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STUDIES ON THE OCCURRENCE AND DISTRIBUTION OF PLANT – PARASITIC NEMATODES IN SOME MAJOR IRRIGATION SITES IN KATSINA STATE, NIGERIA

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ABSTRACT

Nematode pests in Katsina state have not been widely studied. Information on the occurrence and distribution of these pests in various irrigation sites in the state is scanty. This study investigated the geographical distribution and population density of nematodes associated with some irrigation sites in the state. Ten irrigation sites across the state were surveyed in consultation with the Department of Irrigation in the Ministry of Agriculture and natural Resources, Katsina State. Five composite soil samples were taken at different crop fields in each of the irrigation sites. Extraction of nematodes from the samples was done using modified sieving and decanting techniques as described by Coyne *et al*. Analysis of the samples revealed 23 genera of plant parasitic nematodes. The most prominent nematodes found in all the samples collected from the irrigation sites were: *Rotylenchus*, *Tylenchus*, *Pratylenchus*, *Scutellonema*, *Aphelenchus*, *Aphelenchoides*, *Meloidogyne*, *Hoplolaimus*, and *paratylenchus*. While *Telotylenchus*, *Belonolaimus*, *Ditylenchus*, *Heterodera*, *Longidorus*, and *Criconemoides* occurred in very low numbers. The study indicated a widespread distribution of important plant-parasitic nematodes in the irrigation sites. The major nematodes identified in this study portend serious implications on profitable production of crop in the irrigation sites, because these nematodes are known to be damaging to crops. Enlightenment programme for the farmers in the irrigation site should therefore be embarked upon by the proper agencies to inform them of the presence of plant-parasitic nematodes in their crop fields and the implications.

Keywords: Occurrence, Distribution, Plant-Parasitic Nematodes, Irrigation Sites, Katsina State.

INTRODUCTION

Agriculture remains the major occupation for majority of households in Nigeria. Vegetable crops are widely cultivated in northern parts of the country. These crops are very popular and highly consumed in different ways because of their nutritional value and health concern. Furthermore small scale farmers highly depend on these crop productions because of high cash value and demand. However, successful production of vegetables have been hindered to some great extent by several pests and diseases (Plant Resources of Tropical Africa, 2004). While some of the pests and their effects are readily recognizable, nematode pests because of their microscopic sizes and hidden habitat are little known to farmers, hardly recognized and usually overlooked as major pests. (Luc, Skora & Bridge, 2005).

Plant-parasitic nematodes are mostly threadlike worms ranging from 0.25mm to > 1.0mm long, with some up to 4mm. They come in variety of shapes and sizes. Females in some species lose their worm-like shape as they mature becoming enlarged and pear, lemon or kidney-shaped or spherical as adults (Coyne, Nicol & Cladius-Cole, 2007). One of the major challenges of identifying nematodes as the caused agent of crop damage is the fact that many of them do not produce highly diagnostic symptoms which are specific and easy to identify. The damage caused by nematodes is often confused with symptoms of other biotic and abiotic stresses. For example, chlorosis may be due to nitrogen deficiency or may be caused by nematodes; poor stands of growth similarly may be caused by poor soil fertility or moisture stress or may be due to nematodes. It is therefore highly recommended (Coyne *et al.*, 2007) to assess for nematodes when crops are suffering yield loss and exhibiting

symptoms such as chlorosis, stunted growth, wilting, leaf rolling, patchy growth, thin or sparse foliage.

The environmental conditions in the tropics and subtropics are ideal for maximizing nematodes damage. Nematodes thrives at the temperatures under which most crops are grown in these regions, especially where frequent rainfall or irrigation keeps the soil moist. Irrigation sites in northern Nigeria make conducive environment for the survival and spread of nematodes, as crops are grown all year round in these areas. Plant-parasitic nematodes are costly burden in agricultural crop production. Over 4,100 species of plant-parasitic nematodes have been identified. The most economically important species directly target plant roots and prevent water and nutrient uptake, resulting in reduced agronomic performance, overall quantity and yields. Collectively nematodes caused an estimated 120 dollars per year in damage to crops (Decraema & Hunt, 2006).

