The Bioscientist Journal Vol. 11 (1): 81 - 89, January, 2023
Available online at https://www.bioscientistjournal.com



OPEN ACCESS

Full Text of Paper Presented at the 2nd International Conference on Post-Covid-19 Pandemic Resilience: Role of the Biosciences, 10 – 11 January, 2023, Nnamdi Azikiwe University, Awka, Nigeria

PARASITIC NEMATODESOFCASSAVA (*MANIHOT ESCULENTA* CRANTZ) INFARMLANDS ATAMOWELLE-AMANSAE,SOUTHEAST, NIGERIA

Onwuachusi, G.L[1]., Obiakor, O.B[1]., Umeanaeto, P.U[1]., Irikannu, K.C[1]., Elosiuba, N.V[1]., Aniefuna, C.O[1]., Nzeukwu, C.I[1]., & Obiefule, I.E[1].
[1]*Department of Parasitology and Entomology, Nnamdi Azikiwe University, Awka, Nigeria*
Correspondence: gl.onwuachusi@unizik.edu.ng

ABSTRACT

Plant parasitic nematodes are among important Pest threatening cassava production in Nigeria. This study determined the prevalence of plant parasitic nematodes in cassava farmlands at Amowelle Amansea, Anambra State Southeast Nigeria. Ten cassava farmlands were randomly selected from the community for study. From each farmland, five cassava tubers and associated soils were systematically sampled; and nematode extraction was done with modified Baermann technique. Species of nematodes encountered in soils were *Meloidogyne*, *Pratylenchus*, *Helicotylenchus*, *Scutellonema* and *Gracillacus* while those from tubers were *Meloidogyne*, *Helicotylenchus*, *Scutellonema* and *Gracillacus.* Of the 10 farmlands sampled, 8 farms (80%) harboured nematodes in soil while 4 farms (40%) had their cassava tubers infected with nematodes. Among plant parasitic nematodes encountered in soils, the prevalence of *Scutellonema* species was 34%, followed by *Meloidogyne* spp. (21%), *Pratylenchus* spp. (17%), and *Gracillacus* spp. (13%). In cassava tubers, the prevalence was *Scutellonema* spp. (38%), *Meloidogyne* spp. (25%), *Helicotylenchus* spp. (25%), and *Gracillacus* spp. (13%). With the exception of *Helicotylenchus* species, which was not extracted from the soil, there was no significant difference (P>0.05) between prevalence of parasitic nematodes in soils and tubers from the farmlands studied. Presence of these plant nematodes in Amowelle-Amansea is a potential threat to cassava production in the area. This paper recommends that integrated control of plant parasitic nematodes is necessary to ensure profitable cassava production, in terms of quality and quantity ,in the area of study and elsewhere in the country.

Keywords: Nematodes, *Meloidogyne*, *Pratylenchus*, *Helicotylenchus*, *Scutellonema* and *Gracillacus* species, *Manihot esculenta*, Amansea

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is a staple food crop cultivated in developing countries including Nigeria. It is a biennial crop grown for its tuberous roots which are rich in carbohydrate (Burns *et al*.,2010). In Southeast Nigeria, about 84 percent of the people consume cassava and cassava-based products on daily basis (Onyemauwa, 2010). In industries, starch which is a byproduct of cassava can be used as raw materials for other products such as drugs, paper, plywood, confectionery, sweeteners, and textiles amongst others. Cassava chips and pellets are used in animal feed as alternative source of carbohydrate (Aro, *et al*., 2010), and in alcohol production (Asimiea *et al*., 2015).

Cassava may be infested and infected with a wide range of pests and pathogens such as insects, viruses, bacteria, and plant parasitic nematodes (PPNs) that directly or indirectly reduce its yield both in quality and quantity (Coyne, 1994; James *et al*., 2000; Coyne *et al*., 2012a; Tanimola *et al*., 2016). Plant parasitic nematodes are microscopic roundworms which can live freely in the soil until they penetrate into a susceptible host where they become parasitic (Obuezie and Ikpeze, 2012). Plant parasitic nematodes contribute significantly to low yield in cassava (Coyne *et al*., 2012a; Obuezie and Ikpeze, 2012; Tanimola *et al*., 2016).

Parasitic nematodes could attack cassava feeder roots which could result in malformations, swellings, or galls, decay which result in the alteration of the normal movement of water and nutrients within the plant and possibly death of the root (Coyne *et al*., 2012a).

