WEED HOSTS OF THE ROOT-LESION NEMATODE *PRATYLENCHUS SPEIJERI* IN REPLANTING SITES CLEARED FROM NEMATODE-INFESTED PLANTAIN CV. APANTU-PA (*MUSA* SPP., AAB-GROUP) FIELDS IN GHANA

Francis C. Brentu*[1], C. Amoatey[2], and E. Oppong[2]

[1]Forest and Horticultural Crops Research Centre-Kade, Institute of Agricultural Research, College of Agriculture and Consumer Sciences, University of Ghana, Accra, Ghana. [2]School of Agriculture, College of Agriculture and Consumer Sciences, University of Ghana, Accra, Ghana. *Corresponding author: brentu64@yahoo.com

ABSTRACT

Brentu, F. C., C. Amoatey, and E. Oppong. 2013. Weed hosts of the root-lesion nematode *Pratylenchus speijeri* in replanting sites cleared from nematode-infested plantain cv. Apantu-pa (*Musa* spp., Aab-group) fields in Ghana. Nematropica 43:91-96.

Twenty five weed species were collected from six fields after the removal of plantain (*Musa* spp., AAB-group) cv Apantu-pa plants severely damaged by plant–parasitic nematodes in Ghana. Weed roots were processed and analyzed for presence of plant-parasitic nematodes. Three nematode species, *Helicotylenchus multicinctus, Meloidogyne javanica* and *Pratylenchus speijeri* were detected in the roots of ten of the weed species growing in the fields. Six weed species including *Rottboellia cochinchinensis, Panicum maximum, Acalypha ciliata, Sida acuta, Brachiaria deflexa* and *Fleurya aestuans* were found to harbour *P. speijeri*. *Rottboellia cochincinensis* had the highest population density of *P. speijeri* with a mean nematode population density of about 19 vermiforms/g fresh root. Lower root densities of 1.5 and 1/g fresh root were observed on *Sida acuta* and *Fleurya aestuans*, respectively. The remaining four weeds were colonized by *P. speijeri* at population levels < 1 nematode/g fresh root. Three weed species (*Ageratum conyzoides, Chromolaena odorata* and *Synedrella nodiflora*) harboured only *H. multicinctus*. These results emphasize the importance of proper weed management in fallow land that is destined for plantain production.

Key words: Alternate host, host range, lesion nematode, plantain fields, weeds.

RESUMEN

Brentu, F. C., C. Amoatey, y E. Oppong. 2013. Malezas hospedantes del nematodo *Pratylenchus speijeri* en campos previamente sembrados con cultivos de plátano afectados por nematodos fioparásitos en Ghana. Nematropica 43:91-96.

Se colectaron 25 especies de malezas en seis campos después de la eliminación de cultivos de plátano (*Musa* spp., grupo AAB) cv Apantu-pa severamente afectados por nematodos fitoparásitos en Ghana. Se procesaron las raíces de las malezas para determinar la presencia de nematodos fitoparásitos. Se encontraron tres especies de nematodos, *Helicotylenchus multicinctus, Meloidogyne javanica* y *Pratylenchus speijeri*, en las raíces de diez de las malezas colectadas. Seis de las especies de malezas, Rottboellia cochinchinensis, *Panicum maximum, Acalypha ciliata, Sida acuta, Brachiaria deflexa* y *Fleurya aestuans*, albergaban *P. speijeri*. *Rottboellia cochincinensis* tuvo las poblaciones más altas de *P. speijeri* con una densidad promedio de 19 vermiformes/ g de raíz fresca. Se observaron densidades de 1.5 y 1 nematodo/g de raíz fresca en *Sida acuta* y *Fleurya aestuans*, respectivamente. Las cuatro malezas restantes estaban colonizadas por *P. speijeri* a niveles menores de 1 nematodo/g raíz fresca. Tres especies de malezas (*Ageratum conyzoides, Chromolaena odorata* y *Synedrella nodiflora*) albergaron sólo *H. multicinctus*. Estos resultados resaltan la importancia del manejo adecuado de malezas en campos que se van a utilizer para cultivar plátano.

