VOL. 22 NO. 1
ISSN: 2877-1990
SEPTEMBER, 2021

African Scholar Publications & Research International

African Scholar Journal of Agriculture and Agricultural Tech. (JAAT-1)

Studies on Plant Parasitic Nematode Associated with Sweet Potato (*Ipomoea batatas* L.*)* in Gombe Nigeria

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Abstract

Sweet potato (*Ipomoea batatas*) is one of the most important staple foods consumed in Nigeria and around the world, however yields are influenced by both biotic and abiotic variables, with plant parasite nematodes (PPN) being one of the biotic causes. The aim of this study was to document the plant parasitic nematode pests of sweet potato in major sweet potato growing areas in Gombe State. Soil samples were randomly collected from sweet potato fields in Nafada, Kaltungo and Yamaltu Deba Local Government areas representing the three senatorial districts. Plant parasitic nematodes were extracted from soil using whitehead and Hemming method (1965) and identification key for agriculturally important plant-parasitic nematodes was used for the nematode identification. Fifteen plant parasitic nematode were identified across the three local government which include *Scutellonema* sp, *Nacobbus* sp, *Pratylenchus* sp,, *Heterodera* sp, *Longidorus* sp, *Tylenchus* sp, *Xiphinema* sp, *Trichodorus* sp, *Rotylenchus* sp, *Tylenchulus* sp, *Dispaci* sp, *Aphelenchoides* sp, *Helicotylenchus* sp, *Ditylenchus* sp.It is therefore critical to educate farmers about the economic importance of plant-parasitic nematodes on sweet potato in the surveyed areas, as well as how to manage them.

Keyword: Plant parasitic nematode, Sweet potato, survey.

Introduction

Sweet potato (*Ipomoea batatas* (L.) Lam.) is a dicotyledonous perennial crop cultivated both in the warm temperate and tropical parts of the world but grown as an annual crop (Patil, 2020). "It ranks seventh in global food crop production and the third most important root crop after Irish potato and cassava" (Loebenstein, 2015). It is rich in carbohydrate, starch, protein, fats, fiber etc, which make it a very good and reliable source of food energy, sweeteners and industrial raw materials. In Nigeria, sweet potato is produced virtually in every part of the country but predominantly in the Northern Guinea Savannah where many landraces abound (NAERLS *et al*., 2007). It is a major cheap source of energy for more than 80% of Nigerians living below the poverty line especially in the northern part of the country (Olabiyi *et al.* 2016). With the current decline in Nigeria's economy in recent years, the production of sweet potato has significantly increased from 2.4 million metric tons in 2000 to 4.1 million metric tones in 2017 (FAOSTAT, 2018).

Although sweet potato is nutritionally and economically important its production has been hampered by the activities of plant parasitic nematodes. Plant parasitic nematodes have been identified as economic pests of sweet potato (Ames, *et al.*, 1997; Olabiyi, 2007, Olabiyi *et al*. 2016).Plant parasitic nematodes (PPN) cause significant yield losses in agricultural crops (Strange and Scott 2005), with a global cost of more than $120 billion per year (Chitwood 2011). The top ten plant parasitic nematodes are *Meloidogyne* spp., *Heterodera* spp., *Globodera* spp., *Radopholus* spp, *Ditylenchus* spp, *Scutellonema* spp, *Rotylenchulus* spp, *Xiphinema* spp, *Naccobus* spp, and *Aphelenchoides* spp (Jones *et al*. 2013).Root knot nematode (RKN, *Meloidogyne* spp.) is ranked as the most economically damaging nematode due to its ability to rapidly spread to and colonize new locations (Bebber *et al*. 2014) and wide host range (Jonesetal.2013).There are twenty *Meloidogyne* species in Africa, with *M. incognita*, *M. javanica*, and *M. arenaria* being the most common (Onkendi *et al*. 2014).If necessary precautions for their control are not taken prior to the distribution/planting of the planting materials (vines or tubers) these nematodes are capable of causing significant economic loss on sweet potatoes (Olabiyi *et al*. 2016).

