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NEMATICIDAL EFFECTS OF RED ACALYPHA (*Acalypha wilkesiana*) ON PLANTAIN YIELD AND CORM DAMAGE BY NEMATODES

Oso, A. A., Longe, O. O. and Olaniyi, M. O.

Department of Crop, Soil and Environmental Sciences, Ekiti State University, Ado- Ekiti, Nigeria.

ABSTRACT

Plant parasitic nematodes constitute one of the major biological constraints in plantain production. The nematodes destroy the primary roots of plantain, thereby disrupting the plants' anchorage system. Numerous pest management techniques are commercially available for the management of these pests, but the techniques are expensive, laborious and undesirable due to associated toxicity and environmental hazards. This study was conducted to assess the nematicidal effects of red acalypha (Acalypha wilkesiana) leaf extract on plant parasitic nematodes and subsequent plantain yield. The experiment was a randomized complete block design of four treatments; pared control (P), non-pared control (NP), pared+acalypha (PA) and non-pared+ acalypha (NPA). Roots and rhizome damage by nematodes were assessed in order to score the degree of internal necrosis. Parasitic nematodes on the roots were extracted and counted using the modified Bearmann technique. Helicotylenchus multicinctus, Meloidogyne species and Radopholus similes were the most prevalent parasitic nematode species in all root samples examined. Reduced incidence of dead roots and root necrosis index were recorded among the acalypha treated plants. They also gave the best yield. Results from the experiment indicate that red acalypha plant (Acalypha wilkesiana) leaves could be deployed by plantain farmers and stakeholders in crop protection for the management of plant parasitic nematodes.

Keywords: Parasitic nematodes, red acalypha, nematicidal effects, plantain yield, corm damage

INTRODUCTION

Plantain (*Musa parasidiaca*) is an important food staple that is very critical in bridging the gap between the demand and supply of basic carbohydrate. It is an important source of income, particularly for the small holder farmers that grow plantain in their compounds or home gardens (Adesope, *et al.,* 2004). Plantain is an important diet of many Nigerian families; it is eaten in various forms like fried plantain, plantain chips and as plantain flour (Akinwumi, 1999). Plantain

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is relished by livestock; the peels constitute valuable fodder for goat and sheep. The peels and stalk could also be burnt and the resultant ash used for the production of a local soap popularly called black soap.

I spite of the usefulness of plantain, intensification of its production is hampered by some factors which include soil fertility decline, pests and diseases attack and socio-economic problems (Gold *et al;* 1999). Increase in yield is a function of root system, hence high productivity of plantain strongly depends on healthy root systems. Plantain root system consists of adventitious roots which are responsible for anchorage and movement of water and nutrients in the plants (Price, 1995). Major pests which affect the development of the root system in plantain are the parasitic nematodes. The nematodes feed on plantain roots causing root necrosis, root rot and reduced number of functional roots (Kashaija *et* al., 1998). Damage to root impairs nutrient flow; suppress shoot growth and subsequent yield reduction. In heavy infestation, the root lesions can coalesce and the necrosis becomes extensive, causing distortion, root decay and subsequent death of plants (Oso and Longe, 2015).

Nematodes are now recognized as important soil-borne pathogens causing decline in yield of bananas and plantain by as much as 30 – 60 %. The burrowing nematodes or the banana-root nematodes, particularly *Radopholus similis*, cause toppling or blackhead disease of plantain and banana. These nematodes invade and feed on the cortex of the roots causing lesions and cavities. The root systems are reduced, severely damaged and unable to uptake water and nutrients; thus, the plants lack vigour; are stunted, and because of poor anchorage, are prone to topping under bunch weight or to being blown over even by not so strong wind. Where there is severe nematode infestation, ratoon crops are hardly produced as there is continued plant loss and significant reduction of suckering (Homenauth and Dwarka, 2011).

Nematode infested plantain/banana does not respond well to fertilizer application, irrigation or other cultural practices (Homenauth and Dwarka, 2011). Different nematicides had however been tested and found effective against parasitic nematodes but their hazardous and deleterious effects on man and the ecosystem have necessitated the evaluation of other eco-friendly methods of control. *Acalypha wilkesiana* popularly known as red acalypha plant have both antibacterial and antifungal properties (Oladunmoye, 2006). Olaniyi (2006) reported that root dip of plantain suckers in red acalypha leaves extract for 20 minutes improved the vegetative roots and root health of plantain. This study therefore, examined the nematicidal effects of red acalypha (*Acalypha wilkesiana*) leaves extract against the parasitic nematodes affecting plantain in Ekiti State University's moribund plantain orchard.