Accurate yield-loss data due to nematodes are not available for most crops in many nations of Africa including Nigeria (Misari, 1992). However, it is noteworthy that the most important nematodes genera (*Meloidogyne, Pratylenchus, Heterodera, Ditylenchus, Globodera, Tylenchulus, Xiphenema, Radopholus* and *Helicotylenchus*) worldwide reported by Sasser and Freckman (1987) are common in Nigeria and crop loss estimate due to these nematodes in vegetables and cereal crops range from 20 – 100 per cent. (Afolami & Caveness, 1992; Chindo, Emechebe & Marley, 2004). Katsina state is one of the northern states of Nigeria with very vast lands, producing wide range of crops including vegetables which are mainly produced at various irrigation sites in the state. However, information

on plant-parasitic nematodes in the state, especially the irrigation sites is scanty to provide the basis for their management. It is against this background that this study was conducted to identify plant-parasitic nematodes that are associated with corps in some major irrigation sites. This is with the view to determine the relative occurrence, distribution and population densities of the nematodes.

MATERIALS AND METHODS

The study covered five out of the six irrigation zones in Katsina state. Two irrigation sites from each irrigation zone, making a total of ten irrigation sites were surveyed. The selection of the irrigation sites was done in consultation with the Department of Irrigation in the Ministry of Agriculture and Natural resources, Katsina state. The survey was conducted in the month of February, 2018. The following irrigation sites were selected, Nasarawa in Jibia local government, Ajiwa in Rimi local government, Gachi and Makera in Dustinma local government, Daberan in Dutsi local government, Sabke in Mai'adua local government Gangara and Mashigi in Malumfashi local government, Mairuwa in Funtua local government and Machika in Sabuwa local government. A preliminary survey was carried out to pave way for the main work and to make observations as regard to symptoms and nematodes infection in the crops. During the survey farmers were intimated about the main work in this study and the need for their cooperation.

Sample Collection

During the main survey, soil samples were taken from fields selected randomly at each of the irrigation sites. The samples were taken from fully grown plants. Five composite samples were taken from different fields in each of the irrigation sites.

Each composite sample consists of 20-25 sub-samples taken near a crop at a depth of 15-30cm around the roots using auger. The samples from each of the irrigation sites were thoroughly mixed and homogenized and placed in polyethylene bags. Care was taken to allow some air in and kept away from direct sunlight.

Extraction and Identification of Nematodes from Soil Samples

Extraction and identification of nematodes was done in the Nematology Research Laboratory, the Department of Crop Protection, Institute of Agricultural Research (IAR) Ahmadu Bello University, Zaria. Extraction was done using modified sieving and decanting techniques as described by Coyne *et al.*, (2007). Two hundred milliliter (200ml) of soil was collected from each composite sample for the extraction. This was poured into a plastic bucket and 5 litres of water added, stirred well using a glass rod and allowed to settle for 60 seconds. The first $\frac{3}{4}$ of the water in the bucket containing nematodes and fine sand was slowly poured through a sieve 1mm mesh into another plastic bucket. The suspension of nematodes and fine particles was then poured through a set of sieves with 0.075mm nested on 0.045mm. The soil remaining in the container was refilled with some volume of water and treated as in the initial procedure. This was to ensure maximum recovery of nematodes. Contents of top and second sieves were rinsed with a gentle stream of tap water into a labeled-beaker. The beaker containing water/nematodes extracts was then poured into an extraction dish which contains double cotton wool filter paper held in place by a clamp. After 24 hours filtrate was removed from the extraction dish and final suspension containing nematodes was standardized to 100ml in

a measuring cylinder. Ten milliliters was pipette into Doncaster counting dish. Nematodes were counted while viewing with a dissecting microscope. Counting and identification was done twice for each sample and the average recorded.

Data Analysis

The data generated was analyzed to determine the following:

Frequency of occurrence (frequency rating) = $\frac{n}{N} x \frac{100}{1}$

Where n is the number of times an individual nematode occurred in all the samples and N is sample size. Also the percentage nematode population was calculated using the formula $\frac{In}{TN} x \frac{100}{1}$

Where In = individual nematode population.

