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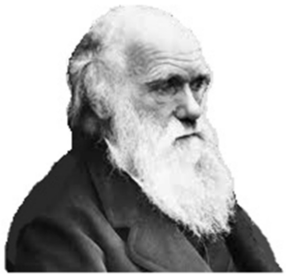

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Field evaluation of insect pests and pathogens associated with Sesame cultivated in the Niger Delta of Nigeria

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ABSTRACT

Field evaluation of insect pests and pathogens associated with sesame cultivated in the Niger Delta region of Nigeria was conducted to provide baseline information on their status. The experiment was laid out in Randomized Complete Block Design. Herein, sesame seeds were obtained from the Jos and Maiduguri main markets. These were sown, then data were collected on insect species beginning three weeks after sowing (WAS) for six weeks and identified to species levels. At 10 WAS, plant parasitic nematodes (PPNs) were extracted from both root and soil samples in the rhizosphere of sesame, using the modified Baermann method. Plant parasitic nematodes were identified to generic level. Infected plant parts from field were thoroughly washed, disinfected and plated on PDA, and subsequently incubated at 25 ± 2 °C. Fungal pathogens were isolated, identified and checked for their viability and purity. Data obtained were subjected to both parametric and none parametric analyses. Insect species collected included *Leptaulaca fissicolis, Gryllus bimaculatus, Apogonia nitidula, Trilophida conturbata, Elis* sp. amongst others. A total of six genera of PPNs, *Helicotylenchus, Pratylenchus, Scutellonema, Gracilacus, Meloidogyne and Tylenchus* were associated with Sesame. *Gracilacus* and *Pratylenchus* had the highest population in soil (37.5%) and roots (37.5%). Three fungal isolates, namely, *Fusarium oxysporum, Fusarium solani* and *Trichoderma* sp, were consistently isolated from the plant parts - with *Fusarium oxysporum* and *Fusarium solani* being pathogenic. Knowledge of these insect pests and pathogens will aid in their management.

***Keywords*:** Jos, Maiduguri, PDA, Plant-parasitic-nematodes, Rhizosphere, Insect species, Fungal isolates

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1. INTRODUCTION

Sesame, *Sesamum indicum* (Lamiales Pedaliaceae) is known as the queen of vegetable oils and a source of nutritious food to man [1] and feed to livestock [2]. It is cultivated as an annual crop with origin traced to Africa [3] and considered by many as one of the oldest source of plant oil [4]. Sesame is also used as both soup thickener and condiment in tropical Africa. Sesame has nutritional values of 44–57% oil, 18–25% protein, 13–14% carbohydrates and it is also of high medicinal values [5]. Other reports revealed other benefits of Sesame as being source of copper and manganese, calcium, magnesium, iron, phosphorus, vitamin B1, zinc, molybdenum, selenium, and dietary fibre [6]. *Sesamum indicum* is also used in manufacture of sesame bars, production of desserts and bakery products [7] with high degree of stability and resistance to rancidity [8].

Sesame is a robust crop that needs little farming support because of its ability to grow in either drought conditions or when rains are in excessive. It has high tolerance to heat, with best yields in a properly fertilized farm [9]. It thrives better in the tropics with high temperatures and can best be described as a survivor crop [10]. Sesame prefers well-drained, fertile soils of medium texture and neutral pH with moderate salt tolerance [11]. It is a deep-rooted crop that is capable of scavenging nutrients beyond the reach of most crop root zones [10] and depending upon the cultivar, the crop matures in 75–150 days after sowing [12].

