 and 80) when compared to Koneyi 1, Koneyi 3, Gbaita 2, Gbaita 3, Yandat 1, Yandat 2 and Paiko Town 3 (18, 28, 32, 28, 38, 38 and 38). There was no significant difference in number of *Pratylenchus* spp. in Koneyi 1, Koneyi 3 and Lugowru 2 yam fields (10, 10 and 10) when compared with Koneyi 2 and Paiko Town 3 (22 and 25).

Similarly, no significant difference was recorded for *Meloidogyne* spp. in Koneyi 2, Yandat 3 and Paiko town 1 (30, 32 and 32) but differed significantly from Lugowru 1, Gbaita 2 Yandat 2 yam fields (22, 25 and 22). There was no significant difference in the number of occurrence for *Rotylenchus* spp. in Koneyi 3, Lugowru 1, Lugowru 3, Gbaita 2, Gbaita 3, Yandat 1 and Yandat 3 (15,12 10, 10, 10, 10 and 10) but these differed significantly from Paiko town 1 and 2 (20 and 25). Also, there was no significant difference in number of *Tylenchus* spp. in Koneyi 1, Lugowru 2, Lugowru 3, Gbaita 1 and Gbaita 3 and Paiko town 2 yam fields (10). Only Paiko town 2 recorded the occurrence of *Xiphinema* spp. (10).

Hoplolaimus spp. was only recorded in Yandat 3 yam fields (28). There was no significant difference in the number of occurrence of *Trichodorus* spp. in Koneyi 3 and Yandat 2 yam fields (10) but differed significantly from Gbaita 1 yam field (28). *Aphelenchus* spp. (10) were found Yandat 1 yam field only. There was no significant difference in the number of occurrence of nematodes of *Longidorus* genus in Koneyi 1, Koneyi 2, Lugowru 2 and Paiko town 1 yam fields (10). *Heterodera* species were found in Paiko town 3 yam fields (10), while *Hemicyclophora* species were recorded in Paiko town 2 (10).

Table 2: Plant parasitic nematodes associated with yam in Paikoro Local Government Areas of Niger State.

Paikoro L.G.A	Scute (fo)	Praty (fo)	Meloido (fo)	Rotylen (fo)	Tylen (fo)	Xiphi (fo)	Hoploli (fo)	Tricho (fo)	Aphelenc (fo)	Longi (fo)	Het (fo)	Hem(fo)
Koneyi 1	18	10	-	-	10	-	-	-	-	10	-	-
Koneyi 2	48	22	30	-	-	-	-	-	-	10	-	-
Koneyi 3	28	10	-	15	-	-	-	10	-	-	-	-
Lugowru1	-	-	22	12	-	-	-	-	-	-	-	-
Lugowru 2	44	10	-	-	10	-	-	-	-	10	-	-
Lugowru 3	42	-	-	10	10	-	-	-	-	-	-	-
Gbaita 1	64	-	-	-	10	-	-	28	-	-	-	-
Gbaita 2	32	-	25	10	-	-	-	-	-	-	-	-
Gbaita 3	28	-	-	10	10	-	-	-	-	-	-	-
Yandat 1	38	-	-	10	-	-	-	-	10	-	-	-
Yandat 2	38	-	22	-	-	-	-	10	-	-	-	-
Yandat 3	44	-	32	10	-	-	28	-	-	-	-	-
Paiko town 1	80	-	32	-	-	-	-	-	-	10	-	-
Paiko town 2	46	-	-	20	10	10	-	-	-	-	-	10
Paiko town 3	38	25	-	28	-	-	-	-	-	-	10	-

KEYS: fo – frequency of occurrence, scute - *Scutellonema*, Praty - *Pratylenchus,* Meloido - *Meloidogyne*, Tylen - *Tylenchus*, Xiphi - *Xiphinema,* Hoplolai - *Hoplolaimus*, Tricho - *Trichodorus*, Aphelenc - *Aphelenchus*, Longi - *Longidorous*, Het - *Heterodera*, Hem - *Hemicyclophora*

DISCUSSION

The results of this research work from Table 1 and 2 showed the occurrence of different parasitic nematodes were associated with yam in all the selected yam farm fields in the Local Government Areas of Lapai and Paikoro Niger State of Nigeria. These plant parasitic nematodes are possible

causes of lower yields in quantity and quality of yam produced in these Local Government Areas. Researchers have reported that nematode damage to crops has increased numerously (Adegbite *et al.*, 2005).

In this study, *Scutellonema* genus had most of the plant parasitic nematodes associated with yam fields which contradicts earlier reports by (Mudiope *et al.*, 2007) that *Meloidogyne* was the most dominant genus on yam, followed by *Pratylenchus*. A total number of twelve genera of PPN were recovered from composite soil samples collected from the surveyed areas within the two LGAs in Niger State as shown in Table 1 and 2. *Aphelenchus, Longidorus, Heterodera* and *Hemicyclophora* had the least spread across the surveyed areas. *Heterodera* and *Hemicyclophora* were not recovered from the soil samples obtained in Lapai LGAs. In West Africa, nematode species of the *Scutellonema*, *Pratylenchus* and *Meloidogyne* genera are serious production constraints of yam. The lists of genera show that the occurrence of PPN in Niger State is abundant. This wide spread distribution of plant parasitic nematodes can be associated with poor yield in Nigeria. It could be a factor in low yam production in the study area. The nature of damage caused by plant parasitic nematodes make their damage potential to be underestimated compared to damage caused by other plant pathogens. It is imperative that awareness be created among farmers on the damaging effects of plant parasitic nematode damage to yam.

CONCLUSION

The result from this study showed that *Scutellonema, Tylenchus, Meloidogyne, Hemicylophora, Heterodera, Rotylenchus, Xiphinema, Longidorus Hoplolaimus, Trichodorus, Aphelenchus* and *Pratylenchus* genera were found to be associated with yam in Lapai and Paikoro Local Government Areas of Niger State of Nigeria. The wide spread distribution of these nematode genera can cause plant deformation, poor yield and low quality of yam. It is therefore recommended that sustainable nematode management strategy be factored into yam production program in the study area to avoid plant – parasitic disease outbreak.

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