According to Obuezie and Ikpeze (2012), all crops grown in Nigeria are prone to nematode attack, causing significant crop loss and low yield to farmers. This low yield could grossly affect the availability of food and possibly lead to food scarcity which could in the long run affect national development. The aim of the study was to determine the prevalent PPNs of Cassava in farmlands at Amowelle Village, Amansea in Awka-North L.G.A, Anambra State. Knowledge of the nematode species of cassava in the area can help ensure better management of both soil infestation and cassava infection, thereby increasing crop yield.

MATERIALS AND METHOD

Study Area

The study was carried out in 10 farmlands in Amowelle (Longitude $7^0$03’58.8”E and Latitude $6^0$12’30.0”N) in Amansea community, Awka North Local Government Area of Anambra State. The area experiences 8 months of wet season (March-October) and 4 months of dry season (November-February) in a year. Daily average temperature ranges between 28℃-33℃. Farming and trading are the major occupation of the inhabitants. The soil in the area supports cultivation of cassava, yam, and cocoyam amongst other cash crops. The farmers are well known for processing cassava into *garri* or *fufu* which are eaten or sold at marginal profit in nearby markets.

Collection of Cassava Roots and Soil Samples

Ten farmlands in Amowelle were sampled with the consent of the farm owners. In each farm five cassava roots and associated soils were sampled, making a total of 50 cassava roots and 50 soil samples. The cassava roots were manually

uprooted and soil samples around the uprooted cassava roots were collected with a hand trowel up to a depth of 30cm. In each farm, the samples were collected randomly and in different trajectories. Cassava roots and soils were taken in polythene bags to Department of Parasitology and Entomology Lab, Nnamdi Azikiwe University, Awka for nematode extraction.

Extraction of Nematodes from Cassava Samples

Nematode extraction from cassava was carried out using the modified Baermann tray (pie-pan) method (Coyne *et al.,* 2007). Cassava samples were washed with tap water and carefully chopped with a kitchen knife and blended manually. Each blended cassava was placed on the extraction paper resting inside a plastic sieve. About 150ml of distilled water was added to the extraction plates and the sieve containing the extraction paper; and blended cassava tuber was placed inside the plate ensuring that water touches the bottom of the sieve but not totally immersed. The set-up was allowed to stand for 48hours. The nematodes present migrated from the sample via the extraction paper into the water in the plate. The procedure was repeated for every sample from different farms. After 48hours the water was stirred and poured in a beaker and then transferred into a test-tube where the water is centrifuged for 2minutes and decanted. Two drops were collected with a pasture pipette onto a glass slide, stained with a drop of iodine and viewed under the microscope.

Extraction of Nematode from Soil Samples

Nematode extraction from soil was also carried out using the modified Baermann tray (pie-pan) method (Coyne *et al.,* 2007). Soil sample was homogenized, and after debris was removed, the sample was sieved with a coarse sieve. The samples were placed on the extraction paper resting inside a plastic sieve. About 150ml of distilled water was added to the extraction plates and the sieve containing the soil sample was placed inside the plate ensuring that water touches the bottom of the sieve but not totally immersed. The set up were allowed to stand for 48hours. The nematodes present migrated from the sample via the extraction paper into the water in the plate. The procedure was repeated for every sample from different farms. After 48hours the water was stirred and poured in a beaker and then transferred into a test-tube where the water is centrifuged for 2minutes and decanted. Two drops were collected with a pasture pipette onto a glass slide, stained with a drop of iodine and viewed under the compound microscope.

Identification of Nematodes extra from cassava roots and soils

Nematode identification was carried out as described by Coyne *et al*. (2009) and according to Rahman and Mian (2010). Photomicrographs of the observed nematodes were produced using a microscope camera.

Data Analyses

Data obtained was entered into excel and analyzed using Statistical Package for Social Science (SPSS) 6.0. Graphs were created using Excel and GraphPad Prism 5. Other data were subjected to descriptive statistics and were presented as mean and percentages.

RESULTS AND DISCUSSION

Species of plant parasitic nematodes encountered in this study were *Pratylenchus*, *Gracillacus*, *Helicotylenchus*, *Scutellonema*, and *Meloidogyne* shown in Plates 1,2,3,4 and 5, respectively.

