PLANT PARASITIC NEMATODE POPULATION DYNAMICS IN HOMESTEAD BANANA (*Musa spp.*), IN NSUKKA COMMUNITY

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Abstract
Banana and plantain (*Musa* spp.) are important crops in Nsukka community for household income and food security. However, yield has been on the decrease due to some biotic and abiotic factors among which is the plant parasitic nematodes. The study was carried out in three autonomous communities in Nsukka and the in university community. From the root samples collected from each farmer, the population of various species of nematodes was estimated. This revealed that the most prevalent nematode in Nsukka is the *Meloidogyne* species, followed by *Radopholus* and *Pratylenchus* species respectively. The nematodes found are known to be injurious to banana plants by reducing yield tremendously. From the same homestead farms, soil samples were collected from which the soil textural class, pH, and the cation exchange capacity (CEC) were determined and related to the total population of nematodes found. The results revealed that soils of textural class of loamy sand with near-neutral pH of 7.2 harboured the highest nematode population. This could be due to the inherent properties of the soil including the neutral pH and the porous nature. The nematode population as observed in the study area could be reduced through participatory research and development approach involving the smallholder farmers. The key intervention measures are proper management system, adequate soil analysis before planting and intervention of integrated pest management which could contribute to food security and poverty reduction.

Keywords: Banana, plantain, plant parasitic nematode and population dynamics.

Introduction

Plant parasitic nematodes which are widespread in the plantain producing area of West and Central Africa are capable of destroying the whole root system (Blake, 1969; Gowen and Quenehervé, 1990). The subsistence farmer has minimal control over nematode infestation and the associated yield decline (Blake, 1969). These important pests have received little attention mainly due to the paucity of information on their occurrence, distribution and relative importance on plantain in West Africa.

Most species of plant parasitic nematodes are found to be detrimental to *Musa* species, but only few are of economic importance. Nematodes inflict wounds on the root as they penetrate the epidermis, but symptoms on attack differ with the groups of nematodes. Sedentary endoparasitic nematodes maintain a close relationship within the host plant and this often results in hypertrophy and hyperplasia of cells (Dropkin, 1989). Migratory endoparasitic nematodes migrate through the root cortex during the process of feeding. This leads to expansion of lesions which coalesce into large necrotic patches. The secondary pathogens (fungi and bacteria) take advantage of these opportunistic lesions to invade the roots resulting in purplish to reddish-black necrosis and eventual decay (Stover, 1996). Root necrosis may result in premature death of the plant. The necrosis interferes with water and nutrient absorption thereby affecting growth and vigor, which in turn leads to reduced bunch yield and prolonged harvest cycle (Sarah, 1989; Gowen *et al*., 1990).

Plant parasitic nematode occurrence is believed to be influenced by environmental factors such as soil texture, moisture, pH and soil fertility, cultivar grown as well as management practices (Lowe, 1992; Queneherve, 1993). Much work still needs to be done to understand the complexities of the nematode species, the processes involved in root damage as well as factors influencing them. The subsequent losses in banana and plantain due to nematode activities need to be properly quantified.

Control of nematode could be achieved by the use of nematicide especially in large commercial farms but not for the rural poor farmers who cannot afford the chemical control measures. Nematode attack could be controlled culturally by the use of resistant varieties, maintaining a clean plantation, planting of healthy suckers and crop rotation (Gowen, 1990).

There is need for further research as to ascertain the control measures for nematode population in order to bring it to the barest minimum. Therefore, the objective of this study was to estimate the population dynamics of plant parasitic nematodes in homestead bananas at varying soil pH, CEC, particle size and textural classes.

Materials and Methods

The study area is Nsukka Local Government Area of Enugu State, made up of three autonomous communities and the university community. Out of the four communities visited, a total of sixteen locations were studied namely, Amukwa,

Umuchim, Ameze, Owerenu, Nguru, Isiakpu, Echara, Umuakashi, Iheagu, Ezema, Edem, Umuoyo, Eni-Njoku, Umunkanka, Ukuta and Margaret Cartwright.

Nsukka local government area lies between latitude 6^0 45' N and $7^0$00'N on longitude $7^0$30'E of the Greenwich meridian. The mean temperature falls between 27^0c and 28^0c. The predominant climatic seasons in the area include rainy season, lasting from April to October and the dry season from November to March (Ofomatta, 1976). The vegetation of the area is derived savannah. The trees found are usually drought resistant. Some patches of relief forest which lie mainly on the hill tops or valley sides are evident that this area was once very densely forested. However, most important parts of this area abound in grasses which form an important aspect of the rural economy as the harvested grasses are used in thatch houses for fencing and roofing (Ugwunkwo, 1977). Farming constitutes a major source of income for a greater percentage of the population (Ugwunkwo, 1977), although trading and civil service also exist.