Palabras clave: hospedantes alternos, malezas, plátano, *Pratylenchus* sp., rango de hospedantes.

INTRODUCTION

Plantain and banana are among the most important food crops in the humid forest zone of West and Central Africa (Faturoti *et al*., 2007). Plantain (*Musa* spp., AAB-group) is a major staple crop in sub-Sahara Africa supplying over 70 million people with more than 25% of their energy requirement (Swennen, 1990). In Ghana, besides serving as a source of income for smallholder farmers, plantain serves as a staple food for over 60% of the population (Akomeah *et al*., 1995). Banana production is also increasing in Ghana and is currently one of the non-traditional export crops in the country. Growing pest and disease pressures have negatively affected production of plantain and banana (Dankyi *et al*., 2007). In Ghana, the cultivation of plantain is constrained by diseases and pests, particularly black sigatoka, banana weevils and nematodes. Among the four plant-parasitic nematodes [*Pratylenchus coffeae* (Zimmermann) Filipjev & Schuurmans Stekhoven, species complex, *Radopholus similis* (Cobb) Thorne, *Helicotylenchus multicinctus* (Cobb) Golden and *Melodoigyne javanica* (Treyb) Chitwood] that attack plantain in Ghana, the coffee root-lesion nematode is the most common and damaging species (Brentu *et al.*, 2004; Schill *et al*., 1996). Populations of this nematode are responsible for over 70% of production losses mainly due to the high incidence of toppling of the parasitized trees (Brentu *et al*., 2004). These damaging populations from Ghana reported by Brentu and others in 2004 as *P. coffeae* have been described recently as a new species called *Pratylenchus speijeri* (De Luca *et al*., 2012), which is closely related to *P. coffeae*. In Ghana, this migratory endoparasitic nematode generally occurs in mixed populations with other nematodes (Schill *et al*., 1996), mainly *M. javanica* and *H. multicinctus* which cause 26 and 30% yield reduction, respectively (Brentu *et al.,* 2004). Field data indicate that *P. speijeri* and other nematode endoparasites are spread within and among *Musa* spp. plantations with nematode-parasitized plantain corms (Schill *et al*., 1996, Brentu *et al.*, 2004). The damaging effects of these nematode pests can be mitigated in replanting sites not previously cropped with plantains by using pest-free propagating planting material (Green *et al*., 1998; Brentu *et al*., 2002). However, *P. speijeri* eventually damages pest-free plantain planted in land not previously cropped to plantain or in fallowed replanting plantain sites (Green *et al.*, 1998). There is therefore the need to identify the source of the infestation. Although competition is usually the most detrimental interference weeds have on crop production, they may also serve as alternative hosts for plant-parasitic nematodes and have long been recognized for their ability to maintain nematode populations (Belair and Benoit, 1996). The host range of *P. speijeri* has not been studied; however, it has been reported on plantain. Preliminary field observations indicate that its host range should be wide as is that of *P. coffeae.*

Weeds may serve as transitional hosts for plant-parasitic nematodes including *P. speijeri,* providing a reservoir for their survival (Quénéhervé *et al,* 2006). The objective of the study was therefore to determine the host status of commonly found weeds to *P. speijeri* in previously cultivated and nematode infested plantain fields.