However, there is paucity of information on the plant parasitic nematodes associated with sweet potato in Gombe. The aim of this work is to survey plant parasitic nematode associated with sweet potato in three major producing sweet potatoes in the State.

MATERIALS AND METHODS

SURVEY SITE:

The survey was conducted in Yamaltu Deba, Kaltungo LGA representing the senatorial district of Gombe State Nigeria.

Sample Collection:

Soil samples for the survey were collected using a soil auger from the rhizosphere of sweet potato plants at a depth of about 0-25 cm and within a 25 cm radius of the sweet potato plants' bases. Thirty soil core samples per hectare were collected in a zigzag pattern from each of the sweet potato fields and bulked together to form a composite sample. Each composite sample was thoroughly mixed and passed through a 10mm diameter mesh sieve to remove any stones or debris before being sent to the laboratory for nematode extraction. Soil samples were collected in sealed bags and labeled with the date, time, location, and field from which the samples were collected.

Extraction of Nematodes from Soil:

The Extraction Tray method developed by Whitehead and Hemming (1965) was used to extract vermiform nematodes from soil samples. Two hundred grams (200g) of each composite sample was placed in the upper sieve of a modified Baermann tray set-up consisting of a double-ply facial tissue sandwiched between a pair of plastic sieves and placed in a bowl of water with about 500 ml of water gently poured into it. The setup was left alone for 24 hours before the sieves were gently lifted off and the contents of the dishes were examined for nematodes.

Nematode identification.

Nematodes species were identified by means of identification key for agricultural important plant-parasitic nematodes (Mekete, *et al*., 2012).

DATA ANALYSIS

The distribution and population density of nematodes were calculated using the formulae of Norton (1989) but with modifications on the percentage similarity as follows

Prominence values (PV) = Population Density × (Frequency of Occurrence) ½ × 10^{-1} were calculated for each nematode species (Fourie, *et al*., 2000)

Population Density $= \frac{number\ of\ nematode\ in\ all\ samples}{total\ number\ of\ samples\ collected} \times 100$

Frequency of Occurrence $= \frac{\text{numberof samples containing nematodes}}{\text{total number of samples collected}} \times 100$

Percentage Similarities $= \frac{KS}{a+b+c\ .....} \times 100$

Where:

K= Number of comparing locations;

S = Number of nematode genera that the comparing locations have in common;

a, b, c, = Number of nematode genera in each of the comparing locations

RESULT AND DISCUSSION

Table 1 shows the occurrence and geographical distribution of plant parasitic nematode genera in sweet potato farms at Yamaltu Deba, Kaltungo and Nafada Local Government areas of Gombe State. A total of 15 plant parasitic nematode were encountered and identified from he surveyed site associated with sweet potatoes which includes *Scutellonema* sp, *Nacobbus* sp, *Pratylenchus* sp, *Meloidogyne* sp, *Heterodera* sp, *Longidorus* sp, *Tylenchus* sp, *Xiphinema* sp, *Trichodorus* sp, *Rotylenchus* sp, *Tylenchulus* sp, *Dispaci* sp, *Aphelenchoides* sp, *Helicotylenchus* sp, *Ditylenchus*. However, among the PPN identified Y/Deba had the highest number (13) followed by Kaltungo (12) and least Nafada with (10.)

Table 2shows the population density and Prevalence value of plant parasitic nematode genera in the rhizosphere soil from sweet potato field of Kaltungo and Nafada Local Government Areas of Gombe State. The result indicates that *Meloidogyne* spp, had the highest population density (128.6) per 200g of soil and prevalence value however *Tylenchulus* spp and *Dispaci* spp. recorded zero population and prevalence value respectively in Y/Deba. Results from Kaltungo

shows that *Scutellonema* sp and *Meloidogyne* sp had (40.0) population density each per 200g of soil while *Longidoru* sp, *Aphelenchoides* sp, *Helicotylenchus* sp, did not record any population and prevalence value. In Nafada local government area *Meloidogyne* spp and *Scutellonema* spp recorded (37.1) and (34.3) population density per 200g of soil while *Longidoru* ssp. Tylenchus sp, *Dispaci* sp, *Aphelenchoides s*sp and *Ditylenchus* spp recorded zero population densities and prevalence value **.**