Sesame cultivation has great prospects in Africa and the world at large for it currently accounts for 90% of the value of oil seeds exports in countries such as Ethiopia amongst others [13]. However, its maximum production is threatened by both, biotic and abiotic factors. Among the biotic stress factors of sesame are insects. Insect pests are responsible for quantitative and qualitative yield reduction in sesame with some insects reported to be agents responsible for transmitting diseases [14]. Quantitative damage due to insect pests' infestation in sesame was reported to be between 5-50% of the total sesame production in Africa [14]. Globally, yield loss in sesame due to insect pest infestation was reported to be 25% with most of the injury inflicted during flowering stage [15]. Also, damage due to the insect infestation on sesame at vegetative stage was reported to be 15-20% and 10-15% at the productive stage [14]. Muzaffar *et al.* [14] also stated that *Thrips tabaci* damages seedling at germination while *Bemisia tabaci* reduces the leaf area and sesame photosynthetic ability leading to poor seed formation and overall yield loss. El-Gindy [18] reported piercing and sucking insects as of great economic importance in sesame production.

Also, plant parasitic nematodes have been reported as one of the banes in sesame production worldwide [17-18]. They are responsible for poor yield in quantity and quality. Notable among these plant-parasitic nematode genera associated with sesame are *Helicotylechus*, *Paratylenchus*, *Tylenchorhynchus*, *Tylenchus*, *Meloidogyne*, *Aphelenchus*, amongst others [17-18]. However, these nematodes vary over time and space and needed to be identified at definite location and time for them to be effectively managed.

Nigeria is one of the countries facing the food insecurity and if left unchecked might become acute because of population growth which is at geometric progression, whereas food production and its availability are at arithmetic progression. Also, the threat to agriculture due to oil exploration and activities together with the advent of global warming poses a threat to crop production especially in the Niger Delta Region of Nigeria. Therefore, more hardy crops need to be introduced and cultivated in the region to help bridge the gap of food shortage. The usefulness of a crop like sesame cannot be overemphasized.

Its favorable cultivation could lead to the food security in the region, especially when likely pests of sesame are known and management strategies are devised before its large scale production. However, there is dearth of information on insect pests and pathogens of sesame in the Niger Delta since it is just being newly introduced. Therefore, the work was carried out to provide baseline information about the pests and pathogens associated with sesame in the Niger delta region prior to its introduction for large scale production in the region.

2. MATERIALS AND METHODS

2. 1. Study Area

The study was carried out at the University of Port Harcourt, Faculty of Agriculture Teaching and Research Farm of the Department of Crop and Soil Science, located at coordinates 4° 52' 30" and 4° 55' 00" N, 6° 54' 40" and 6° 55' 49" E [19]. Sesame seeds were obtained from Jos and Maiduguri main markets located at 11° 85' N and 13°16' E and 9° 56' N and 8° 53' E, respectively, which were later labelled as Jos and Maiduguri locals, respectively**.**

2. 2. Experimental Design and Field Layout

The experiment was laid out in randomized complete block design. The land was cleared and top soil levelled and mapped to a plot size of 4 m × 6.5 m divided into three blocks with five sub-plots per block. A spacing of 0.5 m between subplot and 1m between blocks was adopted. Seeds of Jos local and Maiduguri local sesame accessions were sown each at a spacing of 0.5 m × 0.25 m using a rate of four seeds per hole at a depth of 2 cm. The two varieties were sown parallel at a distance of 0.5 m apart. Agronomic practices included thinning and supplying carried out at two weeks after sowing (WAS), while hand weeding was done at 3 and 6 WAS.

2. 3. Data Collection

2. 3. 1. Insect Collection and Identification

Any insects found on sesame within the research plots from three weeks after sowing (WAS) for six weeks were visually counted using tally counter. Insect samples were handpicked for proper identification to species level. Collection was done early in the morning when insects were still at rest. The samples were kept in a vial containing 75% ethanol. The insects were placed in different sample bottles and sent to Entomological Unit of Ahmadu Bello University, Zaria for identification.

2. 3. 2. Collection of Samples, Extraction and Identification of Plant-parasitic Nematodes

At termination of experiment (10 WAS), four plants per subplot were randomly selected for each of Maiduguri and Jos local varieties. Fresh roots from each plant as well as soil samples from the rhizosphere of each plant were collected using hand trowel. The soil and root samples collected were bulked separately to give composite samples.

