Impact Factor: 5.09

MULTIDISCIPLINARY JOURNAL OF ADVANCED MATERIALS, PHYSICS AND BIO RESEARCH

ISSN: 3067-2619

12(1) 2025 MJAMPBR

DISTRIBUTION AND CONTROL OF PLANT PARASITIC NEMATODES IN NIGERIA

Emeka J. Nwosu

Department of Animal and Environmental Biology, Rivers State University, Port Harcourt, Nigeria

DOI: https://doi.org/10.5281/zenodo.15835463

Abstract

Plant parasitic nematodes are of high relevance and are known to attack several parts of plants. They are distributed widely in Nigeria and occur in all the regions and ecological zones of the country viz: north-west, north-east, north-central, south-east, south-west and south-south. Several losses and damages have been implicated to the pathogenic and parasitic activities of nematodes within the country and this aroused the interest of researchers. Notwithstanding, the use of various plant parts have served as a means in the control of nematode in the country. In addition, botanicals have been used to control and reduce the rate of egg mass production, egg hatching, larval population and gall formation in plant roots and soils. The efficacy of this control method has also caused an increase in the yield of the various tested agricultural crops infected by nematode.

Keywords: Plant parasitic nematode, distribution, plant extract and Nigeria

Introduction

Nematodes which are commonly called round worms belong to the phylum Nematoda and have been reported to be one of the ancient and most diversified animal (Wang et al., 1999; Poinar et al., 1994; Manum, 1994). The phylum is categorically divided into two classes (Chromadorea and Enoplea). While Rhabditida is the only order of Chromadorea, Enoplea is subdivided into two orders (Dorylamida and Triplonchida); all of which are characterized by the shedding of their cuticle (Lambert & Bekal, 2002).

Nematodes are also distinguished into male and female. The male possess a special reproductive structure called "Spicules" while the female are recognized by their distinct vulva position and numerous ovaries (Perry & Moens, 2006).

Different nematodes parasites different organism but of particular interest are those that parasitize plants. Plant parasitic nematodes (PPN) are of various size ranges and shapes. With the use of standard compound microscope, plant parasitic nematodes could be identified easily to the genus category (Lambert & Bekal, 2002).

An important organ of PPN is the stylet which is connected to the pharynx and is used to injure or puncture plant cells (Bird & Bird, 1991). PPN attacks all parts of the plant including the flowers, seed, stem, root and leaves

with the aid of the stylet. However, some may lead to the death of the plant while others may cause cell hypoplasia (Barker et al., 1998).

Several authorities have been able to outline and classify plant nematodes based on their motility and part of the plant they feed (Campbell & Kaya, 1999).

Ectoparasite: this category of nemaodes resides and feeds outside root of the plant. They are characterized by numerous feeding host and very long feeding stylet. These sets of PPN are nonmotile, easily attached by predators and affected by changes in the environment. A critical example is the dagger nematode (Xiphinema) (Chen & Dickson, 2004).

Semi-endoparasite: these are sets of PPN that are capable of penetrating the plant partially and establishing a permanent feeding site. However, stops motility once a proper feeding site is reached. Nematodes of this category include Rotylenchulus reniformis and Tylenchulus semipenetrans (Lee, 2000).

Migratory endoparasite: these are nematodes that migrate and cause severe damages leading to necrosis and death of plant cells. They provide enabling platform for secondary infection by bacteria and fungi (Zunke, 1991). Examples are the lesion nematode (Pratylenchus, Hirschmanniella) and burrowing nematode (Radopholus) (Chen et al., 2004).

Sedentary endoparasitic: being the most dangerous, they cause very severe damage from the roots and extend towards the vascular cells that are developing. Perculiar nematodes of this category are the Meloidogyne, Globodera and Heterodera species (Mai et al., 1996).

Other PPN which are classified based on the part they attack are Ditylenchus spp and Bursaphelenchus xylophilus (stem and bulb nematode), Auguina spp (seed gall nematode) and Aphenlenchoides spp (follar nematode) (Shurtteff & Averre, 2000).

MENACE OF PPN IN NIGERIA

Agriculture which is an important sector in the Nigerian economy has always been faced with the challenge of pathogen and pest attack. This situation has led to losses in yield and productivity (Aghale et al., 2017). The menace of plant parasitic nematodes in Nigeria cannot be overlooked as they have led to several losses in crop yield among important economic cash crops.