Among the 15 encountered plants parasitic nematodes are those classified as ten top most important nematode that are threat to world agricultural production. These include: *Meloidogyne, Pratylenchus, Heterodera, Ditylenchus*, *Globodera, Tylenchulus, Xiphinema*, *Radopholus, Rotylenchulus* and *Helicotylenchus* (Nicol *et al*., 2011; Sasser and Freckman, 1987; Hodda *et al*., 2012,) and some of which are economic nematode pests of sweet potato (Coyne *et al*., 2007, Olabiyi *etal.*,2016). *Meloidogyne* spp., *Ditylenchus destructor*, *D. dipsaci*, *Rotylenchulus reniformis, Trichodorus* spp, *Nacobbus* spp, and *Pratylenchus* spp. have been confirmed as nematode pests of sweet potatoes.

This result is in line with the findings of Olabiyi *et al*., 2016 and Hanna *et al*., 2016 who reported (7) and (13) genera of plant parasitic nematode associated with sweet potatoes in Nigeria and Kenya respectively. However, increased in number of PPN from this work might be due to some factors such varietal difference, temperature, rainfall pattern, soil, location and management practices by the farmers. Also 8 PPN were identified in all the locations surveyed (*Scutellonema* sp, *Nacobbus* sp, *Pratylenchus sp, Meloidogyne* sp, *Heterodera* sp, *Xiphinema* sp, *Trichodorus* sp, *Rotylenchus* sp,), of which some have been confirmed as nematode pest of sweet potatoes.

Frequency of occurrence in Y/Deba LGA shows *Meloidogyne* sp, *Scutellonema* and *Longidoru* ssp and *Xiphinema* to be the most occurring genera (Fig.1). In Kaltungo LGA however, *Scutellonema* species and *Rotylenchus* species were the most occurring genus and were significantly higher than all other species (Fig. 2). Fig 4 shows that Meloidogyne species, *Scutellonema* species, *Longidorus* species and *Xiphinema* species were the most occurring genera in Kaltungo LGA. This finding collaborate with the findings of (*Bulus et al. 2017,* Abdulsalam *et al*. 2017 and Jibrin *et al*. 2013) whose report shows that *Scutellonema, Xiphinema Pratylenchus* and *Meloidogyne* species were among

the frequently encountered genera in soils of northern Nigeria under different crop cultivation.

Fig 4 shows percentage similarities when two locations are compared, i.e. Kaltungo and Nafada LGA gave the highest percent similarities but were not significantly higher than when Yamaltu/Deba is compared with Kaltungo and Y/Deba compared to Nafada. However, when the three locations(Y/Deba, Kaltungo and Nafada) were compared together, they recorded significantly lower percent similarities than any of the two locations compared.

CONCLUSION

Sweet potato (*Ipomoea batatas*) is one of the most important staple foods consumed in Nigeria and around the world, however yields are influenced by both biotic and abiotic variables, with plant parasite nematodes (PPN) being one of the biotic causes. From this work 15 plant parasitic nematode were found to be in association with sweet potatoes in major sweet potatoes areas in Gombe Nigeria which include *Meloidogyne sp Scutellonema* sp, *Nacobbus* sp, *Pratylenchus* sp, *Heterodera* sp, *Longidorus* sp, *Tylenchus* sp, *Xiphinema* sp, *Trichodorus* sp, *Rotylenchus* sp, *Tylenchulus* sp, *Dispaci* sp, *Aphelenchoides* sp, *Helicotylenchus* sp, *Ditylenchus* sp among which are considered major nematode pest of sweet potatoes worldwide. The economic damage caused by this nematode cannot be over emphasized as such the need to educate farmers of this hidden enemy and the dangers it posed toward the production of sweet potatoes in the surveyed areas.