Of the 10 farms sampled, 80% of them had their soils infected with PPNs while 40% had their cassava tubers infected (Figure 1).Species prevalence of plant nematodes recovered from soil samples associated with cassava tubers from the 10 farms are presented in Table 1. It was obvious that *Scutellonema*s pp., was the most prevalent (34%) followed by *Meloidogyne* spp., (21.1%), *Pratylenchus* spp. (16.7%), *Helicotylenchus* spp. (14.4%), and *Gracillacus* spp. (13.3%). However, mean distributions of PPNs in the soil was not significant P=0.266 (p>0.05). Table 1 also indicated that Farm 8 had the highest relative percentage of infection (25.6%) followed by Farm 2 (17.8%) and Farm 3 with 16.7%.



Plate 1: *Pratylenchus* spp.



Plate 2: *Gracillacus* spp.



Plate 3: *Helicotylenchus* spp.



Plate 4: *Scutellonema* spp.



Plate 5: *Meloidogyne* spp.

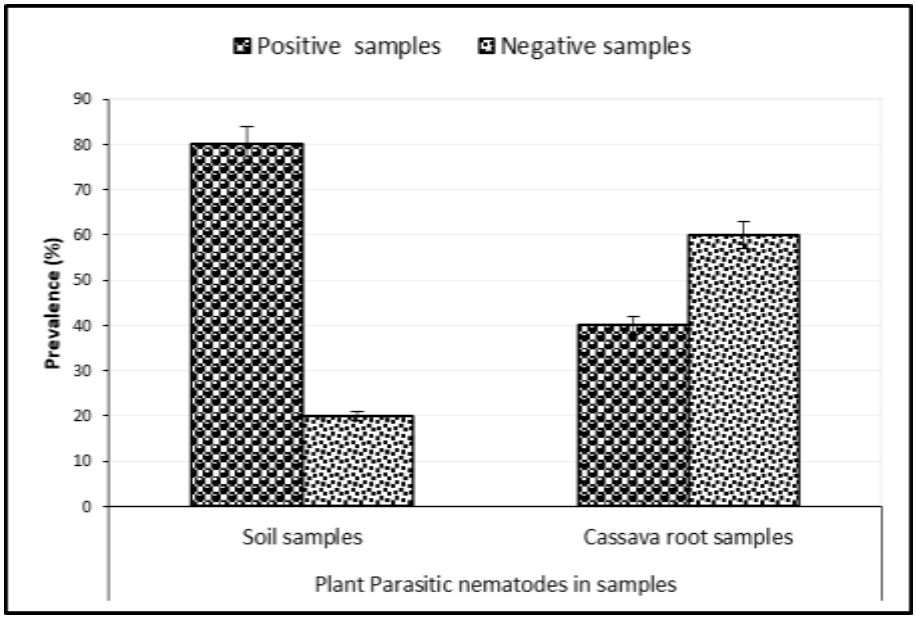


Figure 1: Farm prevalence of parasitic nematodes regarding soil and cassava tubers

Table 1: Plant nematodes recovered from soil samples associated with cassava tubers

ID of Farms	Species of plant nematodes recovered (no.)						
	Meloidogyne	***Pratylenchus***	***Helicotylenchus***	***Scutellonema***	***Gracillacus***	**Total**	**%**
1	0	0	0	3	0	3	3.3
2	2	4	5	0	5	16	17.8
3	3	3	2	7	0	15	16.7
4	1	1	2	4	1	9	10.0
5	0	0	0	0	0	0	0.0
6	1	2	0	6	1	10	11.1
7	4	1	2	2	1	10	11.1
8	5	3	2	9	4	23	25.6
9	3	1	0	0	0	4	4.4
10	0	0	0	0	0	0	0.0
Total	19	15	13	31	12	90	100.0
%	21.1	16.7	14.4	34.5	13.3	100.0	
Mean±SE	1.9±0.6	1.5±0.5	1.3±0.5	3.1±1.0	1.2±0.6		

P=0.266 (p>0.05)

The species of PPNs extracted from cassava tubers from the 10 farms sampled were *Meloidogyne, Helicotylenchus*, *Scutellonema* and *Gracillacus* (Table 2). Farm 6 had the highest prevalence of PPN (Table 2), with 38% *Scutellonema* spp., from roots. However, *Gracillacus* spp., were the lowest isolated.