A total of 10 composite samples of soil and roots were collected each for Maiduguri and Jos local. Each composite soil sample per variety was thoroughly mixed and 200 mL soil sub-sample was collected using a graduated beaker for nematode extraction. Plant-parasitic nematodes were extracted from the soil sample using the modified Baermann method [20].

The 200 mL soil sample was poured on a facial tissue and placed on a plastic sieve and water was added by the side of the plastic sieve placed on an extraction tray. The set-up was left for 48 hours after which nematode suspension collected on the tray were poured into a well labelled beaker.

Each composite root samples were thoroughly rinsed with water to dislodge dirt and soil particles. Roots were chopped into 1-2 cm length and mixed together. The modified Baermann method [20] was adopted for extraction of plant-parasitic nematodes. For the root samples, 8 g of chopped roots was weighed and then poured on the facial tissue in a plastic sieve. Water was added by the side of the plastic sieve placed on the extraction tray. The extraction set-up for both the soil and root samples was allowed to stay for 48 hours and the nematode suspension collected in the tray was poured into a labeled beaker. The suspension was allowed to settle for 24 hrs after which the nematode suspension was decanted into sample bottles which were later sent to International Institute for Tropical Agriculture (IITA), Ibadan for identification and quantification of plant-parasitic nematodes.

2. 3. 3. Fungal isolation and identification

Infected plant materials (leaf, stem and root) from field were brought to the laboratory, cut into 5 mm pieces and surface sterilized with 1.0% sodium hypochlorite (NaOCl) solution for five minutes and rinsed thrice in sterile water.

The pieces were dried with sterile filter paper and plated (three pieces of different plant parts per plate) on fresh potato dextrose agar (PDA) medium impregnated with streptomycin at 0.5 g per litre and incubated at 25 ±2 °C with alternating circles of 12 h light and 12 h darkness for seven days. Sub-cultures were made from emerging colonies repeatedly until pure cultures were obtained. The fungal isolates were viewed under the microscope and identified using Illustrated Genera of Imperfect Fungi by Barnett and Hunter [21].

The isolates were further checked for their viability and purity using standard biochemical test as described by Cheebrough [22]. Pathogenicity of the fungi species was confirmed by inoculating 2-week-old seedlings of both Jos and Maiduguri locals with each of the fungi species. Plant segments excised from plant parts were surface sterilized and plated on PDA media and incubated at 25 ±2 °C. Observations were made on symptom development.

2. 4. Data Analysis

Descriptive statistics (%frequency and mean) were used to present information on insect population dynamics, occurrence and abundance of plant-parasitic nematodes. Frequencies of occurrence of plant-parasitic nematodes in the samples collected were also determined using the formula stated by Norton [23]:

$$\text{Absolute frequency} = \frac{No.of\ samples\ containing\ a\ species}{No.of\ samples\ collected} \times 100\%$$

$$\text{Relative frequency} = \frac{Frequency\ of\ occurrence\ of\ a\ species}{Sum\ of\ frequency\ of\ all\ species} \times 100\%$$

3. RESULTS

3. 1. Insect Abundance and Species Collected from Sesame Accessions

Insect species collected included *Leptaulaca fissicolis*, *Gryllus bimaculatus*, *Apogonia nitidula*, *Trilophida conturbata*, *Elis* sp. amongst others (**Table 1**). Insect species such as *L. fissicolis*, *Homeoxipha thoracica* and *Megachile mephistophelica* appeared from the first week of collection till the end of the collection while species such as *Durmia* sp, *Anthidium* sp, *Cheilomenes sulphurea* and *Metarctia flaiciliata* appeared only in at the late stage of growth of the crop. *Elis* sp., *C. sulphurea* and *M. flaviciliata* appeared in the third and fourth week of the plants growth. *Elis* sp. was the dominant insect with its peak of abundance in the 5th week of collection (Table 1).