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Table 1: Occurrence and Geographical Distribution of Plant Parasitic nematode genera in sweet potato farms at Yamaltu Deba, Kaltungo and Nafada Local Government Areas of Gombe State.

PPN GENERA	LOCATION				
	Y/DEBA	KALTUNGO	NAFADA		
Scutellonema spp	+	+	+		
Nacobbus spp	+	+	+		
Pratylenchus spp	+	+	+		
Meloidogyne spp	+	+	+		
Heterodera spp	+	+	+		
Longidorus spp	+	-	-		
Tylenchus spp	+	+	-		
Xiphinema spp	+	+	+		
Trichodorus spp	+	+	+		
Rotylenchus spp	+	+	+		
Tylenchulus spp	-	+	+		
Dispaci spp	-	+	-		
Aphelenchoides spp	+	-	-		
Helicotylenchus spp	+	-	+		
Ditylenchus spp	+	+	-		
Total	**13**	**12**	**10**		

+ =Present - =Absent PPN= Plant Parasitic Nematode

Table 2**:** Population Density, and Prevalence value of Plant Parasitic Nematode genera in the rhizosphere soil from sweet potato field of Kaltungo and Nafada Local Government Areas of Gombe State

PPN GENERA			LOCATION			
	Y/DEBA		KALTUNGO		NAFADA	
	PD	PV	PD	PV	PD	PV
Scutellonema spp	31.4	1.30	40.0	1.66	34.3	1.53
Nacobbus spp	17.1	0.64	11.4	0.33	20.0	0.83
Pratylenchus spp	31.4	1.18	8.6	0.25	17.1	0.65
Meloidogyne spp	128.6	6.14	40.0	1.51	37.1	1.66
Heterodera spp	17.1	0.58	25.6	0.87	25.7	1.00
Longidorus spp	20.0	0.82	0.0	0.00	0.0	0.00
Tylenchus spp	11.4	0.33	11.4	0.33	0.0	0.00
Xiphinema spp	31.4	1.30	11.4	0.39	17.1	0.58
Trichodorus spp	25.7	1..00	8.6	0.20	28.6	1.18
Rotylenchus spp	31.4	1.18	22.7	0.94	8.6	0.25
Tylenchulus spp	*0.0*	0.00	17.1	0.58	14.3	0.48
Dispaci spp	0.0	0.00	14.3	0.48	0.0	0.00
Aphelenchoides spp	11.4	0.33	0,0	0.00	0.0	0.00
Helicotylenchus spp	14.3	0.48	0.0	0.00	25.7	1.06
Ditylenchus spp	22.8	0.88	8.6	0.20	0.0	0.00