It was again obvious that *Scutellonema* spp., the most prevalent (37.5%)was followed by both *Meloidogyne* and *Helicotylenchus* spp., with 25% each while *Gracillacus* spp., had prevalence of 12.5%. The root-lesion nematodes *Pratylenchus* spp., is typically a migratory endoparasite of plant roots (Obuezie and Ikpeze, 2012), so it was surprising that they were not

extracted from the tubers even when they constituted about 16.7% of nematodes extracted from soil samples. With the exception of *Pratylenchus* spp., the mean distributions of PPNs in the roots was not significant P=0.683(p>0.05). Table 2 also indicated that Farm 6 had the highest relative percentage of infection (37.5%) followed by Farms1 and 8with 25% each.

Table 2: Plant nematodes recovered from cassava root samples

ID of Farms	Species of plant nematodes recovered (no.)						
	Meloidogyne	***Pratylenchus***	***Helicotylenchus***	***Scutellonema***	***Gracillacus***	**Total**	**%**
1	0	0	1	0	1	2	25.0
2	0	0	0	0	0	0	0.0
3	0	0	0	1	0	1	12.5
4	0	0	0	0	0	0	0.0
5	0	0	0	0	0	0	0.0
6	2	0	1	0	0	3	37.5
7	0	0	0	0	0	0	0.0
8	0	0	0	2	0	2	25.0
9	0	0	0	0	0	0	0.0
10	0	0	0	0	0	0	0.0
Total	2	0	2	3	1	8	100.0
%	25.0	0.0	25.0	37.5	12.5	100.0	
Mean±SE	0.2±0.2	0.0±0.0	0.2±0.1	0.3±0.2	0.1±0.1		

P=0.683 (p>0.05)

Comparative abundance of parasitic nematodes in soil and cassava tubers from the 10 farmlands sampled is shown Figure 2. The abundance of PPNs was highest in soils from Farm 8, followed by Farms 2 and 3. Soils from Farms 4, 5, and 6 had similar abundance while nematodes were not observed in soils from Farms 5 and 10. Cassava tubers from four of the farms were infected with species of plant nematodes. Farm 6 had the highest infection, and equally followed by Farms 1 and 8. The presence of PPNs in soils but absent from tubers from Farms 2, 4, 7 and 9, could be that the nematodes were exoparasites that feed on the roots with their stylets whilst their bodies remain in the soil but those nematodes found in tubers from Farms 1, 3, 6 and 8 are definitely migratory endoparasites (Obuezie and Ikpeze, 2012). It could be seen from Figure 2 that the difference in abundance of parasitic nematodes between soil and roots at each farmland was significant ($p<0.05$), except Farm 8 where abundance in soils and tubers were about 25%.

The five nematode species reported in this study namely, *Meloidogyne, Helicotylenchus, Scutellonema, Gracillacus,* and *Pratylenchus*, have also been reported by other workers (Asimiea *et al.,* 2015; Taniola *et al.,* 2016), implying that these species of parasites may be the most common cassava parasite of economic importance, and should be taken into account to reduce possible infestation and increasing plant yield.