MATERIALS AND METHODS

The survey was conducted in two climatically different regions represented by two research sites. The University of Ghana Forest and Horticultural Crops Research Centre (FOHCREC), Kade, located 175 km north-west of Accra 6° 05N, 0°5W in the humid region (Gray, 1987). The climate of this site, at 150 m above sea level, is influenced by two wet seasons and a dry season. The major wet season extends from March to mid July, followed by a minor wet season from mid September to the end of November, whereas the main dry season occurs from November to February. The average annual rainfall is approximately 1700 mm. The vegetation of the centre is representative of a moist, semi-deciduous tropical rain forest (Taylor, 1967). The University of Ghana farm, Legon, Accra, where additional experiments were conducted, is located in the dry region. This locality has coastal savannah vegetation and an annual rainfall of 112 mm and temperature of 32°C (Dickson and Benneh, 1995). The surveys were conducted between August and September 2009. Six previously cultivated plantain (*Musa* spp., AAB-group) cv "Apantu-pa" (false horn plantain) fields, each not less than 4 years in fallow, were identified for the study in the two regions. Five fields were selected in FOHCREC, Kade and one in University of Ghana farm, Legon, Accra. University of Ghana (Forest and Horticultural Crops Research Centre, Kade) records indicate that declining plantains were growing in these sites and that the root-lesion nematodes extracted from the roots of the declining plants were identified morphologically and molecularly using PCR-RFLP analysis of the D_2-D_3 of the 28S rRNA gene as *P. speijeri* (De Luca *et al.*, 2012). Other nematode species were identified morphologically. A quadrant of size 0.6 m x 0.6 m was used to collect the weed samples at these sites. It was thrown arbitrarily three times in each of the fields and all weeds were carefully harvested by hand using a spade. In the laboratory, these weeds were grouped into families and species before nematodes were extracted from their roots. Weed species were identified from comparisons to data contained in a weed reference book (Akobundu, 1987).

After identification of the weed species, all roots were washed using tap water to remove soil and then cut into 2-3 cm in length. Nematodes were extracted from

5-10 g subsamples of chopped roots using a modified Baermann technique (Hooper, 1990). Nematodes were counted from three aliquots of 2 ml subsample from a 25 ml sample. Nematodes were identified to species and population densities were expressed as number of nematodes/g of fresh root. Nematode population densities were $\log_{(x + 1)}$ transformed prior to analysis because of the presence of zeros in the data (Gomez and Gomez, 1984). Significant differences for nematode population densities were calculated using the least square means t-test (LSMEANS) of PROC GLM in SAS (SAS Institute, 1997).

RESULTS

Weed identification

Twenty-five different weed species from 14 families were collected from the fallowed plantain fields at the two sites (Table 1). Of these 25 different species, 16 were found only in Kade, five different species were collected only from the University of Ghana farm, Legon and four of the weeds (*Panicum maximum, Ageratum conyzoides, Talinum triangulare* and *Spigelia anthelmia*), occurred in both sites. Data collected from the two sites were combined prior to analyses. The highest percentage of weeds observed belonged to the Poaceae family (25%), followed by Asteraceae (18%), Euphorbiaceae (14%), Cyperaceae (7%) and 3.6% each for the other 10 families (Table 1).

Nematodes identified as parasites of weeds

Ten of 25 plant species had detectable numbers of plant-parasitic nematodes recovered from their roots (Table 2). *Meloidogyne javanica, P. speijeri* and *H. multicinctus* were extracted from 3, 7 and 9 different weed species, respectively. Differences in the relative dominance of the 3 species were significant (P=0.05). *Fleurya aestuans* had the highest level of *P. speijeri* as a percentage of the total plant parasitic nematode community (Table 2). All but one of the infested weeds were colonized by *H. multicinctus* and four species were colonized by *M. javanica*. In spite of the small number of *R. cochinchinensis* specimens recovered at the study sites, this weed species had the highest population density of *P. speijeri* (Table 3). The other species had fewer (P = 0.05) *P. speijeri* than *R. cochinchinensis* and did not differ from each other as hosts of this nematode. Roots of *P. maximum, S. acuta* and *F. aestuans* were colonized by *P. speijeri* but at low density (Table 3). *Rottboellia cochinchinensis* and *A. ciliata* were the only weed species found to harbour *M. javanica, P. speijeri* and *H. multicinctus*. Fourteen weeds in the study sites as well as *Centrosema pubescens*, a cover crop, did not harbour detectable numbers of plant-parasitic nematodes listed previously (Table 4).