TOTAL	**393.6**	**15.68**	**219.7**	**7.74**	**197.5**	**9.22**

PD=population density, PV=Prevalence Value, PPN= Plant Parasitic Nematode

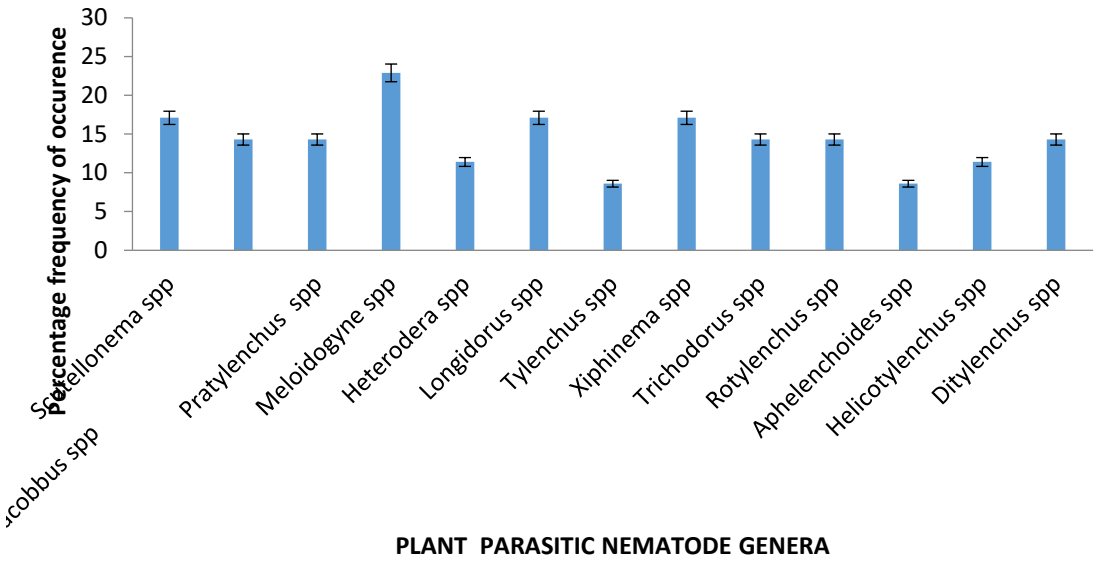

FIG.1 Frequency of occurrence of plant parasitic nematode associated with sweet potato in Yamaltu Deba Local Government Gombe State.. Bars indicate standard error of means at 5% probability level.

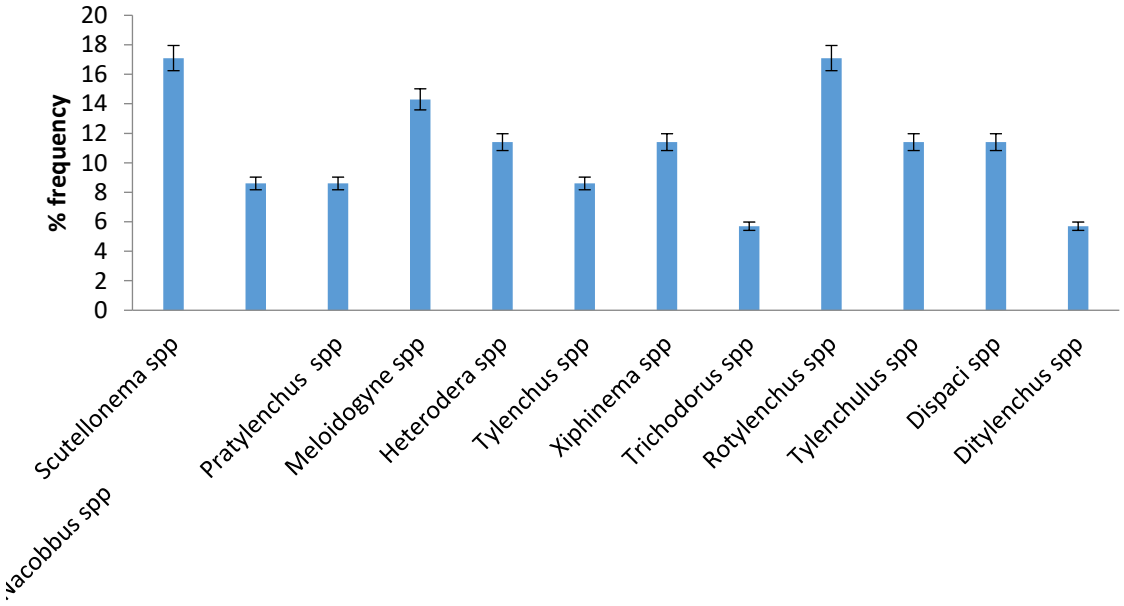

FIG.2 Frequency of occurrence of plant parasitic nematode associated with sweet potato in Kaltungo Local Government Area Gombe State.. Bars indicate standard error of means at 5% probability level.