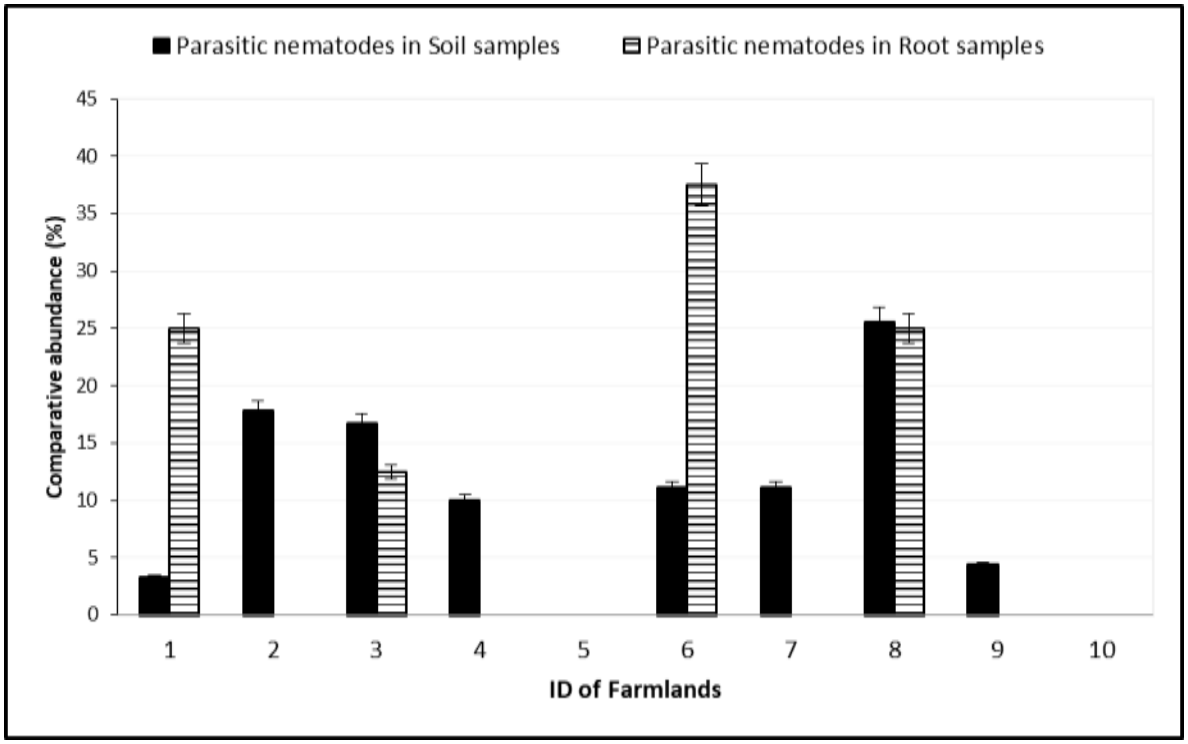


Figure 2: Comparative abundance of parasitic nematodes in 10 farmlands sampled

Among the plant parasitic nematodes found in soil and cassava root, *Scutellonema*a yam nematode was predominant. This suggests that the nematode is one of the most prevalent PPNs and has also been reported by other studies (Asimiea *et al.,* 2015; Taniola *et al.,* 2016). The second most prevalent in this study is *Meloidogyne* which is a root-knot nematode- migratory endoparasites of plant roots which enter roots by forcing their way between epidermal cells or penetrating through cells. Stylet is used to penetrate the cell wall several times and then the nematode enters through the opening. Its three species known in Nigeria are *Meloidogyne incognita* races 1 and 2, *M. javanica* and *M. arenaria* race 2 (Ikpeze O.O. Personal communications).

The *Pratylenchus* spp. was found in the soil while none was found in the roots. This is different from other studies that showed that *Pratylenchus spp.,* are found more in the root than in the soil because of its migratory endoparasitic feeding habit (Asimiea *et al.,* 2015). Three species of *Practylenchus* are known In Nigeria namely, *Practylenchus brachyrus* which attack and damage the roots of Cowpea species, Tomato, and Sugarcane. *Practylenchus zeae* which attack and damage the roots of Cowpea, Groundnut, Lettuce, Maize, Millet, Onion., Sweet Potato, Sugarcane, Pepper, Rice while *Practylenchus sefaensis* attack and damage the roots of Cotton, Maize, Millet, Rice, Sorghum. Characteristically, species of *Meloidogyne* form galls on tubers but in some cases, tubers may carry large numbers of females without showing knots or galls. (Ikpeze O.O. Personal communications). It was observed that cassava was inter cropped with maize, cowpea, pepper, and tomatoes in the study area, and this might be responsible for the introduction of *Practylenchus* in the area.

All the species reported in this study were encountered with the highest prevalence in soils from Farm 8 where it was observed that yam was also planted. Mixed cropping of cassava and yam in this farm could be the reason behind the high prevalence in soil. Also, the highest percentage of *Scutellonema* spp., was also recorded in the soil and tuber from farm 8 *Scutellonema* spp., especially *Scutellonema bradys*, which occur abundantly in tropical soils causing visible damage not only to yams (*Dioscorea* spp.) but other field crops, has been implicated as a major nematode pest of yam (Duru *et al.,* 2015; Coyne *et al.,* 2012b). High abundance of parasitic nematodes in roots were recorded in Farm 6 could be due to massive disposal of leaves of other crops observed during the study.