The research of Onyenobi, (1992) showed the devastating effect of root knot nematodes on banana and yam as 12.5 18 tons and 25% losses were reported respectively. The south western part of the country also witnessed a 27% reduction of maize production due to the infestation of root lesion nematodes (Egunjobi, 2014). More so, the findings of Atungwu et al., (2012) revealed the menace of root knot nematodes on the production of soybean in a commercial scale.

DISTRIBUTION OF PPN IN NIGERIA

PPN possesses great pathogenic potential; they are adapted and distributed both in the temperate and tropics (Okafor et al., 2015). The occurrence and distribution of PPN have been studied and reported by early researchers and they have shown that PPN occupies different ecological zones in the country; more so exhibits an extensive host range in various economic plants (Olaniyi, 2011).

Studies carried out by Speijer et al., (2001a) revealed the presence of PPN in southern Nigeria. They implicated H. multicnctus, H. pararobustus, P. coffeae, R. similis and Meloidogyne spp on Musa spp (palantain). P. coffeae was also reported to be present in the west and mid-west of southern Nigeria while R. similis was more common in the east (Speijer et al., 2001a; 2001b).

The findings of Tanimola et al., (2013) agreed with that reported by Speijer et al as they revealed the menace of PPN on Musa paradisica in Choba, Rivers State.

In the eastern part of Nigeria, Okafor et al., (2015) surveyed PPN distribution on Musa spp in Nsukka agricultural ecological zone and they were able to implicate Meloidogyne spp, R. similis, R. reniformis, R. borealis, P. goodeyi, P coffeae, H. multicinctus and Mesocriconema spp. However, they recorded highest root damage for Meloidogyne spp, R. similis and R. borealis.

Extensive research on root knot nematodes (Meloidogyne spp) carried out in the 31 states and federal capital of Nigeria for 248 major cowpea growing areas in the different ecological zones showed that M. javanica had high abundance in the core north of the Sudan savannah comprising the north-east and north-west. M. incognita was prevalent in the humid region of the southern forest which includes the south-west, south-east and south-south regions. Nevertheless, M. javanica and M. incognita were reported in the guinea savannah of the north-central region (Rotimi, 2003; Makumbi-kidza et al., 2000; Eisenback &Triantaphyou, 1991).

Samuel, (2012a) sampled the distribution of pant parasitic nematode of tea plant in Kusuku in Plateau state of Nigeria and showed that Meloidogyne spp, Pratylenchus coffeae, Helicotylenchus coffeae, Rotylenchus reniformis, Radapholus spp and Diphenism spp were the six genera that parasitized the roots and soils of tea plant.

In 2014, Fisayo & Steven studied the distribution of PPN associated with pineapple in Delta, Cross River and Imo states of Nigeria. They implicated several PPN viz: M. incognita, Tylenchus spp, Pratylenchus brachyurus, Paratylenchus minutus, Heicotylenchus dihystera, Scutellonema brachyurum, Hoplolaimus pararobustus, Rotylenchus reniformis, Gracilacus spp, Criconemoides limitaneum, Hemicycliophora spp, Phyllanthus spp, Aphelenchoides spp and Xiphinema nigeriense. However, they revealed that their total population prevalence per 200m soil were 13051, 8852 and 4825 for Imo, Cross River and Delta States respectively.

Furthermore, ten genera of PPN of cashew were surveyed in seven locations Oyo state (Ibadan), Kogi state (Ochaja, Ejule, Ayingba, Kabba and Okene) and Kwara state (Oro) in north-central

Nigeria. Meloidogyne sp, H. coffeae, Xiphinema sp, Criconemoides xenoplax, P. coffeae, S. brachyurus, Hemicycliophora sp, Radopholus sp, R. reniformis and Trichodorus spp were all implicated in the soil and root of cashew (Samuel, 2012b).

The study of Samuel, (2012b) was in line with that reported earlier by Agu, (2007) for the infection of cashew by Criconemella sp, Xiphinema and Scutellonema in south-eastern Nigeria.

PLANT PARASITIC NEMATODE CONTROL IN NIGERIA USING PLANT EXTRACT

Literatures and several authors have revealed the prevailing damages caused by plant parasitic nematodes. However, several means have been employed to reduce the losses and damages caused by PPN. The use of nematicides and chemicals has dwindled along the years as they pose as treats to non-target organisms and the environment (Eapen et al., 2005).