DISCUSSION

Schill *et al.* (1996) observed most of the same 25 weeds we found in our study in their survey of plantain in 52 sites in the plantain growing regions of Ghana, but did not assess for the presence or absence of plant parasitic nematodes in the weed roots. Ours is the first report on weeds that harbour plant parasitic nematodes known to parasitize plantain in plantain fields in Ghana. In this study, 10 of the weed species, primarily belonging to the Poaceae family, had detectable numbers of plant-parasitic nematodes recovered from their roots. The nematodes recovered were mainly, *P. speijeri, M. javanica* and *H. multicinctus*. This may be attributed to the plantain that was grown in the study areas, because plantain is a major host of *P. speijeri* (Brentu *et al*., 2004). Although, *F. aestuans* and *S. acuta* do not belong to the Poaceae family, the highest percentage of *P. speijeri* was detected in these two species, but in terms of nematode population density, *R. cochinchinensis* was the best host. *Pratylenchus speijeri* had a higher preference for these weed species in the absence of the major host plantain. *Pratylenchus coffeae*, also attained high densities on *R. cochinchinensis* in Martinique (Quénéhervé *et al*., 2006) but was not found in this study.

According to Brentu *et al.* (2004), *H. multicinctus* and *M. javanica* infection on plantain also resulted in 26 and 30% yield losses, respectively. This demonstrates the need to exclude weeds found to harbour these nematodes from fallow lands intended for plantain production. The results of the survey also revealed that most of the infected weed species harboured *H. multicinctus* or *M. javanica* Although weed species such as *P. maximum, S. acuta* and *F. aestuans* were colonized by *P. speijeri*, the nematode population densities were low, whereas *R. cochinchinensis* and *A. ciliata* harboured high population densities of all the three major species of nematodes that parasitize plantain in Ghana and should be a cause of concern to plantain farmers (Brentu *et al*., 2002). It is therefore imperative for plantain farmers to exclude *R. cochinchinensis* from fallow lands.

Centrosema pubescens, a cover crop, and a few other weed species did not host any of the nematodes listed previously. Wendy-Ann *et al.* (2007) reported that cover crops can improve soil fertility, reduce erosion, fix nitrogen, reduce evaporation; non-host weeds also reduce nematodes infestations. Absence of plant-parasitic nematodes from the roots of these weed species means they are potential non-host and that *C. pubescens* may be useful as a cover crop for fallow of previously cultivated plantain fields to reduce *P. speijeri* populations in the soil and improve the fertility status of the land.

Our findings indicate that the host range of *P. speijeri* is not restricted to *Musa* spp. and includes many weeds associated with plantains. However, more

Table 1. Weeds found in plantain fields in Ghana and the percentage of total plants represented by each family is shown in parentheses.

Scientific name [x]	Family [y]	Common name
	Monocots	
Rottboellia cochinchinensis (K)	Poaceae (25%)	Corn grass
Brachiara deflexa (K)	Poaceae	-
Digitaria insularis (K, L)	Poaceae	-
Panicum maximum (K,L)	Poaceae	Guinea corn
Sporobolus pyramidalis (K	Poaceae	Cat's tail grass
Cyperus haspen (K)	Cyperaceae (7%)	Dwarf papyrus
Mariscus alternifolius (K)	Cyperaceae	-
	Dicots	
Ageratum conyizoides (K, L)	Asteraceae (18%)	Goat weed
Chromolaena odorata (K)	Asteraceae	Siam weed
Tridax procumbens (L)	Asteraceae	Coat buttons
Synedrella nodiflora (K)	Asteraceae	Node weed
Acalypha ciliata (K)	Euphorbiaceae (14%)	Copper leaf
Euphorbia hirta (K)	Euphorbiaceae	Asthma weed
Phyllanthus amarus (K)	Euphorbiaceae	-
Euphorbia heterophylla (L)	Euphorbiaceae	Spurge
Centrocema pubescen (K)	Fabaceae (3.6%)	Pois bâtard
Fleurya aestuans (K)	Urticaceae (3.6%)	Tropical nettle
Sida acuta (K)	Malvaceae (3.6%)	Broom weed
Monechma ciliatum (K)	Acantheceae (3.6%)	-
Paullinia pinnata (K)	Sapindaceae (3.6%)	Brimstone bush
Morinda geminata (K)	Rubiaceae (3.6)	-
Talinum triangulare (K, L)	Portulacaceae(3.6%)	Water leaf
Commelina diffusa (L)	Commelinaceae(3.6%)	Spreading day flower
Boerhavia diffusa (L)	Nyctaginaceae (3.6%)	Red spiderling
Spigelia anthelmia (L)	Loganiaceae (3.6%)	Worm bush