Table 1. Insects dynamics collected weekly for six weeks in sesame plants cultivated in University of Port Harcourt, Choba, Rivers State.

Insect species	**Frequency of insect population dynamics**						
	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	**Total**
	Pre flowering pests			Post flowering pests			
Leptaulaca fissicolis	2	3	5	7	2	2	21
Homeoxipha thoracica	1	4	3	5	4	4	21
Megachile mephistophelica	5	9	2	4	9	6	35
Cheilomenes sulphurea	-	-	1	2	5	-	8
Metarctia flaviciliata	-	-	1	2	-	-	3
Acraea anacreon	4	2	5	9	7	5	32
Apogonia nitidula	1	3	2	2	3	2	13
Zonocerus variegates	-	-	1	3	4	6	14
Cyclopelta dorsalis	-	2	3	7	3	2	17
Catantopsilus taeniolatus	2	3	3	5	3	3	19
Gryllus bimaculatus	2	1	2	2	-	1	8

Homeocerus pallens	4	6	3	3	8	2	26
Anthidium sp.	4	1	2	2	-	-	9
Trilophida conturbata	5	7	6	4	3	5	30
Aspavia sp.	-	-	2	3	-	-	5
Elis sp.	-	-	7	22	43	15	87
Durmia sp.	-	3	4	2	-	-	9
Total	**30**	**44**	**52**	**84**	**94**	**53**	**357**

Insect species	**Frequency in percentage of insect population dynamics**						
	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	**Total**
	Pre flowering pests			Post flowering pests			
Leptaulaca fissicolis	9.52	14.29	23.81	33.33	9.52	9.52	99.99
Homeoxipha thoracica	4.76	19.05	14.29	23.81	19.05	19.05	100.01
Megachile mephistophelica	14.29	25.71	5.71	11.43	25.71	17.14	99.99
Cheilomenes sulphurea	0.00	0.00	12.50	25.00	62.50	0.00	100.00
Metarctia flaviciliata	0.00	0.00	33.33	66.67	0.00	0.00	100.00
Acraea anacreon	12.50	6.25	15.63	28.13	21.88	15.63	100.02
Apogonia nitidula	7.69	23.08	15.38	15.38	23.08	15.38	99.99
Zonocerus variegates	0.00	0.00	7.14	21.43	28.57	42.86	100.00
Cyclopelta dorsalis	0.00	11.76	17.65	41.18	17.65	11.76	100.00
Catantopsilus taeniolatus	10.53	15.79	15.79	26.32	15.79	15.79	100.01
Gryllus bimaculatus	25.00	12.5	25.00	25.00	0.00	12.5	100.00

Homeocerus pallens	15.38	23.08	11.54	11.54	30.77	7.69	100
Anthidium sp.	44.44	11.11	22.22	22.22	0.00	0.00	99.99
Trilophida conturbata	16.67	23.33	20.00	13.33	10.00	16.67	100
Aspavia sp.	0.00	0.00	40.00	60.00	0.00	0.00	100
Elis sp.	0.00	0.00	8.05	25.29	49.43	17.24	100.01
Durmia sp.	0.00	33.33	44.44	22.22	0.00	0.00	99.99
Total	**8.40**	**12.32**	**14.57**	**23.53**	**26.33**	**14.85**	**100**

3. 2. Sesame Insect Taxonomic Classification and their Pest Status

Table 2 shows that insects' spectrum on sesame in the study area belong to the order Orthoptera, Hemiptera, Hymenoptera, Heterocera, Coleoptera and Rhopalocera. These insects belong to the families of Pyrgomorphidae, Coreidae, Gryllidae, Acrididae, Coccinellidae, Scarabaeidae, Acraeidae, Apidae, Pentatomidae, Syntondae, Chrysomelidae, Tridactylidae, Pompilidae. Only one insect was reported to be a predator; while the rest have pest status.

Table 2. Insect classification and their potential pest status collected on sesame plants cultivated in the University of Port Harcourt, Choba, Rivers State.

Order	Family	Scientific name	Pest status
Orthoptera	Pyrgomorphidae	*Zonocerus variegates*	Pest
Hemiptera	Coreidae	*Homeocerus pallens*	Pest
Orthoptera	Gryllidae	*Grylles bimaculatus*	Pest
Orthoptera	Acrididae	*Catantopsilus taeniolatus*	Pest
Orthoptera	Acrididae	*Trilophida conturbata*	Pest
Coleoptera	Coccinellidae	*Cheilomenes sulphurea*	Predator
Coleoptera	Scarabaeidae	*Apogonia nitidula*	Pest

Hymenoptera	Apidae	*Megachila mephistophelica*	Pest
Hemiptera	Pentatomidae	*Cyclopelta dorsalis*	Pest
Rhopalocera	Acraeidae	*Acraea Anacreon*	Pest
Hymenoptera	Apidae	*Anthidium* spp	Pest
Heterocera	Syntondae	*Metarctia flaviciliata*	Pest
Hemiptera	Pentatomidae	*Aspavia* spp	Pest
Coleoptera	Chrysomelidae	*Leptaulaca fissicollis*	Pest
Hymenoptera	Pompilidae	*Elis* spp	Pest
Orthopera	Tridactylidae	*Homoeoxipha thoracica*	Pest
Hemiptera	Pentatomidae	*Durmia* spp	Pest

3. 3. Plant-parasitic Nematodes of Sesame Accessions

In the soil samples of Maiduguri local accession, the most frequently occurring plant-parasitic nematode (PPN) was *Helicotylenchus* spp. with frequency of occurrence (FOC) of 37.5% and followed by *Pratylenchus* spp. (FOC 25.0%) (**Table 3**). However, *Gracilacus* spp., *Scutellonema* spp. and *Meloidogyne* spp. recorded the same FOC of 12.5%. In the root samples, both *Pratylenchus* spp. and *Scutellonema* spp. recorded same FOC of 50% and *Helicotylenchus* spp., *Meloidogyne* spp., *Gracilacus* spp. were not found (Table 3). In soil samples collected in the rhizosphere of sesame (Jos local accession), *Helicotylenchus* spp. With FOC of 33.3%, the most frequently occurring plant-parasitic nematode, whereas, *Meloidogyne* spp., *Pratylenchus* spp., *Tylenchus* spp. and *Gracilacus* spp. recorded the same FOC of 16.7%. No PPNs was found in the roots of Jos local accession of sesame.

Gracilacus species had the highest population of plant-parasitic nematodes associated with Maiduguri local accession, which translated to 36.3% of the total population of plant-parasitic nematodes in the soil (**Table 4**). *Helicotylenchus* spp. and *Pratylenchus* spp. had population of plant-parasitic nematodes of 30/200 mL in soil and 20/200 mL in soil, respectively; and their population densities translated to 27.3 and 18.2%, respectively. *Meloidogyne* spp. and *Scutellonema* spp. had the lowest and equal population of 10/200 mL in soil with a percentage population of 9.1% among plant-parasitic nematodes in soil of Maiduguri local accession of Sesame. In the roots of Maiduguri local, *Pratylenchus* spp. had the highest population of plant-parasitic nematodes which translated to 75% of the total population of plant-parasitic nematodes.

Table 3. Occurrence of plant-parasitic nematodes in soil and roots of Sesame, Maiduguri and Jos accessions cultivated in Choba, Rivers State.

