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Plant Parasitic Nematode in Nigeria: A Concise Review

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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.

Key words: *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 catergory 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 non-motile, 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 *Xiphenema 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, Aphenlenchus 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 leaves 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 (*Hyptis 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.

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