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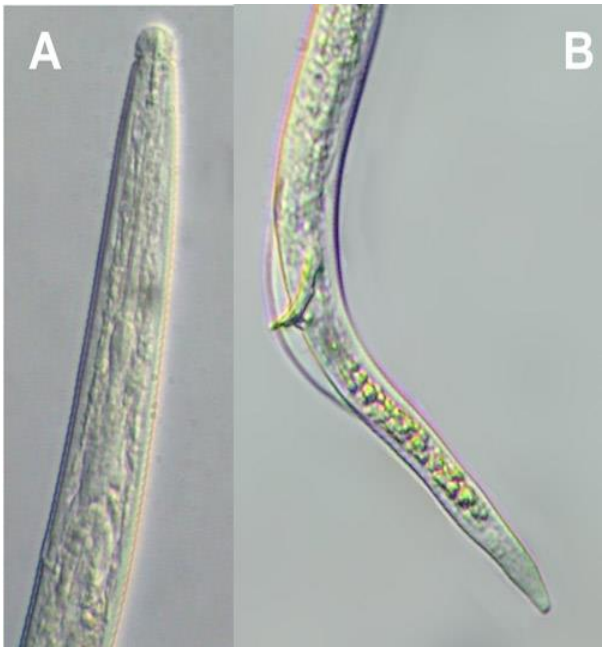
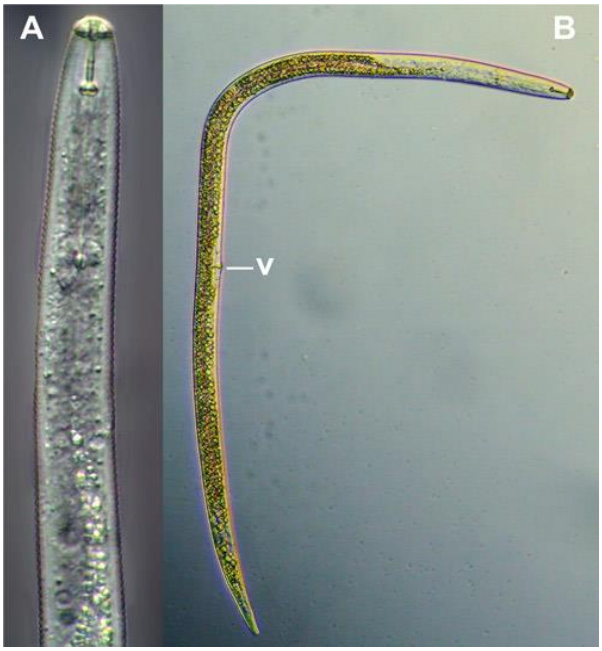


Radopholus similis (Male head: A; Tail: B)



Radopholus similis (Female head: A; Full body: B)

MATERIALS AND METHODS

Description of Experimental Area

The study was carried out on an established plantain orchard at the Teaching and Research Farm of Ekiti State University located on the bearing of 7^0 31N and 5^0 13E, approximately elevation of 730 m above sea level. The trial was arranged in randomized complete block design of four treatments; pared suckers (P), non-pared suckers (NP), Pared suckers dipped in acalypha leaves extracts (PA) and non-pared suckers dipped in acalypha leaves extracts (NPA). The experimental site covers a total area of 419 m^2 spaced at 2.5 m X 2.5 m between and within the rows.

Preparation of Red Acalypha Leaves Extracts and Treatment of Plantain Suckers

Fresh acalypha leaves collected from the University were air dried and milled into powdery form. 90 g of the powder was dissolved in 10 litres of water and a wooden rod used to stir the mixture in order to ensure that the solution properly mixed after which it was left to stand for 20 minutes. Suckers were dipped into the solution for another 20 minutes before planting them on the field.

Roots and Rhizomes Assessment

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Five functional roots were randomly selected and each was reduced to 10 cm length. Damage assessment was done on the roots and scored as follows:

1 = when the lateral feeder roots are all healthy

2 = when the feeder roots are mostly healthy

3 = when the feeder roots are mostly dead

4 = when all feeder roots are adjudged dead (Speijer and Gold, 1996).

Root necrosis was also assessed by slicing the 10 cm root lengthwise and each root piece was scored 0- 20 % based on the degree of internal necrosis. The sum of the necrosis score for the root pieces gave the necrosis index (Speijer and De waele, 1997).

Nematode Extraction and Identification

Nematodes were extracted from 5 grams sub samples of the assessed roots after they were chopped into smaller pieces and blended for 15 seconds. Extraction was done using a modified Bearmann tray technique (Gowen and Queneherve 1990). A white pile of paper serviette was used to line a sieve placed in a collecting plate, the solution was carefully poured on the lined sieve and left to stand for at least 24 hours before pouring. The resulting suspension was reduced to 30 ml with a syringe after leaving it to settle for at least 4 hours and the nematodes were then counted using a compound microscope.