[x] Site of detection, K: Kade, L: Legon.
[y] % of observed plant species contained in each family

Table 2. Percentage of the total nematode population of three plant parasitic nematodes extracted from plants collected in replanting plantain sites in Ghana.

Weed	*Meloidogyne javanica (%)*	*Pratylenchus speijeri (%)*	*Helicotylenchus multicinctus (%)*
Rottboellia cochinchinensis	32.7	55.1	12.2
Brachiara deflexa	0	42.9	57.1
Fleurya aestuans	0	95.8	4.2
Panicum maximum	44.4	55.6	0
Sida acuta	0	81.4	18.6
Acalypha ciliata	27.3	45.6	27.3
Ageratum conyzoides	0	0	100
Synedrella nodiflora	0	0	100
Chromolaena odorata	0	0	100
Boerhavia diffusa	0	57.1	42.9
Mean percentage	10.4	43.3	46.3

LSD = 14.5
Standard error of difference = 7.89

Table 3. *Pratylenchus speijeri* population density per gram (fw) of roots from plants collected in replanting plantain sites in Ghana.

Weed	Total number of weed species found in samples taken	Total population of *P. speijeri*	Mean population of *P. speijeri*
Rottboellia cochinchinensis	3	56.3	18.8
Brachiara deflexa	9	12.5	1.4
Fleurya aestuans	9	9.6	1.1
Panicum maximum	9	8.3	1.0
Sida acuta	5	7.3	1.5
Acalypha ciliata	5	4.2	<1
Boerhavia diffusa	5	1.7	<1
LSD			0.7
Standard error of difference			0.3

Table 4. Weed species where no known plant-parasitic nematode pests of plantains were found in replanting sites in Ghana.

Weed species	Family
Sporobolus pyramidalis	Poaceae
Digitaria insularis	Poaceae
Euphorbia hirta	Euphorbiaceae
Pyllanthus amarus	Euphorbiaceae
Euphorbia heterophylla	Euphorbiaceae
tridax procumbens	Asteraceae
Cyperus haspen	Cyperaceae
Mariscus alternifolius	Cyperaceae
Monechma ciliatum	Acanthaceae
Paullinia pinnata	Sapinaceae
Morinda geminata	Rubiaceae
Talinum triangulare	Portulacaceae
Spigelia anthelmia	Loganiaceae
Commelina diffusa	Commelinaceae
Centrosema pubescen	Fabaceae

host studies are needed to clarify the range of crops and other plants susceptible to parasitism by this pest.

ACKNOWLEDGEMENT

The authors thank Renato Inserra and Larry Duncan for helpful suggestions to improve the manscript.

LITERATURE CITED

Akobundu, I. O. 1987. Weed science in the tropics: Principles and practices. John Wiley & Sons. ISBN 471915440. 522 pp.

Akomeah, F., L. Ohemeng-Appiah, and D. Adomamko. 1995. Plantain production in Ghana. Musa Africa 7:11-13.

Belair, G. and D. L. Benoit. 1996. Host suitability of 32 common weeds to *Meloidogyne hapla* in organic soil of south western Quebec. Journal of Nematology, 28:643-647.

