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PARASITIC NEMATODES OF MAIZE IN FARMS AT OBA, IDEMILI-SOUTH LOCAL GOVERNMENT AREA OF ANAMBRA STATE NIGERIA

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Abstract
Soil-inhabiting plant-parasitic nematodes of maize crops were investigated in maize farms in 9 communities at Oba, Idemili South Local Government Area of Anambra State Nigeria. About 59.2% of the maize farms were positive for parasitic nematodes. Farms at Urueze and Umueze recorded the highest with 11.1% each, followed by Umuogali, Okuzu and Aboji (7.4% each). The remaining 5 communities contributed 3.7% each of the total nematode collected. Percentage composition of nematodes from soil samples were *Pratylenchus* species (25.2%), *Helicotylenchus* species (24.0%), *Meloidogyne* species (20.3%), *Longidorus* species (19.0%), *Xiphinema* species (6.4%), and *Heterodera* species (5.1%). Similarly, those recovered from maize roots were *Pratylenchus* species (30.8%), *Meloidogyne* species (28.2%), *Heterodera* species (17.9%), *Helicotylenchus* species (12.8%), and *Longidorus* species (10.3%). *Xiphinema* species was not observed in maize roots. Current intensification of maize production by women in Oba may result to a rise in plant parasitic nematode (PPN) population in infested farmlands. The situation will be worsened by scarcity of farmland because of the prevailing land-tenure system where women, due to gender discrimination in land matters, are restricted to cultivating mixed crops only on small parcels of designated family land. Nematode damage is doubtless an important factor in quality reduction and yield loss in standing maize crops, and may impact heavily on the productivity and means of livelihood of the women farmers. Further study is required on the socio-economic importance of nematodes of maize and other food crops cultivated by women farmers in Oba in particular and Anambra State in general.
Keywords: Plant parasitic nematodes, maize, women farmers, livelihood patterns, Oba, Nigeria

Introduction
Plant parasitic nematodes are microscopic roundworms are widely distributed and persist as soil plant pest for indefinite period. Some species attach to the outside surface of plant roots piercing the root tissue to suck up the cellular content; other species pierce and penetrate the roots of plants, living and reproducing entirely within the root itself. Nematodes cause damage to roots, resulting in root systems which are less able to take up nutrients and water (Olabiyi *et al*., 2009). A relatively small numbers of important plant-parasitic nematode species are known to cause substantial economic damage in cropping systems around the world. The determination of tolerance limits or economic thresholds for plant-parasitic nematodes varies with many factors like species, plant tolerance, and soil type (Ugarte and Zaborski, 2012). All crops grown in Nigeria are prone to nematode attack, causing farmers' significant crop loss annually. Farmers are not always aware of losses being caused as a result of nematodes because they are hidden from sight and at times misconstrue to be loss from other pathogenic organism or certain environmental factors (Olabiyi *et al*., 2009).

Maize is a major cereal crop being cultivated in the rainforest and derived savannah zone of Nigeria. Nigeria produces about 8 million tons of maize annually. Maize thrives best in a warm climate and is now grown in most of the countries that have suitable climatic conditions (Olaniyi

and Adewale, 2012). This study is carried out because there have been a dearth of information on the nematodes affecting maize plants in Oba and thereby affecting the productivity and means of livelihood of women, whose major crop is maize, in the area. There are several species of nematodes or microscopic roundworms that can cause damage on maize. The groups of species most likely to cause damage to maize include: root-lesion nematodes (*Pratylenchus* spp.), root-knot nematodes (*Meloidogyne* spp.), needle nematodes (*Longidorus* spp.), sting nematodes (*Belonolaimus* spp.), stubby-root nematodes (*Paratrichodorus* spp.), Lance nematodes (*Hoplolaimus* spp.), spiral nematodes (*Helicotylenchus* spp.), cyst nematodes (*Heterodera* spp.) and dagger nematode (*Xiphinema americanum*) (Nicol *et al.*, 2011). The most important groups of plant parasitic nematodes demonstrated to be important limiting factors in maize production from all over the world are; the root knot nematodes, *Meloidogyne* species; the root lesion nematodes, *Pratylenchus* species; and the cyst nematodes, *Heterodera* species (McDonald and Nicol, 2005).Most of them have been recorded from roots and soil around maize roots with information on the biology or pathogenicity of many of these species not readily available. The effects of parasitic nematodes on production of grain maize have been studied.

The presence of nematode in the field depends on the soil type and its properties, other soil microorganisms, cropping history, climatic factors such as temperature and rainfall, tillage and the use of pesticides (Sweet and Wright, 2008). All plant-parasitic nematodes have piercing-sucking mouthparts called stylets, which they use to puncture the cell walls of fine roots and extract cellular contents. The needle and sting nematodes have particularly long stylets and feed only on cells that can be reached from outside the root; these nematodes are known collectively as ectoparasites. Other groups, including the root-lesion and root-knot nematodes, lay their eggs and also hatches the eggs into the juvenile stages in the soil before completely entering (J2) root tissue and move from cell to cell within the root as they feed; these nematodes are known as endoparasites (Ingham and Merrifield, 1996).

It is difficult to generalize about the symptom caused by nematodes because they vary with the nematode species, the number of nematodes present and the soil environmental factors. Damage can occur in any soil type, maize growing in well-drained soils, especially sandy soils, is most susceptible to damage. In poorly drained soil, nematode populations usually increase slowly or may even decline. The extent of nematode damage is often related to the growing conditions of the plant (Sweets and Wright, 2008). In maize, nematode problems are usually very difficult to detect because these pathogens usually cause uneven growth, without any clear above-ground symptoms. Uneven growth could be the result of several factors including other soil borne pathogens, poor drainage, soil compaction, and herbicide carry over; nematodes are rarely ever considered the cause of such problems. The levels of damage and yield loss depend on the type of nematode and the population level (Pierce *et al.*, 2009). According to Pierce *et al.*, 2009, it is rare to find a single type of nematode causing damage in any given maize field. Nematodes usually occur as a community comprised of different species and damage is usually the result of a nematode complex made up of several different types of nematodes. Nematodes cannot be eradicated from groves once they become established, so periodic management of populations may be required. According to Duncan *et al*., (2010), nematode control should be considered only after the results of soil and root sampling are available. These nematodes can be easily isolated from both soil and root samples for viewing and identification of the actual incriminating parasite(s); and this identification is essential for effective disease control (Rahman and Mian, 2010). The major aim of this study was to determine the type of soil-inhabiting parasitic nematode associated with maize in Oba, Idemili South Local Government Area (LGA) of Anambra State, Nigeria

Materials and Methods

***Study Area*:** Oba (6°4′N 6°50′E) in Idemili South Local Government Area (IDSLGA) of Anambra State, Nigeria. Oba is traversed by the Onitsha - Owerri Federal Highway, and is bounded by Ojoto

to the East, and Ichi to the South. The nine farming Communities that constitute Oba are Urueze, Umu-ogali, Isu, Okuzu, Umueze, Aboime, Ifite, Aboji and Ezele. Fertility of the soil supports the cropping of Yam, cocoyam, maize and vegetables, although many homesteads keep domestic livestock such as chickens, goats and sheep.

***Sampling Techniques for Nematodes of Maize*:** Three (3) farms each were randomly selected for sampling from the nine (9) villages in Oba. Hence a total of twenty-seven (27) farms sampled. Five (5) maize plants were randomly selected for sampling from each of the 27 farms. Soil samples from around the roots of maize plant were also collected, using a hand trowel, along the four cardinal directions at the base of each plant so as to obtain much of the rhizosphere as possible. Soil samples were collected to a depth of 15-30cm with hand trowel. Samples (soil and root) from each farm were pooled and sealed in polythene bags and protected from the sun. The samples were properly labeled and taken to the Parasitology Laboratory at Nnamdi Azikiwe University, Awka for further analysis and identification of plant parasitic nematodes.

***Sample Analysis*:** Plant parasitic nematodes were extracted from the soil using the Extraction Tray method. Each composite soil samples were mixed thoroughly, using a coarse sieve, debris and stones were removed by passing the soil through the sieve into a suitable container. A sub-sample was removed using a beaker of known volume measuring 200g of soil. The paper napkin was placed in a plastic sieve and then placed on a plastic plate. The base of the sieve was fully covered by the paper napkin, and then it was labeled. The 200g of soil measured was placed on the tissue in the sieve. A set volume of water was added to the extraction plates between the edge of the sieve and the side of the plate, ensuring that water was not poured onto the paper napkin or soil. The set up was left undisturbed in the dark for 24 hours. Following this method, nine extraction trays were set up representing each of the nine villages. Nematodes were expected to move from the soil through the paper napkin into the water below, resting on the plates. After the extraction period, excess water from the sieve and the soil was drained into the plate. The soil and the paper napkin were removed and disposed. Water from the plate was poured into a labeled beaker. During counting and identification, the volume of the water was reduced by gently pouring off through a very small aperture sieve.

***Root Samples*:** Maize roots were gently tapped in order to obtain the adherent soil. Roots were examined for gall formation. Using scissors, the roots were finely chopped and placed in a labeled dish. The chopped roots were thoroughly mixed together. A sub-sample was removed and weighed, 50g of root material was measured out using a measuring scales. The weighed sub-sample was placed on the paper napkin in the labeled sieve, placed on a plate. A set volume of water was added to the extraction plates and left for 24hrs.

***Identification of Nematodes*:** Identification of nematodes to genera level was according to Coyne *et al.*, (2007).

Results and Discussions

Plant parasitic nematodes recovered from the soil and roots sampled in maize farms at Oba were *Longidorus* spp., *Heterodera* spp., *Xiphinema* spp., *Helicotylenchus* spp., *Pratylenchus* spp., and *Meloidogyne* spp. Table 1 indicated that from the 27 farms sampled, 16 (59.2%) were positive for parasitic nematodes. Farms at Urueze and Umueze recorded the highest positive (11.1% each), followed by Umuogali, Okuzu and Aboji with 7.4% each. The other communities had 3.7% each.

Table 2 showed the composition and numbers of the nematodes encountered in soil samples as *Pratylenchus* species 20 (25.2%), *Helicotylenchus* species 19 (24.0%), *Meloidogyne* species 16 (20.3%), *Longidorus* species 15 (19.0%), *Xiphinema* species 5 (6.4%), and *Heterodera* species 4 (5.1%); while Table 3 indicated that the 39 nematodes recovered from root of maize sampled were

in the order *Pratylenchus* species 12 (30.8%), *Meloidogyne* species 11 (28.2%), *Heterodera* species 7 (17.9%), *Helicotylenchus s*pecies 5 (12.8%), and *Longidorus* species 4 (10.3%). *Xiphinema* species was not encountered in maize roots. The overall distribution of plant nematodes in soil and root of maize sampled in Oba is shown in Table 4.

Table 1: Overall prevalence of nematodes in soil from farms in communities sampled in Oba

Site		Samples examined		Positive Samples		Negative Samples	
		No.	%	No.	%	No.	%
1	Urueze	3	11.1	3	11.1	0	0.0
2	Umu-ogali	3	11.1	2	7.4	1	3.7
3	Isu	3	11.1	1	3.7	2	7.4
4	Okuzu	3	11.1	2	7.4	1	3.7
5	Umueze	3	11.1	3	11.1	0	0.0
6	Aboime	3	11.1	1	3.7	2	7.4
7	Ifite	3	11.1	1	3.7	2	7.4
8	Aboji	3	11.1	2	7.4	1	3.7
9	Ezele	3	11.1	1	3.7	2	7.4
	Total	**27**	**99.9**	**16**	**59.2**	**11**	**40.7**

Table 2: Percentage composition of nematodes in soils from farms in communities sampled in Oba

Site	Total		*Practy.*		*Longid.*		*Helico.*		*Xiphi.*		*Meloid.*		*Hetero.*	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1	14	17.7	3	3.8	2	2.5	4	5.0	1	1.3	3	3.8	1	1.3
2	15	19.0	4	5.0	2	2.5	2	2.5	2	2.5	3	3.8	2	2.5
3	9	11.4	2	2.5	1	1.3	3	3.8	0	0.0	3	3.8	0	0.0
4	13	16.5	7	8.8	1	1.3	3	3.8	0	0.0	2	2.5	0	0.0
5	9	11.4	2	2.5	3	3.8	2	2.5	1	1.3	1	1.3	0	0.0
6	5	6.4	0	0.0	2	2.5	1	1.3	0	0.0	2	2.5	0	0.0
7	7	8.8	1	1.3	2	2.5	3	3.8	0	0.0	1	1.3	0	0.0
8	3	3.8	0	0.0	1	1.3	1	1.3	1	1.3	0	0.0	0	0.0
9	4	5.0	1	1.3	1	1.3	0	0.0	0	0.0	1	1.3	1	1.3
Total	**79**	**100.0**	**20**	**25.2**	**15**	**19.0**	**19**	**24.0**	**5**	**6.4**	**16**	**20.3**	**4**	**5.1**

Table 3: Percentage composition of nematodes in roots of maize in communities sampled in Oba

Site	Nematodes											
	Total		*Praty.* spp.		*Heter.* spp.		*Meloid.* spp.		*Longi.* spp.		*Helico.* spp.	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1	5	12.82	2	5.13	1	2.56	2	5.13	0	0.00	0	0.00
2	4	10.25	1	2.56	1	2.56	2	5.13	0	0.00	0	0.00
3	5	12.82	1	2.56	2	5.13	0	0.00	1	2.56	1	2.56
4	6	15.30	3	7.70	0	0.00	1	2.56	0	0.00	2	5.13
5	3	7.70	0	0.00	1	2.56	0	0.00	0	0.00	2	5.13
6	5	12.82	1	2.56	1	2.56	3	7.70	0	0.00	0	0.00
7	4	10.25	3	7.70	0	0.00	1	2.56	0	0.00	0	0.00
8	3	7.70	0	0.00	0	0.00	2	5.13	1	2.56	0	0.00
9	4	10.25	1	2.56	1	2.56	0	0.00	2	5.13	0	0.00
Total	**39**	**100.00**	**12**	**30.80**	**7**	**17.90**	**11**	**28.20**	**4**	**10.30**	**5**	**12.80**

Table 4: Overall distribution of nematodes in soil and root of maize plant sampled in Oba

Sample	Genera of plant nematode												Total	
	Practy. spp.		*Helico.* spp.		*Meloid.* spp		*Longi.* spp		*Xiphi.* spp		*Hetero.* spp			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Soil	20	16.9	19	16.1	16	13.6	15	12.7	5	4.2	4	3.4	79	66.9
Maize Root	12	10.2	5	4.2	11	9.3	4	3.4	0	0.0	7	5.9	39	33.1
Total	**32**	**27.1**	**24**	**20.3**	**27**	**22.9**	**19**	**16.1**	**5**	**4.2**	**11**	**9.3**	**118**	**100**

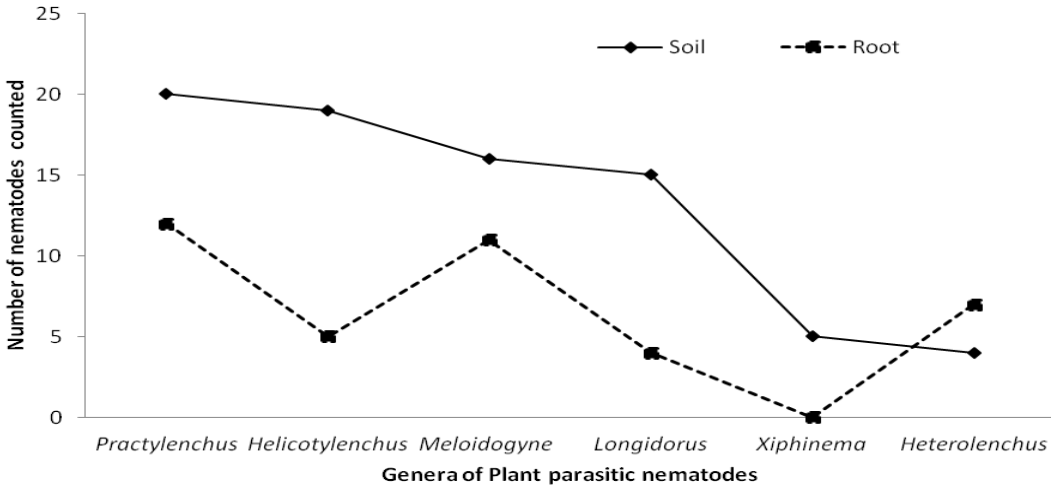

Figure 1: Comparison of the numbers ofplant parasitic nematodes recovered from soil and roots of maize plants in farms sampled in Oba

Figure 1 showed clearly that with the exception of *Heterolenchus* spp., more of the nematodes were recovered from the soil than in the roots of maize plants. However the presence of six species of parasitic nematodes within the roots was an indication that maize plants in Oba are subjected to nematode attack. The intensification of agriculture has led to continuous change and lack of stability in the ecosystem, making conditions favourable for certain species of plant parasitic nematodes while exerting immense selection pressure upon others. From the nine villages sampled in Oba, nematodes are most prevalent in Urueze and Umueze, more prevalent in Umu-ogali, Okuzu, and Aboji and least prevalent in nematode include; Isu, Aboime, Ifite and Ezele. The reason for the number of positive samples encountered in these areas could be because of the use of fertilizers by the farmers to enhance growth of their crops thereby leading to development of the natural enemies of the nematodes which leads to the killing of these nematodes. These corroborate with the findings of Abawi and Moktan, (2010) and Mohamed *et al*., (2011), which is that chemicals or organic matters reduces nematode population.

The presence of different genera of nematodes is in line with the findings of Pierce *et al.*, 2009, who reported that Nematodes usually occur as a community comprised of different species and damage is usually the result of a nematode complex made up of several different types of nematodes. *Pratylenchus* and *Meloidogyne* species are endoparasites but were encountered more in the soil than in root, perhaps due to the fact that part of their life stages (juvenile stage) are found in the soil (Ingham and Merrifield, 1996). *Heterodera* spp. which is an endoparasite is found more in the root than in the soil. *Longidorus* spp., *Helicotylenchus* spp. and *Xiphinema* spp. are found more in the soil than in the root because they are ectoparasite of maize plants but feeds on the roots of maize from the soil (Ingham and Merrifield, 1996). From this study, the relatively low number of nematodes encountered in both soil and root samples could be as a result of the soil texture, the use of domestic organic matters in the farm (Talwana *et al*., 2008, Mohamed *et al*., 2011). With the current intensification of maize production by women, as observed in Oba, there is potential danger that a rise in plant parasitic nematode (PPN) population could occur in infested plots which are cultivated with maize continuously.

Conclusion and Recommendations

Maize are vulnerable to nematode damage as they reduce the yield and quality as a result of root gallings, root lesions, dry and soft rots of the seeds depending on the type of plant parasitic nematodes present. Plant-parasitic nematodes damage is an important factor in quality reduction and yield loss in maize in the field, and may impact heavily on the productivity and means of livelihood of the women farmers who engage in maize cultivation. The presence of plant parasitic nematodes could constitute serious impediments to the growth and yield of maize in Oba. Further

study is required on the socio-economic importance of nematodes associated with maize and other food crops cultivated by women farmers in Oba.

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