Nematode Genera	Sesame Accession	Medium	Sample containing species	Absolute Frequency	Relative Frequency
	Maiduguri Local	Soil			
Helicotylenchus spp.			6	60.0	37.5
Meloidogyne spp.			2	20.0	12.5
Pratylenchus spp.			4	40.0	25.0
Scutellonema spp.			2	20.0	12.5
Gracilacus spp.			2	20.0	12.5
Sample size = 10			Total	160.0	100.0
		Root			
Helicotylenchus spp.			0	0	0
Meloidogyne spp.			0	0	0
Pratylenchus spp.			2	20.0	50.0
Scutellonema spp.			2	20.0	50.0
Gracilacus spp.			0	0	0
Sample size = 10			Total	40.0	100.0
	Jos Local	Soil			
Helicotylenchus spp.			4	40.0	33.3
Meloidogyne spp.			2	20.0	16.7
Pratylenchus spp.			2	20.0	16.7
Gracilacus spp.			2	20.0	16.7
Tylenchus spp.			2	20.0	16.7

Sample size = 10			Total	120.0	100.0
		Root			
Helicotylenchus spp.			0	0	0
Meloidogyne spp.			0	0	0
Pratylenchus spp.			0	0	0
Gracilacus spp.			0	0	0
Tylenchus spp.			0	0	0
Sample size = 10			Total	0	0

Table 4. Population of plant-parasitic nematodes in soil and roots of Sesame (Maiduguri Local) in Uniport, Choba, Rivers State

Nematode genera	Soil		Roots	
	Nematode population**	%Nematode population***	Nematode population/10 g*	%Nematode population***
Meloidogyne spp.	10.0	9.1	0.0	0.0
Gracilacus spp.	40	36.3	0.0	0.0
Scutellonema spp.	10	9.1	10	25.0
Pratylenchus spp.	20.0	18.2	30	75.0
Helicotylenchus spp.	30.0	27.3	0.0	0.00
Total Sample size = 20	110.0	100	80.0	100

*n/N × 100 (number of times individual nematodes occurred and N = Sample size (20)
** Nematode population per 200 ml of soil
***In/TN × 100 (In = individual nematode in all the samples and TN = Total Population of all nematodes extracted in all the samples)

This was followed by *Scutellonema* spp. with a population of 10/8 g of sesame roots which had 25% of the total population of plant-parasitic nematodes (Table 4).

Helicotylenchus spp. (20/200 mL soil) had the highest population of plant-parasitic nematodes associated with Jos local accession of sesame and this translated to 33.3% of the total population of plant-parasitic nematodes in the soil (**Table 5**). *Meloidogyne* spp., *Gracilacus* spp, *Tylenchus* spp. and *Pratylenchus* spp. had equal population of 10/200 ml in soil and percentage population of 16.7% each. In roots of Jos local accession of Sesame, no plant parasitic nematodes were found.

3. 4. Fungal Pathogens in the Different Parts of Sesame Accessions

The result of fungal pathogen isolates showed *Fusarium oxysporum, Fusarium solani* and *Trichoderma* sp. were consistently isolated from the plant parts (**Table 6**). Symptoms of *Fusarium* wilt and rot disease was observed on the infected sesame plants with higher occurrence found on the stems and roots. The pathogens exhibited a whitish mycelia round the whole plant parts. The entire dried plants and partly infected branches were the major symptoms. The partly wilted branches were limited to one side of the stem and plants having these symptoms were completely dead within days. Black discoloration of the vascular tissue was also noticed. Pathogenicity test showed that the *Fusarium* species produced whitish mycelia growths with conidia produced on the infected plant parts. Symptoms similar to those observed in the field appeared on inoculated seedlings and *Fusarium* species consistently re-isolated from the symptomatic plants.

Table 5. Population of plant-parasitic nematodes in soil and roots of Sesame (Jos Local) in Choba, Rivers State, Nigeria

Nematode genera	Soil		Roots	
	Nematode population**	%Nematode population***	Nematode population/10 g*	%Nematode population***
Meloidogyne spp.	10.0	16.7	0.0	0.0
Gracilacus spp.	10.0	16.7	0.0	0.0
Tylenchus spp.	10.0	16.7	0.0	0.0
Pratylenchus spp.	10.0	16.7	0.0	0.0
Helicotylenchus spp.	20.0	33.3	0.0	0.0
Total Sample size = 20	60.0	100	0.0	0.0

*n/N ×100 (number of times individual nematodes occurred and N = Sample size (20)
** Nematode population per 200 ml of soil
***In/TN ×100 (In = individual nematode in all the samples and TN = Total population of all nematodes extracted in all the samples)

Table 6. Fungal pathogens isolated from the different parts of Sesame plant accessions (Maiduguri and Jos locals) cultivated in Choba, Rivers State.

Pathogen	Plant part		
	Leaf	Stem	Root
Fusarium oxysporum	+	+	+
Fusarium solani	-	+	+
Trichoderma sp	-	-	+

+ Present; - Absent

4. DISCUSSION

4. 1. Insect Pests Found Sesame Accessions

Sesame alike any other crop is associated with insect pests from vegetative stage to fruiting and possibly up to its storage. The presence of *L. fissicolis*, *H. thoracica* and *M. mephistophelica* from the first week of sesame emergence through its flowering stage may suggest that such insect pests may be foliage pests of sesame. However, the finding is in contrast with crop profile for sesame in the United States [24] which recorded *Aphis* sp., *Bemisia tabaci* and *Achyra rantalis* as foliage pests of Sesame. *Elis* sp., *C. sulphurea* and *M. flaviciliata* appearing at flowering stage of sesame cultivated in the Niger Delta region may suggest such insect pests to be flower pests of sesame. Although Mahmoud [25] recorded *Heteracris littoralis, Acrotylus insubricus, Nezara viridula and Pyrrhocoris* sp. as insect pests attacking sesame at flowering stage, such difference might be attributed to dominant pests of Sesame and other agro-ecological differences. However, in the study area, Sesame is being evaluated for the first time and it is possible that with wide area under cultivation and its adaptation in the Niger Delta region such insect pests and more might be recorded. The appearance of insect species such as *Durmia* spp., *Anthidium* spp., *C. sulphurea* and *M. flaiciliata* at the late stage of plant growth especially at seed formation stage may suggest that such pests may be Sesame frugivores. Although Muez *et al.* [26] reported *Elasmolomus sordidus* attacking sesame at fruiting stage, such differences might not be far from the earlier explanation of dominant pests of Sesame and other agro-ecological differences. Members of the order Orthoptera, Hemiptera, Hymenoptera, Heterocera, Coleoptera and Rhopalocera found on sesame crops cultivated in the study area support the earlier reports by some workers, though they recorded insects from other members of the order Lepidoptera, Diptera, Odonata, Neuroptera and Dictyoptera which were not observed in this study area [25, 27]. The difference in the order of insects observed might be attributed to environmental factors and possibly the available vegetation surrounding the experimental site and cropping pattern adopted in the research study. Sintim *et al*. [27] earlier report on *Anthidium* sp. and *Zonocerus variegatus* as predominant visitors of sesame differs from this study where *Elis* sp. was reported to be the most dominant insect species associated with sesame grown in the deltaic region. Such differences might be attributed to the presence of other crops in cultivation adjacent to Sesame crop research plots. In the study area, the experimental site was boarded by yam and cassava where *Z. variegatus* is not a threat at maturity. Also, insects collected were within the radius of 200 m from neighboring crops which was not the scope of the current study.

4. 2. Plant-parasitic Nematodes Associated with Sesame Accessions

The presence of plant-parasitic nematodes found on sesame grown in Choba might be an indication of its susceptibility to plant-parasitic nematodes [18, 28, 29]. However, not all plant-parasitic nematodes associated with any crop might be responsible for economic damage which might justify the need for their management [30]. The plant-parasitic nematodes such as *Helicotylenchus*, *Scutellonema*, *Pratylenchus*, *Gracilacus*, *Tylenchus* and *Meloidogyne* encountered in this study are of economic importance on many crops worldwide as they contribute to poor growth and yield losses [29, 31, 32]. Three genera of plant-parasitic nematodes, *Pratylenchus*, *Tylenchus* and *Helicotylenchus* species frequently encountered in this study have been reported as major plant-parasitic nematodes of Sesame at some other locations [33]. The similarity observed in the occurrence of these three nematodes on Sesame at Choba with other locations might be due to suitability of the plant as a good host to these nematodes [17]. The presence of *Meloidogyne* species in terms of occurrence and abundance on Sesame might be due to its ubiquitous nature, high rate of reproduction and development and a very wide host range including Sesame [17, 34, 35].