Tn = Total number of all the nematodes extracted in all the samples.

RESULTS AND DISCUSSION

Twenty three plant-parasitic nematodes were identified and recoded in association with the ten irrigation sites in Katsina state (Table 1). Out of the twenty three genera recorded, nine were found in all the soil samples collected from the ten irrigation sites, these are; *Rotylenchus*, *Tylenchulus*, *Pratylenchus*, *Scutellonema*, *Aphelenchus*, *Aphelenchoides*, *Meloidogyne*, *Hoplolaimus* and *Paratylenchus*. Other nematodes with high occurrence and geographical distribution in most of the irrigation sites include; *Tylenchorhynchus*, *Longidorus*, *Hemicycliophora*, *Tylenchulus*, *Heterodera*, *Tylenchus* and *Xiphinema*. However, *Belonolaimus* was only found in two irrigation sites (Daberan and Sabke) which are incidentally in the same irrigation zone and geographical area. *Tclotylenchus* was only recorded in Sabke (Table 1).

The highest number of nematode genera recorded was in Sabke site with 21 followed by Ajiwa, Gachi, Mashigi and Machika each with 19 genera. The lowest number of nematodes genera was recorded in Nasarawa irrigation site (Table 1). This has shown the wide spread of the nematodes genera in the irrigation sites across the state that even the lowest number recorded (16 genera) in Nasarawa has about 70% of the total number of genera recorded in all the ten irrigation sites. Five nematodes genera are found to be most ubiquitous with high frequency rating of more than 60%; *Meloidogyne* (74%), *Rotylenchus* (66%), *Hoplolaimus* (66%), *Pratylenchus* (64%), and *Scutellonema* (64%). Other nematodes having up to 50% frequency rating include *Paratylenchus*, *Aphelenchus*, *Aphelenchoides* and *Tylenchus*. However, *Telotylenchus*, *Ditylenchus*, *Belonolaimus* and *Tetylenchus* were found to have low frequency ratings (Table 1).

The highest populations with more than 10% was recorded in *Rotylenchus* (11.3%), *Scutellonema* (11%) and *Hoplolaimus* (10.5%). Low population, below 2% was recorded in *Ditylenchus*, *Telotylenchus*, *Criconemoides*, *Belonolaimus* and *Longidorus*. It should be noted that *Meloidogyne* recorded the highest frequency rating of 74% but its percent population was low (7.1%) compared to the highest recorded (11.3%) in *Rotylenchus* (Table 2). The results of this survey of ten irrigation sites in Katsina state reveals the presence of twenty three nematodes genera with varying frequency of occurrences and population densities in the samples collected. From the nine most ubiquitous nematodes reported in this study, *Meloidogyne*, *Rotylenchus* and *Pratylenchus* were reported earlier in another study at Ajiwa irrigation site (Usman, 2012). This study is also in line with the earlier reports on the

presence of *Meloidogyne* at Mashigi and Nasarawa (Usman, 2016) and Makera Irrigation sites (Jibia *et al.*, 2016). *Meloidogyne* has been variously reported as wide spread and devastating nematode in various parts of tropical and sub tropical regions (Chindo & Bello, 2009; Anamika *et al.*, 2011).

The nine most prevalent nematodes in this study were reported associated with pineapple plant in Delta, Imo and Cross Rivers states (Fisayo & Afolami, 2014). *Meloidogne*, *Pratylenchus*, *paratylenchus*, *Tylenchus* and *Tylenchorhynchus* found with high population and frequency ratings in this study, have been reported as major nematodes associated with plantain in Choba, Rivers State (Tanimola, Asimea & Ofura, 2013). The widespread distribution of important plant-parasitic nematodes identified in this study and which are known to cause plant debility and poor yields in crops, could be a factor in the low production of many crops especially under irrigation in Nigeria. The insidious nature of damage caused by plant-parasitic nematodes make their damaging potential to be underestimated and often mistaken for damage caused by other plant pathogens or nutrients deficiency. In most cases, farmers are not aware or adequately informed about this menace to crops. It is therefore imperative that awareness be created for farmers on the damaging effects of plant-parasitic nematodes on crops especially under irrigation.