Brentu, F. C., P. R. Speijer, K. R. Green, B. M. S. Hemeng, and K. Afreh-Nuamah. 2002. Effect of treatment of planting material on the growth and yield of plantain (*Musa* AAB group) in Ghana. Ghana Journal of Horticulture 1:59-72

Brentu, F. C., P. R. Speijer, K. R. Green, B. M. S. Hemeng, D. de Waele, and D. L. Coyne. 2004.

Micro-plot evaluation of the yield reduction potential of *Pratylenchus coffeae, Helicotylenchus multicinctus* and *Meloidogyne javanica* on 'Apantu-pa' (*Musa* AAB group) in Ghana. Nematology 6:455-462.

Dankyi, A. A., B. M. Dzomeku, F. O. Anno-Nyarko, A Adu-Appiah, and G. Antwi. 2007. Plantain production practices in the Ashanti, Brong-Ahafo and Eastern Region of Ghana. Asian Journal Agriculture Research 1:1-9.

De Luca, F., A. Troccoli, W. L. Duncan, S. A. Subbotin, L. Waeyenberge, D. L. Coyne, F. C. Brentu, and R. N. Inserra. 2012. *Pratylenchus speijeri* n. sp. (Nematoda: Pratylenchidae) a new root-lesion nematode pest of plantain in West Africa. Nematology 14: 987-1004.

Dickson, K. B. and G. Benneh. 1995. A new geography in Ghana. Longman group limited, England, 169 pp.

Faturoti, B. O., M. C. Madukwe, A. Tenkouano, and A. E. Agwu. 2007. A review of policy acts and initiatives in plantain and banana innovation system in Nigeria. African Journal of Biotechnology 6: 2297-2302

Gomez, K. A. and A. A. Gomez. 1984. Statistical procedures for Agricultural Research. Second edition, J. Wiley and Sons. New York 680 pp.

Gray, A. E. 1987. The seed bank of *Eupatorium odoratum* along a succession gradient in a tropical rain forest in Ghana. Journal of Tropical Ecology 3:139-149.

Green, K. R., A. Mensah-Bonsu, S. Adjei-Nsiah, and K. Afreh-Nuamah. 1998. Farmers' perception of integrated pest management strategies for plantain production in Ghana (C. Picq, E. Foure, and E. A. Frison, eds). Proceedings of an International Conference on Banana and Food Security, Douala, Cameroun, 10-14 November, 1997, 697-705. INIBAP Publication. 795 pp.

Hooper, D. J. 1990. Extraction and processing of plant and soil nematodes. Pp. 45-68 *in* Luc, M., Sikora, R. A. and Bridge, J. (ed). Plant parasitic nematodes in subtropical and tropical agriculture. Wallingford, UK, CAB International,.

Quénéhervé, P., C. Chabrier, A. Auwerkerken, P. Topart, B. Martiny, and S. Marie-Luce. 2006. Status of weeds as reservoir of plant parasitic nematodes in banana fields in Martinique. Crop Protection 25:8, 860-867.

SAS Institute. 1997. Changes and enhancements through release 6.12, SAS Inst., Cary, NC.

Schill P. F., K. Afreh-Nuamah and C. S. Gold. 1996. Assessment and characterization of constraints in plantain production in Ghana as an example for West Africa, pp 45-51, *in* Ortiz, J and M. O. Akorada (ed) plantain and banana, production and research in west Africa: proceedings of a regional workshop held at Onne, Nigeria. 23-27th September, 1995.

Swennen, R. 1990. Plantain cultivation under West African conditions: a reference manual. IITA, Ibadan, Nigeria p. 2.

Taylor, G. J. 1967. Synecology and sivicultural in Ghana Nelson, Edinburgh, UK. 420 pp.

Wendy-Ann, P. I., R. A. I. Brathwaite, W. G. Ganpat, and I. Bekele. 2007. The impact of selected cover crops on soil fertility, weed and nematode suppression through farmer participatory research by Fair-trade Banana Growers in St. Vincent and the Grenadines: Technical Report. World Journal of Agricultural Sciences 3:371-379.

Received: 8/III/2013

Recibido:

Accepted for publication: 8/V/2013

Aceptado para publicación: