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Impact of Gateway Organic Fertilizer on Herbivorous and Non-Parasitic Nematodes Associated with *Telfairia Occidentalis* Hook F. Field

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Abstract

Although fluted pumpkin (Telfairia occidentalis Hook F.) is cherished because of its nutritional, medicinal and industrial values, its profitable production and sustainability in agro-ecosystems is threatened by plant-parasitic nematodes. This study, therefore, tested the hypothesis that Gateway organic fertilizer can effectively suppress herbivorous nematodes while increasing the non-parasitic types. Gateway organic fertilizer (GOF) is one of the series of novel commercial fertilizers being utilized by organic farmers in South-Western Nigeria. In this assessment, GOF was applied at the recommended rate of 5 tha^{-1}. Application of 0 tha^{-1} served as control. Treatments were laid out in randomized complete block design and replicated four times. Nematode identification, census and population analysis were conducted following extraction from soil collected from the field. Six cores were randomly taken per plot at 0-30 cm, bulked to obtain homogenous composite sample out of which 250 g sub sample for nematode extraction. The procedure was repeated once every month for three successive months. It was evident from the results that six (6) genera of herbivorous (plant-parasitic) nematodeswere found associated with the fluted pumpkin, namely Rotylenchulus, Helicotylenchus, Hoplolaimus, Pratylenchus, Caloosiaand Meloidogyne. Total riddance (100%) was observed in GOF-treated plots ($P \leq 0.05$) compared to the control on herbivorous nematodes except for Helicotylenchus (100-36%). On the contrary the non-parasitic nematodes increased significantly ($P \leq 0.05$)in the treated plots (from 0 to 10 and to 81). This work demonstrated that GOF caused fewer parasitic and greater populations of beneficial nematodes in fluted pumpkin.

Introduction

Fluted pumpkin, scientifically known as *Telfairia occidentalis* Hook F. is one of the most important vegetables grown in Southeastern part of Nigeria, but now becoming popular in other parts of the country (Ndor and Dauda, 2013). It is a crop of commercial importance. Nigeria, Ghana and Serra Leone are the major producers of fluted pumpkin (Ononuju, Ekeoma, Orikara, and Ikwunagu, 2015). It is generally regarded as a leaf and seed vegetable. Tindall (1986) reported that fluted pumpkin is known for its high nutritional, medicinal andindustrial values, it has 29% protein, 18% fat and 20% minerals and vitamins. Apart from the leaf of fluted pumpkin, the seed is also an economic part which can be consumed by cookingor roasting or grounded and added as condiment to soup (Badifu and Ogunsua, 1991). Oil extracted from pumpkin seed can be used in industrial soap making and in cooking (Fashina *et al*., 2002). Precedent, fluted pumpkin had gained medicinal recognition, it has been discovered to be blood purifiers and could therefore be useful in maintaining good health (Aletor *et al.*, 2002).

Telfairia occidentalis is highly susceptible to nematodes, most especially to the root-knot nematodes, which cause reduction in the yield of fluted pumpkin as a result of conspicuous gall that affect water and nutrient uptake (Mai and Lyon, 1975; Ononuju *et al*., 2015). Organic fertilizers increase

the yield and quality of crops as well as the soil properties. Al-Rehiayani (2001) stated that plants grown on less organic matter soil are prone severe nematode disease compare to plants grown on high organic matter soil. Therefore, organic crop production system must put in place a sound nematode control program.

The objective of this study, therefore, was to determine the effect of gateway organic fertilizer on herbivorous and non-parasitic nematodes in fluted pumpkin field.

Materials and Methods

Experimental location

Soil samples were collected on an established fluted pumpkin field set-up on organic agriculture skills demonstration plot of the Federal University of Agriculture Abeokuta (FUNAAB) between October and December, 2014. This site falls within forest-transition savannah ecological zone.

Experimental design and plot layout

The design used for the experiment was Randomized Complete Block Design (RCBD). The study was carried out an established fluted pumpkin plot aged 14 weeks fertilized with Gateway organic fertilizer at 5 tons ha-1 or 0 ton ha-1 which serves as the control and replicated fourtimes. The total land area for the experiment was 97.75 m^2. The experimental field consisted of 8 experimental units, each measuring 5 m x 1.5 m with a walkway of 0.5 m.

Sampling for nematode assay

Soil samples for nematode assay were collected in random sampling pattern from the fluted pumpkin plots around the rhizosphere early in the morning. Six core soil samples were collected per plot randomly at depth 0 – 30 cm and 2 – 4 cm away from the plant root in order not to destroy the root system, with the aid of a soil auger to form a composite soil sample. The soil samples were sealed in polythene bags, properly labeled and transported to Crop Protection Laboratory in FUNNAB for nematode extraction and identification.