CONCLUSION

The study identified twenty three nematodes genera in the ten irrigation sites surveyed across Katsina state. Nine genera were found in all the samples collected from the ten irrigation sites. Most of the nematodes identified with high population and frequency ratings have been widely reported and

implicated as important nematode pests of crops. Most of these nematodes have not been previously reported associated with the irrigation sites. The widespread distribution of these nematodes in the irrigation sites is disturbing. Farmers should therefore be encouraged to embrace sustainable cultural practices that could promote good yield and efficiently manage and reduce the spread of the nematodes in the irrigation sites.

Enlightenment programmes for the farmers should therefore be embarked upon by the proper agencies to inform them of the presence of the plant-parasitic nematodes in the crop fields and the implications. There is the need for further studies to determine the pathogenicity of these nematodes on the different crops in the irrigation sites. It is hoped that the findings of this study will provide the baseline data for the possibility of developing a strategy for sustainable management of the nematodes in the irrigation sites.

Table 1: Occurrence and geographical distribution of plant-parasitic nematodes in ten irrigation sites in Katsina state

Nematode Genera	Irrigation Sites									
	Daberan	Sabke	Makera	Machika	Nasarawa	Mashigi	Mairuwa	Gangara	Gachi	Ajiwa
Rotylenchus	x	x	x	x	x	x	x	x	x	x
Tylenchus	x	x	x	x	x	x	x	x	x	x
Pratylenchus	x	x	x	x	x	x	x	x	x	x
Scutellonema	x	x	x	x	x	x	x	x	x	x
Aphelenchus	x	x	x	x	x	x	x	x	x	x
Aphelenchoides	x	x	x	x	x	x	x	x	x	x
Meloidogyne	x	x	x	x	x	x	x	x	x	x
Hoplolaimus	x	x	x	x	x	x	x	x	x	x
Paratylenchus	x	x	x	x	x	x	x	x	x	x
Tylenchorhynchus	x	x	x	x	o	x	x	x	x	x
Longidorus	x	x	x	x	x	x	x	o	x	x
Hemicycliophora	x	x	x	x	o	x	x	x	x	x
Heterodera	x	x	o	x	x	x	x	x	x	x
Tetylenchus	x	x	o	x	o	x	x	o	o	x
Xiphenema	x	x	x	x	x	x	o	o	x	x
Belonolaimus	x	x	o	o	o	o	o	o	o	o
Criconemoides	x	x	x	x	o	x	x	x	o	o
Helicotylenchus	o	x	x	o	x	x	x	x	x	x
Trichodorus	o	x	x	x	x	x	x	x	x	x
Telotylenchus	o	x	o	o	o	o	o	o	o	o
Tylenchulus	o	x	x	x	x	x	x	x	x	x
Ditylenchus	o	o	o	x	o	o	x	x	x	o
Rotylenchulus	o	o	x	o	x	o	x	x	x	x

X = Present; 0 = Absent

Table 2: Frequency ratings of plant-parasitic nematodes found in ten irrigation sites in Katsina State

Nematode Genera	Frequency of occurrence	% frequency rating (Absolute frequency)	Nematode Population	% Nematode Population
Rotylenchus	33	66	925	11.3
Tylenchus	25	50	430	5.3
Pratylenchus	32	64	750	9.9
Scutellonema	32	64	900	11.0
Aphelenchus	28	56	535	6.5
Aphelenchoides	25	50	330	4.0
Meloidogyne	37	74	580	7.1
Hoplolaimus	33	66	860	10.5
Paratylenchus	29	58	475	5.8
Tylenchorhynchus	22	44	310	3.8
Longidorus	14	28	160	1.9
Hemicycliophora	21	42	282	3.4
Heterodera	20	40	285	3.5
Tetylenchus	6	12	46	0.6
Xiphenema	13	26	170	2.1
Belonolaimus	2	4	10	0.1
Criconemoides	10	20	70	0.9
Helicotylenchus	23	46	390	4.8
Trichodorus	19	38	220	2.7
Telotylenchus	1	2	5	0.1
Tylenchulus	17	34	235	2.9
Ditylenchus	5	10	25	0.3
Rotylenchulus	13	26	175	2.1
			8,168	

Sample Size = 50

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REFERENCES

Afolami, S. O. & Caveness, F. E. (1982). The Frequency of Occurrence and Geographical Distribution of Plant-Parasitic Nematodes Associated with Theobroma cacao L. in Nigeria. *Turrialba* 33(7): 97-100.

Anamika, S., Sing, K. P. & Ghosh, C. (2011). Distribution of Root Knot Nematode on Major Fruits Crops. *Archives of Phytopathology and Plant Protection* 44(23): 191-197

Chindo, P. S., Emechebe, A. M. & Marley, P. S. (2004). Characterisation of Plant-Parasitic Nematodes Associated with Maize, Sorghum and Pearl Must in Northern Nigeria. *Samaru Journal of Agricultural Research* 20.

Chindo, P. S. & Bello, L. Y. (2009). Distribution and Abundance of Root Knot Nematode Species (*Meloidogyne*) in Northern Nigeria. *Biological and Environmental Sciences Journal for the tropics* 6(4): 61-63.

Coyne, D. L., Nicol, J. M. & Claudius-Cole, B. (2007). *Practical Plant Nematology: A Field and Laboratory* Guide SP-IPM. Secretariat International Institute of Tropical Agriculture (IITA) Contonou, Benin pp. 82.

Decraemer, W. & Hunt, D. J. (2006). Structure and Classification. In: Perry, R. N. & Moens, M. (eds) Plant Nematology. CABI Publishing Wallingford pp. 832

Fisayo, D. & Afolami, S. O. (2014). Studies on the Distribution of Plant-Parasitic Nematodes Associated with Pineapple in Delta, Imo and Cross Rivers States of Nigeria. *Australian journal of basic and Applied Sciences* 8(7) 248-256.

Jibia, A. B., Zurmi, R. S., Iliya, M. S., Sani, G. M. & Sanusi, L. (2016). Incidence and Population of Plant-Parasitic Nematodes in Green Amaranth (*Amaranthus hybridus* L.) (*Earyophyllales; Amaranthaceae*) from three selected areas in Dutsinma town, Katsina State Nigeria. Brazilian Journal of Biological Sciences 3(6) 319-330.

Luc, M. Sikora, R. A. & Bridge, J. (2005). *Plant-Parasitic Nematodes in Subtropical and Tropical Agriculture*, 2nd Edition, CABI Wallingford, 871pp.

Misari, S. M. (1992). The Biology and Control of Nematode Pests of Food Crops in Africa. An Essential Pre-Requisite for Food Self Sufficiency. In: The Biology and Control of Nematode Pests: Regional Symposium, Ibadan, Nigeria 26-29 July, 1992.

Plant Resources of Tropical Africa (2004). Grubben G. H. J. & Denton, O. A. (eds) PROTA 2 Vegetables PROTA Foundation Wageningen, Netherlands. Backlays Publishers. Laiden Netherlands/CTA Wageningen Netherlands 668pp.

Sasser, J. N. & Freckman, D. W. (1987). A World Perspective on Nematology: The Role of the Society. In; Vcech, J.A., & Dickson, D. W. (eds) Vistas on Nematology Society of Nematologists Inc. Hyattsville, pp 7-14.

Tanimola, A. A., Asimea, A. O. & Ofura, S. (2013). State of Plant-Parasitic Nematode on Plantain (Musa parasidiaea) in Choba, Rivers State Nigeria. *World Journal of Agricultural Science* 9(2) 189-195.

Usman, A. (2012). Effect of Neem Fruit Powder on Soil Population of Plant-Parasitic Nematodes and Yield of Tomato in Borno State, Nigeria. *Biological and Environmental Sciences Journal for the tropics*, 9(1): 141-144.

Usman, A. (2016). Survey of Root Knot Nematodes (*Meloidogyne* species) Disease on Tomato. A Case study of Five Selected Irrigation Sites in Katsina State, Nigeria. *Katsina Journal of Sciences* 3(2) 17-21.