The few five genera of plant-parasitic nematodes encountered in the study might be due to environmental constraints which have been reported to always reduce the range of plant-parasitic nematodes to 3 to 6 species at a particular time on any field [29, 36]. The presence of some nematode genera such as *Pratylenchus* and *Scutellonema* in roots of Sesame Maiduguri local, whereas others are absent might be due to endoparasitic feeding habits of these nematodes. The endoparasitic habit allows these nematodes more in the roots of Sesame than in soil. However, the absence of all the plant-parasitic nematodes in roots of Jos local accession of sesame might be due to resistance factor that hindered penetration into roots, despite the fact that these nematodes were present in the rhizosphere of Sesame roots. Sesame has been reported to produce root exudates that are nematicidal thereby hindering penetration of plant-parasitic nematodes into their roots [37].

This observation might also be an indication of varietal difference between Maiduguri and Jos local accessions attributed to differences in PPNs penetration into roots. The abundance of *Helicotylenchus* species and *Gracilacus* species in the soil grown with Maiduguri and Jos local accessions might be linked to the semi-endoparasitic and ectoparasitic feeding habits of these nematodes. The lower population of all plant parasitic nematodes in Jos local accession of Sesame compared to Maiduguri local might be indicative of resistance in Jos local. However, it is the screening of these two accessions for resistance to major plant-parasitic nematodes encountered in this study that will reveal either their resistance or susceptibility statuses. Resistance potentials of Sesame to some plant-parasitic nematodes have been reported by some workers and they recommended the inclusion of Sesame in rotation-based management of plant-parasitic nematodes [28, 38-40].

Some active principles with nematicidal effects such as sesamin, sesamolin and sesamol have been identified in sesame [41] and might be responsible for the resistance observed in the two accessions, especially Jos local. The ability of sesame to suppress nematode development and reproduction have been linked to production of nematicidal and nematostatic principles as exudates from its roots.

4. 3. Fungi Found on Sesame Accessions

Fusarium species are economically important pathogens in Nigeria and worldwide and this study and other studies [42-44] have revealed the susceptibility of sesame to the pathogens which could cause damping-off of young seedlings and wilting of older plants. Afolagboye [45] associated *Fusarium* species as pathogens of sesame and this agrees with the current findings in this study which showed the presence of pathogens on the different parts of sesame. El-Shazly *et al.* [42] observed considerable variability in reaction of sesame germplasm to *Fusarium* infection, while Kavak and Boydak [43] recorded *Fusarium* infection rate of between 10 – 41% in 26 sesame breeding lines. However, the presence of *Trichoderma* sp. on the root could mainly be symbiotic and not antagonistic to the plant as revealed by the pathogenicity test. Many authors [46-48] have used *Trichoderma* species as biological control agent against *Fusarium* and other fungal diseases of sesame with encouraging results.

5. CONCLUSION

The two sesame varieties grown in the study area were highly susceptible to pest infestation and pathogens. Insect pests, such as *Elis* sp. caused considerable damage to the crop and the presence of the fungal pathogens is an indication of the susceptibility of Sesame to *Fusarium* species in the region. Nematodes, such as *Helicotylenchus* spp., *Pratylenchus* spp. and *Gracilacus* spp., are serious plant-parasitic nematodes associated with Sesame. However, Jos local accession of sesame had fewer nematodes associated with it and their population was lower than Maiduguri local.

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