Nevertheless, researches have shown that the use of botanicals (plant extracts) which are human and eco-friendly drastically affects and suppress the activities of PPN (Akhtar, 1993; Adekunle & Fawole, 2003). Plants possess potential chemicals such as alkaloids, thainnins, thiophenics, phenolics, glycosides and isothiocyanates which exhibit cidal effects on PPN (Fatoki & Fawole, 2000).

Adekunle & Akinlua, (2007) profiled the nematicidal effects of Leucaena leucocephala and Gliricidia sepium extracts on Meloidogyne incognita infecting okra. They revealed that the application of leave and root extracts of both plants at 40, 000mg/kg and 80, 000mg/kg reduced the rate of reproduction, galling and population of M. incognita. They also showed that the okra fruit weight increased as M. incognita was controlled using these botanicals.

Agbenin et al., (2005) used several botanicals and indicated that they possessed in vitro and in vivo nematicidal action on M. incognita of tomato. They used the extracts from neem leaf, Borelia sp, garlic bulb and groundnut leave to inhibit egg hatching and reduced the number of larval population, females and egg masses. More so, they

reported a reduction in the root-knot infection indices on tomato and implicated garlic extract to have the highest potential in the control of M. incognita infection of tomato.

Leaf extracts of tobacco (Nicotiana tabacum), nitta (Haptic sauveoleus) and paw-paw (Carica papaya) were used to suppress the prevailance of nematode pests (Meloidogyne spp, Pratylenchus spp, Xiphinema spp and Helicotylenchus spp) of tomato (Olabiyi et al., 2011). Olabiyi and colleagues showed that paw-paw, nitta and tobacco leaf extracts at 100% and 50% concentrations significantly reduced these nematodes and caused an improved yield and growth of tomato.

Their research was supported by the findings of Idorenyin et al., (2014) as they showed that Lantana camara leaf extract was effective against M. incognita of tomato following the inhibition of egg mass and gall production.

Oyedunmade et al., (2009) also explored the nematicidal activities of some plant materials on tomato infesting nematodes. They showed that the extracts from the leaves of Vernonia amygdalina, Morinda lucida, peels of Citrus sinensis and Azadirachta indica caused a reduction in the root gall index and population of Pratylenchus spp and Scutellonema spp in the roots of tomato and soil.

In addition, Bawa et al., (2014) reported the nematicidal action of neem leaf, Caspsicum annum fruit, rhizome of ginger and seed of Biglobosa on M. incognita of tomato.

Furthermore, Ononuju & Nzenwa, (2011) reported the nematicidal effects of some plant extracts such as Luffa cylindrical, Momordica charantia, Euphorbia hirta, Desmodium scorpiurus, Stachytarpheta cayennensis and wood ash of Gmelina aborea on hatchability and control of Meloidogyne spp in cowpea. Their report revealed that the extracts of these botanicals inhibited hatching of the eggs, reduced the number of root gall, reduced the root and soil population of Meloigogyne spp.; more so, improved the yield of cowpea significantly.

Akpheokhai et al., (2012) reported the action of some plant extracts on soybean nematode. They revealed that the extracts of Datura metel, Tithonia diversifolia and Azadiracha indica reduced gall formation and nematode population in the soil. They also confirmed that it resulted to the significant increase in the yield of soybean.

Their research was in agreement with Adegbite & Adesiyan, (2005) which showed that extracts of lemon grass, siam weed, castor bean and neem caused larval mortality, egg inhibition and juvenile mortality of M. incognita of edible soybean.

CONCLUSION

Plant parasitic nematodes have been of great importance in Nigeria as they have caused damages and several yield losses of agricultural crops and produce. Nevertheless, the use of botanicals (plant extracts) in their control have been of great aid as several researchers and authors have reported their usage in nematode control. The cidal effect is as a result of the presence of some chemicals and metabolites found in the plants. The application of botanicals to nematode infection and infestation has not only been effective but also human and eco-friendly compared to the use of chemicals.

REFERENCES

Adegbite, A. A., & Adesiyan, S. O. (2005). Root extracts of plants to control root-knot nematode on edible soybean. World Journal of Agricultural Science, 1(1), 18-21.

Adekunle, O. K., & Akinlua, A. (2007). Nematicidal effects of Leucaena leucocephala and Gliricidia sepium extracts on Meloidogyne incognita infecting okra. Journal of Agricultural Science, 52(1), 53-63.