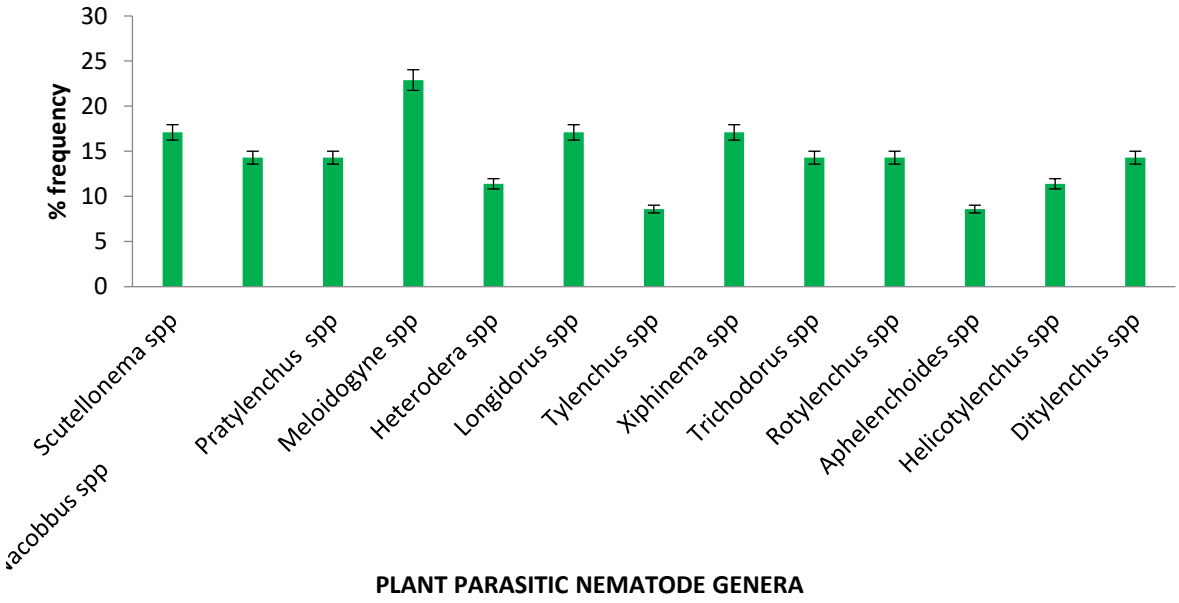

FIG.3 Frequency of occurrence of plant parasitic nematode associated with sweet potato in Nafada Local Government Area Gombe State.. Bars indicate standard error of means at 5% probability level.

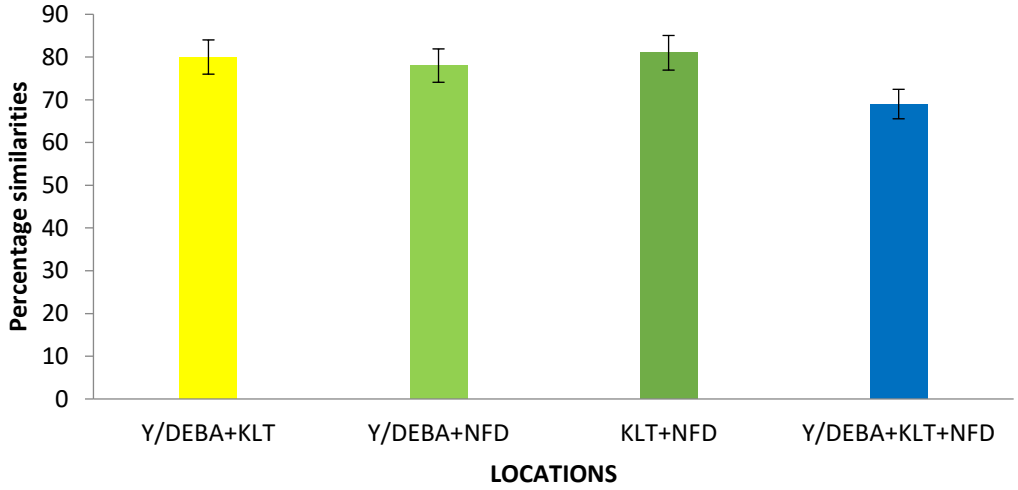

Fig.4: Percentage Similarities of plant parasitic nematode genera among associated with sweet potato field of Yamaltu Deba (YD), Kaltungo (KT), and Nafada (NF) Local Government Areas of Gombe State. Bars indicate standard error of means at 5% probability level