Extraction of nematodes from soil

Each composite soil sample collected per plot was thoroughly mixed to form a homogeneous soil sample and 250 g sub-soil was taken for nematode assay using Whitehead and Hemming (1965) nematode extraction technique. Double-ply nematode extractor tissue paper was sandwiched between two plastic sieves of 15 cm inside diameter. Sieves were placed in a 25 cm inside diameter bowl, in which each 250 g of homogeneous soil was measured and spread evenly in the sieve, labeled and arranged carefully in the laboratory. Debris and pebbles were removed and soil lumps were carefully broken in order to allow free swimming of the nematodes out from the soil to water. Two hundred and fifty millimeter (250 ml) of water was gently poured to the extraction bowl and the set up was left undisturbed for 24 h. Thereafter, the plastic sieve containing the soil was removed briskly, allowed the last water to drop and the nematode suspension in the bowl was decanted into a 500 ml Nalgene wash bottle and topped up with water to factory-calibrated point and left undisturbed in the laboratory for 5 hrs to ensure that most nematodes settled down to the bottom. The supernatant was siphoned out with the aid of 3 mm inside diameter siphoning tube, the suspension containing nematodes was poured into McCartney bottle and immediately refrigerated at 15^{o}C. Nematode suspension was quantified using Doncaster (1962) ringed nematode counting dish and examined under stereo and compound microscope.

Nematode assay and identification

Nematodes in the suspension poured into McCartney bottle were picked one after the other under the stereomicroscope after counting with the aid of stereomicroscope and placed on a glass slide covered with a cover slip, the nematodes were identified with the aid of compound microscope using the simplified nematode pictorial key of Mai and Lyon (1975).

Data collection and analysis

Soil sample collected each month were assayed for nematode presence, types and number of nematodes. Data collected on the number of nematodes were transformed to reduction percentage (Puntener, 1981).

Results

Six genera of herbivorous nematodes; namely *Rotylenchus, Helicotylenchus, Hoplolaimus, Pratylenchus, Caloosia* and *Meloidogyne* belonging to the order *Tylenchida* were found associated with *T. occidentalis* in Abeokuta, Ogun State between October and December 2014 (Table 1). The six genera belong to five different families which include *Nacobbidae, Hoplolaimidae, Hoplolaimidae, Pratylenchidae, Hemicycliophoridae and Meloidogynidae. Population of herbivorous nematodes encountered on T. occidentalis field was suppressed* ($P<0.05$) by 100% except for *Helicotylenchus* which was suppressed ($P<0.05$) from 36 - 100% on plots with 5tha^{-1} GOF. Non-parasitic nematodes were suppressed by 10 – 81% between November and December.

Table 1. **Taxonomy of herbivorous nematodes found on *Telfairia occidentalis* field within October and December 2014 in Abeokuta, Ogun State**

Genera	Family	Order
Rotylenchus	*Nacobbidae*	*Tylenchida*
Helicotylenchus	*Hoplolaimidae*	*Tylenchida*
Hoplolaimus	*Hoplolaimidae*	*Tylenchida*
Pratylenchus	*Pratylenchidae*	*Tylenchida*
Caloosia	*Hemicycliophoridae*	*Tylenchida*
Meloidogyne	*Meloidogynidae*	*Tylenchida*

Table 2. **Reduction percentage of herbivorous and non-parasitic nematodes found on** *Telfairia occidentalis* **field in October 2014 at Abeokuta, Ogun State**

TRT	ROT (%)	HEL (%)	HOP (%)	PRA (%)	CAL (%)	MEL (%)	NPN (%)
				October			
0 tha^{-1}	0	0	0	0	0	0	0
5 tha^{-1}	0	36	0	100	100	100	0
				November			
0 tha^{-1}	0	0	0	0	0	0	0
5 tha^{-1}	100	100	100	100	100	100	81
				December			
0 tha^{-1}	0	0	0	0	0	0	0
5 tha^{-1}	100	64	100	100	100	100	10

KEY: TRT - Treatment, ROT - *Rotylenchus,* HEL - *Helicotylenchus, HOP – Hoplolaimus,*PRA - *Pratylenchus, CAL - Calosia,* MEL – *Meloidogyne,* % - Percentage, NPN - Non-parasitic nematodes

Discussion

There are countless of research on nematode control using organic based fertilizer and organic soil amendment, this study also added additional information to the existing knowledge on the control of hidden enemy of farmers using Gateway organic fertilizer. This work showed that Gateway organic fertilizer had effect on the herbivorous nematodes population in the soil by reducing their numbers and thereby increased the non-parasitic nematodes population in the soil, which has been proven in the past that organic fertilizer reduced the plant-parasitic nematodes population in the soil (Atungwu *et al.*, 2010). Singh and Sitaramaiah (1970) documented that reduction in plant-parasitic nematodes population may be as a result of toxic by-product of decomposed organic amendment or biological antagonist stimulated by organic amendments.

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