The abundance of nematodes in the soil more than the roots observed in this study corroborates the report of Obuezie and Ikpeze (2012)that some genera, mainly exoparasites, t were found more in the soil than in root, perhaps due to the fact that part of the life stages of the juvenile are found in the soil. The distribution of nematodes in different farmlands found to be asymmetrical could be attributed to the influence on edaphic and climatic factors like soil pH, temperature, texture, and mineral concentration (Imafidor and Nzeako, 2008).

CONCLUSION

This study has established the existence of plant PPN in the soil and cassava root in farms in the study area. The presence of plant parasitic nematodes could result to serious impairments to the growth and yield of cassava in the area. There is need to educate the local farmers about PPN associated with cassava, their damage potentials through awareness programmes. Effective nematode management strategies should be employed to improve yield of cassava and other root crops in the area.

ACKNOWLEDGEMENT

We acknowledge all the technologists in the Department of Parasitology and Entomology Lab, Nnamdi Azikiwe University, for their technical assistance.

REFERENCES

Aro, S.O., Aletor, VA., Tewe, O.O. and Agbede, J.O. (2010). Nutritional potentials of cassava tuber wastes: A case study of a cassava starch processing factory in south-western Nigeria. *Livestock Research for Rural Development.* 22(11).

Asimiea, A.O., Tanimola, A.A. and Bob-Manuel, B.P. (2015). Nematode pests of cassava in Three Local Government Areas in Rivers State. Journal of Applied Science and Agriculture 10 (6):68-77.

Burns, A., Gleadow, R., Cliff, J., Zacarias, A. and Cavagnaro, T. (2010). Cassava: the drought, war, and famine crop in a changing world. *Sustainability*,2:3572–3607.

Coyne, D.L., Nicol, J.M. and Claudius-Cole, B. (2007). Practical plant nematology: a field and laboratory guide. SP-IPM Secretariat, International Institute of Tropical Agriculture (IITA), Cotonou, Benin, pp.31-42.

Coyne, D.L., Kagoda, F. and Mbiru, E. (2012a). Rapid Screening Technique for Assessing Resistance to *Meloidogyne* spp., in Cassava.

Nematologia Mediterranea, 40:111-117.

Coyne, D., Williamson, V., Tchabi, A., Baimey, H. and Rotifa, I. (2012b). Comparison of Pathogenicity of Geographically Separate Populations of Scutellonema bradys on Yam (Dioscorea spp.) in West Africa. *Nematropica,* 42:181-190.

Coyne, D.L., Nicol, J.M. and Claudius-Cole, B. (2009). *Practical Plant Nematology: a field and laboratory guide*. SP-IPM Secretariat, International institute of Tropical Agriculture (IITA), Cotonou, Benin. 31-42.

Coyne, D.L. (1994). Nematode Pests of Cassava. *African Crop Science Journal*. 2(4):355-359.

Duru, V.C., Nwankwo E.N., Ogbonna, C.U., Onyido, A.E. and Adewuyi, O. (2015). A Survey of Plant Parasitic Nematodes of Yam Farm in Awka North Local Government Area, Anambra State, Nigeria. *Journal of Applied Biosciences,* 95:8950-5902.

Imafidor, H.O and Nzeako, S.O. (2008). Pathogenicity of *Meliodogyne javanica* on growth of tomato (*Lycopersicon esculentum*) cv. Derica: Effect on fruit yield. *Nigerian Journal of Parasitology*, 29(2):121-124.

James, B., Yaninek, J., Neuenschwander, P., Cudjoe, A., Modder, W., Echendu, N. and Toko, M. (2000). *Pest control in cassava farms*. International Institute for Tropical Agriculture (IITA).

Obuezie, C.B. and Ikpeze, O.O. (2012). Parasitic Nematodes of Maize in Farms at Oba, Idemili-South Local Government Area of Anambra State. *Nigeria Journal of Occupational Safety and Environmental Health*,1:73-78.

Onyemauwa, C.S. (2010). Analysis of Household Consumption of Cassava Products in Ohaozara, Ebonyi State, Southeast Nigeria. *Researcher*.2(6).

Rahman, M.M., and Mian, I.H. (2010). Isolation and Identification of Ten Genera of Plant Parasitic Nematodes; *Bangladesh Journal of Scientific and Industrial Research.* 45(3): 267-270

Tanimola, A.A., Wokoma, E.C. and Brown, Idier-Ipelme. (2016). Plant parasitic nematodes associated with cassava in the west senatorial district of Rivers State, Nigeria. *RUFORUM Working Document Series,* 14(1):559-566.