Adekunle, O. K., & Fawole, B. (2003). Comparison of effects of Siam weed, neem, and carbofuran on generation time and reproduction of Meloidogyne incognita Race 2 on tomato. Environment and Ecology, 21(3), 720-726.

Agbenin, N. O., Emechebe, A. M., Marley, P. S., & Akpa, A. D. (2005). Evaluation of nematicidal action of some botanicals on Meloidogyne incognita in vivo and in vitro. Journal of Agricultural and Rural Development in Tropics and Subtropics, 106(1), 29-39.

Aghale, D. N., Egbucha, K. C., & Umeh, O. J. (2017). Plant parasitic nematode threat to Nigerian agriculture food security. International Journal of Advanced Research in Botany, 3(3), 15-21.

Agu, C. M. (2007). Survey and effects of plant parasitic root knot nematodes of cashew (Anacardium occidentale) in south-eastern Nigeria. Journal of American Science, 3, 50-54.

Akhtar, M. (1993). Utilization of plant origin waste materials in nematode control: A review. Bioresource Technology, 46, 255-257.

Akpheokhai, I. L., Claudius-Cole, A. O., & Fawole, B. (2012). Evaluation of some plant extracts for the management of Meloidogyne incognita on soybean (Glycine max). World Journal of Agricultural Science, 8(4), 429-435.

Atungwu, J. J., Lawal, M. O., Afolani, S. O., & Adejuyigbe, C. O. (2012). Appraisal of composts for the suppression of Meloidogyne species and enrichment of microarthropods in soybean fields. Biological Agriculture & Horticulture: An International Journal for Sustainable Production Systems.

Barker, K. R., Pederson, G. A., & Windham, G. L. (1998). Plant and nematodes interactions. ASA, CSSA, and SSSA, Madison, WI.

Bawa, J. A., Mohammed, I., & Liadi, S. (2014). Nematicidal effect of some plant extracts on root-knot nematodes (Meloidogyne incognita) of tomato (Lycopersicon esculentum). World Journal of Life Science & Medical Research, 3(3), 81-87.

Bird, A. F., & Bird, J. (1991). The structure of nematodes (2nd ed.). Academic Press Inc.

Campbell, J. F., & Kaya, H. K. (1999). How and why a parasitic nematode jumps. Nature, 397, 485-486.

Chen, Z. X., & Dickson, D. W. (2004). Nematology: Advances and perspective vol. 1: Nematode morphology, physiology, and ecology. CABI.

Chen, Z. X., Chen, S. Y., & Dickson, D. W. (2004). Nematology: Advances and perspective vol. 2: Nematode management and utilization. CABI.

Eapen, S. J., Beena, B., & Ramana, K. V. (2005). Tropical soil microflora of spice-based cropping systems as potential antagonists of root-knot nematodes. Journal of Invertebrate Pathology, 88, 218-225.

Egunjobi, O. A. (2014). Nematode and man's welfare. Nigerian Journal of Nematology, 2, 3-7.

Eisenback, J. D., & Triantaphyllou, H. H. (1991). Root-knot nematodes: Meloidogyne species and races. In W. R. Nickle (Ed.), Manual of Agricultural Nematology (pp. 281-286). Marcel Dekker.

Fatoki, O. K., & Fawole, B. (2000). Identification of nematicidal ingredients from neem leaves, siam weed leaves, and roots. African Journal of Plant Protection, 10, 33-38.

Fisayo, D., & Steven, A. (2014). Studies on the distribution of plant parasitic nematodes associated with pineapple in Delta, Imo, and Cross Rivers states of Nigeria. Australian Journal of Basic and Applied Sciences, 8(7), 248-256.

Idorenyin, A. U., Ephraim, O. O., & Donald, A. U. (2014). Management of root-knot disease of tomato with bioformulated Paecilomyces lilacinus and leaf extracts of Lantana camara. Brazilian Archives of Biology and Technology, 57(4), 486-492.

Lambert, K., & Bekal, S. (2002). Introduction to plant-parasitic nematodes. The American Phytopathological Society Education Center Editorial Board. https://www.apsnet.org/edcenter/disandpath/nematode/intro/pages/intro. Retrieved May 22, 2019.

Lee, D. L. (2002). The biology of nematodes. Taylor & Francis.