Combinations of purposive and random sampling procedures were adopted in the selection of respondents. Four communities in Nsukka LGA were randomly selected for this study. The selected communities included: Ihe/owere, Nru, Nkpunano and the University community. Twenty respondents were randomly sampled in each of the communities, in which case a total of 80 respondents were interviewed. Data collection was carried out using both primary and secondary sources. The primary data were collected using questionnaires including the age of the existing plants, source of planting materials, cropping systems, cultural practices of the people, disease manifestations, nature of the plants in terms of number of hands per bunch, number of fingers, and finger size, the girth and height of the plant and the number of plants per mat. Secondly, root and soil samples were collected at 20 × 20 × 20 cm, (length by width by depth) around the plant to determine which genera of nematodes were present and their population. Garden trowel was used to dig up plant roots and the surrounding soils. The labelled plant roots were wrapped in plastic bags and returned to the pathology laboratory of the Department of Crop Science where they were stored (10-12°C) and later processed. Soil samples were also taken to the Department of Soil Science laboratory for routine analysis including particle sizes, textural classes, soil pH and the Cation exchange capacity. In the laboratory, Bearmen Funnel method of nematode extraction (Swennen, 2001) was used. The roots were pooled, washed with tap water, cut into 10 cm long and dried between tissue paper. A 15g root sample was added to 100ml distilled water and stored in the refrigerator at 4°C. The next day, the roots were removed from the distilled water and macerated in kitchen blender with the addition of 100ml distilled water for 10 sec (separated by 5 sec interval). The macerated suspension was poured through 40-µm sieve. A syringe was used to collect 0.05ml aliquot into the counting slide and viewed under a 40x magnification light microscope. With this, I was able to determine the genera and population of nematodes in each community.

The specific objectives guided the techniques for data analysis. Descriptive statistical techniques such as cross tabulations, percentages and other measures of central tendencies were used. Furthermore, relationship between the nematode population per 0.05ml aliquot and the existing management practices was established using correlation analysis to satisfy the objective of the study.

Results

The result (Table 1) reveals the prevalent nematode species identified in homesteads in Nsukka. Of the total nematode population per 0.05ml aliquot each, 56% represents adult male *Meloidogyne spp*. The juvenile stage of the same *Meloidogyne spp* makes up to 14% of the total population. The mature female represents about 5% of the total population. *Radopholus reniformis* represents about 7%, while *Radopholus similis represents 13%* of the total population. *Pratylenchus coffeae* made up the remaining 5%.

The data in Table 2 shows the relative prevalence of nematode species in each location. From the table, *Meloidogyne spp.* are present in all location, while *Radopholus spp* are found in eleven locations out of the sixteen locations. *Pratylenchus spp* represents the minority. Also from the same data, conclusions can be made on plantain being the most grown in Nsukka community as compared to banana.

The Population Dynamics of the Nematodes Present at Different Soil Ph, Particle Size, Cec, and Textural Classes

Table 3 shows that Ikejiani, Umunkanka, Edem, Umuoyo, Ezema, Isiakpu, Umuakashi, Amukwa and Umuchim were characterized as sandy loam with pH range of 5.9 - 7.2

The least population of nematodes was found in Ezema soil with a neutral pH of 7.1. Also, relatively few nematode populations were identified in Ikejiani, Eni-njoku and Ukuta soils with slight acidic pH (5.9 - 6.5).

Ukuta had the least plant population per mat, and was the only soil classified as sandy clay loam with relatively few nematode populations (4.9%).

The Echara loamy sand haboured the highest population of nematode (12.3% of the total population) followed by Umuoyo and Iheagu representing 7.4% each. Edem had the highest plant population per mat, followed by Iheagu, Eni-njoku, Umuoyo and Ezema respectively. These communities had relatively high population of nematodes.

Discussion

In this study, the species of nematodes found to be prevalent in most of the farms in Nsukka metropolis is the *Meloidogyne spp.,* with the adult male, the stage four juveniles and the adult females, dominating in the nematodes found in sixteen locations. *Meloidogyne spp* are important species on plantain because of their contribution to the plant parasitic nematode population in the communities studied. Meloidogyne having a specialized sedentary endoparasitic feeding habit may not respond to different environmental factors (Rotimi, 1994). *R. similis* may not be a problem unless it has been recently introduced as revealed by its significance in the inoculated plants. This buttresses other reports (Speijer *et al*, 2001; Bridger, et al., 1995; Sarah 1987; Rotimi, 2003), that it is introduced through the use of infected planting materials. Mulch environment was found to be more conducive for R. similis (Rotimi, 2003). This author suggested that the manipulation of soil environment might be helpful in its control; however the mulch environment that supported the high population density of this species also supported optimum plant growth. In light of these, manipulating the cropping environment in the control of nematode species requires better and more systematic investigations.

Pratylenchus coffeae were also found. It was among the nematode species known to cause the most serious damage to Musa spp. (Sher & Allen, 1968). It has a very low population which may be due to the nature of the soil.

From the study, soil type played an important role in the population of the nematode with the highest population in Echara, which has a texture of loamy sand with particle sizes of 6% clay, 11% silt, 28% fine sand and 55% coarse sand. The soil pH in water is 7.2 which mean that it is slightly alkaline. This is to buttress the fact earlier stated that nematodes does not thrive well in acidic soil (Mbah, 2010), so the increase in the population of the nematode is clear indicative of the fact that the soil in Echara has the higher pH value. It also shows that the higher the plant population the higher the nematode population. Some area like Edem, Ezema, Umuakashi had high pH, but intermittently palm oil and ashes were thrown into the plant area thereby increasing both the pH and reducing it respectively. These areas were mulched and mulching increases plant vigor but provide a conducive environment for the nematodes to thrive.

Conclusion

A reliable soil analysis should be conducted before embarking on banana production because these nematodes which are soil borne pathogens have some conditions and features in the soil that make them survive. Finally nematode infestation is one of the major constraints in banana production. This infestation and other processes in the growth and development of a crop result to yield decline. Improved agronomic practices, including better soil management, in combination with improved genetic potential may combat this menace.

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TABLE 1: DISTRIBUTION OF NEMATODE SPECIES IN ROOT SAMPLES FROM SIXTEEN LOCATIONS.

Nematode spp/0.05ml aliquot	Number	Percent (%)
Meloidogyne spp. adult male	111.00	56.3
Meloidogyne spp. Juvenile stage	28.00	14.2
*Meloidogyne spp.*Mature female	9.00	4.6
Radopholus rerniformis	13.00	6.6
Radopholus similes	26.00	13.2
Pratylenchus coffeae	10.00	5.1
Total	197.00	100.0

TABLE 2: RELATIVE PREVALENCE OF NEMATODE SPECIES IN EACH LOCATION WITH THE EXISTING PLANT POPULATION

Nematode species/0.05ml aliquot					Plant population		
Location	**R. species**	**M. Species**	**Juvenile stage of M. species**	**P. coffeae**	**Banana**	**Cooking banana**	**Plantain**
IKEJIANI	1	1	-	-	1	-	4
ENI-NJOKU	-	1	1	-	-	-	5
UKUTA	-	1	1	-	1	1	3
UMUNKAKA	1	1	1	-	2	-	3
EDEM	-	1	1	-	1	1	3
UMUOYO	1	1	-	1	-	-	5
IHEAGU	1	2	-	-	1	-	4
EZEMA	1	1	-	-	-	-	5
ISIAKPU	1	1	-	1	1	-	4
NGURU	1	1	-	1	-	1	4
ECHARA	1	3	1	-	1	-	4
UMUAKASHI	1	1	-	-	-	-	5
AMUKWA	-	1	1	-	1	-	4
UMUCHIM	-	1	-	1	-	2	3
AMEZE	-	1	1	-	-	-	5
OWERENU	-	1.	1	-	3	-	2

TABLE 3: ESTIMATION OF POPULATION DYNAMICS OF THE NEMATODES PRESENT AT DIFFERENT SOIL PH, PARTICLE SIZES, CEC, AND TEXTURAL CLASSES.

	COMMUNITY	**TEXTURAL CLASS**	**PARTICLE SIZE (%)**				**pH**		**CEC Meq/ 100g**	**PLANT POPULATION per mat**	**NEMATODE POPULATION**	
			CLAY	**SILT**	**FINE SAND**	**COARSE SAND**	**H2O**	**KCL**			**PER 0.05ml aliquot**	**Percent of population**
	IKEJIANI	SL	12	13	30	45	5.9	5.1	25	12	2	4.9
	ENI-NJOKU	LS	6	9	33	52	6.4	5.7	17.2	16	2	4.9
UNN	UKUTA	SCL	22	13	31	34	6.5	5.7	20.4	4	2	4.9
	UMUNKAKA	SL	14	11	24	51	6.3	5.5	16	6	3	8.3
										25	2	5.4
	EDEM	SL	16	13	34	37	7.1	6	17.6			
NRU	UMUOYO	SL	12	13	28	47	6.5	5.8	16.4	16	3	7.4
	IHEAGU	LS	6	9	31	54	6.5	5.8	17.2	16	3	7.4
	EZEMA	SL	10	15	16	59	7.1	6.3	16.8	14	2	3.4
										8	3	6.9
	ISIAKPU	SL	10	11	28	51	6.4	5.6	18			
NKPUNANO	NGURU	LS	6	9	26	59	6.7	5.7	16.8	5	3	6.9
	ECHARA	LS	6	11	28	55	7.2	5.9	18	7	5	12.3
	UMUAKASHI	SL	10	11	25	54	7.2	6.1	17.2	9	2	4.9
										10	3	5.9
	AMUKWA	SL	12	13	14	61	6.9	6.3	18			
IHE/OWERE	UMUCHIM	SL	10	11	24	55	6.8	5.8	18.8	9	2	5.4
	AMEZE	LS	6	9	27	58	6.4	5.5	16.4	8	2	5.4
	OWERENU	LS	6	9	35	50	5.7	5	16.4	9	2	5.9
	Mean		**10.3**	**11.3**	**27.1**	**51.4**	**6.6**	**5.7**	**17.9**	**10.9**	**2**	

Where; SL = Sandy loam, LS = Loamy sand and SCL = Sandy clay loam