Mai, W. F., Mullin, P. G., Lyon, H. H., & Loeffler, K. (1996). Plant-parasitic nematodes: A pictorial key to genera. Cornell University Press.

Makumbi-Kidza, N. N., Speijer, P. R., & Sikora, R. A. (2000). Effects of Meloidogyne incognita on growth and storage-root formation of cassava (Manihot esculenta). Journal of Nematology, 32(4), 475-477.

Manum, S. B., Bose, M. N., Sayer, R. T., & Bostrom, S. (1994). A nematode (Cativonema-cretacea Gen. et Sp.-N) preserved in a clitellate cocoon wall from the early Cretaceous. Zoological Scripta, 23, 27-31.

Okafor, O. E., Ugwuoke, K. I., Mba, C. L., Okafor, F. C., & Mbadianya, J. I. (2015). The distribution of plant parasitic nematodes of Musa spp. in Nsukka agricultural ecological zone, Nigeria. African Journal of Agricultural Research, 10(48), 4338-4347.

Olabiyi, T. I., Adepoju, I. O., Abolusoro, S. A., & Oyedunmade, E. E. A. (2011). Suppression of nematode pests of tomato with aqueous leaf extracts of nitta, tobacco, and paw-paw. American-Eurasian Journal of Agronomy, 4(2), 23-27.

Olaniyi, M. O. (2011). Plant parasitic nematode constraint to plantain production in Nigeria: Incidence of plant parasitic nematodes on plantain in Nigeria and impact on plant growth, root damage, and yield. LAP Lambert Academic Publishing.

Ononuju, C. C., & Nzenwa, P. O. (2011). Nematicidal effects of some plant extracts on egg hatchability and control of Meloidogyne spp. in cowpea (Vigna unguiculata). African Journal of Plant Science, 5(3), 176-186.

Onyenobi, F. I. (1992). Root knot nematode: An economic problem in Nigeria. In The biology and control of nematodes of food crops in Nigeria (pp. 37-48).

Oyedunmade, E. E. A., Abolusoro, S. A., & Olabiyi, I. I. (2009). Nematicidal activities of carbofuran and some organic materials on plant parasitic nematode control on tomato. International Journal of Nematology, 19(1), 96-102.

Perry, R. N., & Moens, M. (2006). Plant nematology. CABI.

Poinar, G. O., Acra, A., & Acra, F. (1994). Earliest fossil nematode (Mermithidae) in Cretaceous Lebanese amber. Fundamental and Applied Nematology, 17, 475-477.

Rotimi, M. O. (2003). Incidence of plant parasitic nematodes on plantain (Musa spp., AAB) in Nigeria and their effect on root health, plant growth, and yield. Banana Plantain Information, Musa, 12(2), 41.

Samuel, B. O. (2012a). Distribution of plant parasitic nematodes associated with tea in Nigeria. World Journal of Agricultural Science, 8(5), 459-463.

Samuel, B. O. (2012b). Distribution and effect of plant parasitic nematodes associated with cashew in north-central Nigeria. Agricultural Journal, 7(6), 405-407.

Shurtleff, M. C., & Averre, C. W. (2000). Diagnosing plant disease caused by nematodes. APS Press.

Speijer, P. R., Rotimi, O. M., & De Waele, D. (2001a). Plant parasitic nematodes associated with plantain (Musa spp., AAB group) in southern Nigeria and their relative importance compared to other biotic constraints. Nematology, 3, 75-79.

Speijer, P. R., Rotimi, O. M., & De Waele, D. (2001b). Plant parasitic nematodes associated with plantain (Musa spp., AAB group) in southeastern Nigeria and their relative importance compared to other biotic constraints. Nematology, 3, 423-436.

Taminola, A. A., Asimeaa, A. O., & Ofufu-Joseph, S. (2013). Status of plant parasitic nematodes on plantain (Musa parasidiaca L.) in Choba, Rivers state, Nigeria. World Journal of Agricultural Science, 9(2), 189-195.

Wang, D. Y. C., Kumar, S., & Hedges, B. S. (1999). Divergence time estimate for the early history of animal phyla and the origin of plants, animals, and fungi. Proceedings of the Society of London, B, 266, 163-171.

Zunke, U. (1991). Observations on the invasion and endoparasitic behavior of the root lesion nematode Pratylenchus penetrans. Journal of Nematology, 22, 309-320.