Suckers dipped in red acalypha leaves extract

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RESULTS AND DISCUSSION

The effects of red acalypha leaves extract on plantain root and corm damage is shown in Table 1. The number of dead root counted as represented by DR was significantly ($p<0.05$) higher in the non-pared (NP) suckers, when compared with other treatments. Non pared treatment also had higher incidences of root necrosis (6.67) than all the other treatments. This was followed by non pared acalypha (NPA) treated suckers (3.37). Although no significant differences were observed for the feeder root index (FRI) among all the treatments, nevertheless feeder roots from non-pared suckers and non suckers treated in acalypha extract were observed to be mostly dead. On the corms of detached suckers, more small and large lesions were observed on non-pared suckers and non-suckers treated with acalypha. The higher level of root and corm damages recorded in NP and NPA treated suckers suggests the susceptibility of these treatments to invasion by parasitic nematodes.

Table 1: Effects of red acalypha leaves extract on plantain root and corm damage.

Treatment	Dead roots	Root necrosis index	Feeder root index	Small lesions	Large lesions
Pared	25.67b	0.67c	2.67a	0.67c	2.67ab
Non-pared	46.33a	6.67a	3.00a	2.00ab	2.00b
Pared+acalypha	36.33b	1.67c	2.33a	1.33bc	2.00b
Non-pared+acalypha	34.00b	3.67b	3.00a	2.67a	3.67a

Data followed by the same letters do not differ significantly according to DMRT

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Table 2; Effects of red acalypha leaves extract on plantain yield

Treatment	Bunch weight(kg)	Number of hands	Number of fingers
Pared	5.85b	4.67c	23.67b
Non-pared	6.61b	5.48bc	30.60a
Pared+acalypha	8.06a	6.75ab	27.86a
Non-pared+acalypha	4.40c	8.00a	20.00c

Data followed by the same letters do not differ significantly according to DMRT

Table 3. Showing the linear correlation matrix of the site in mean values, using *Helicotylenchus multicinctus* (Hm) and *Meloidogyne spp* (Ms).

	TRT	DR	RNI	SL	LL	BW	NH	NF	HEL	MEL	NS	FL	PH	FRI	TR
TRT	1	.77	-.38	.36	.60*	-35	.78**	-.26	-.98**	.04	-.50	-.23	.07	-.09	-.43
DR		1	.73*	.14	-.66*	.30	-.42	-.30	.72**	.09	.70*	-.26	-.58*	.12	-.08
RNI			1	.65*	-.07	-.09	.11	-.20	.36	-.08	.62*	-.48	77**	.49	-.58*
SL				1	.42	-.40	.53	-.27	-.34	-.14	.19	-.65*	.67*	.47	-.81**
LL					1	-.75*	.43	-.01	-.47	-.56	-.59*	.09	.25	.30	-.32
BW						1	-.19	.08	.20	.83**	.42	-.08	-.23	-.45	.29
NH							1	-.56	-.81**	.17	-.07	-.44	-.36	.09	-73**
NF								1	.30	-.15	.08	.20	.37	.13	.39
Hm									1	-.20	.41	.31	.02	.18	.45
Ms										1	.35	-.41	-.41	-.48	.05
NS											1	-.60*	-.70*	.32	.32
FL												1	.85**	-.10	.81**
PH													1	-.41	.75**
FRI														1	-.21

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TR 1

* = Correlation coefficient significant at p≤ 0.05 ** = Correlation coefficient significant at p≤ 0.01

KEY TO THE LINEAR MATRIX TABLE (Table 3)

DR = Dead Roots

RNI = Root Necrosis Index

FRI = Feeder Root Index

TR = Total Roots

FL = Functional Leaves

PH = Plant Height

NS = Number of Suckers

LL = Large Lesions

SL = Small Lesions

BW = Bunch Weight

NH = Number of Hands

NF = Number of Fingers

Hm = *Helicotylenchus multicinctus*

Ms = *Meloidogyne spp*.

Table 2 shows the effect of red acalypha leaves extract on plantain yield. Pared and red acalypha treated suckers produced significantly greater bunch weight. Highest numbers of fingers were recorded in non-pared treatments which did not significantly differ from pared and acalypha treated suckers. Similarly, highest numbers of hands were recorded among non-pared acalypha

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treated suckers and this was not significantly higher than the number of hands observed in pared acalypha treated suckers.

Table 3. Showing linear correlation matrix (half) of site mean values for nematode population densities / 100g fresh root and corm damage parameters is shown in table 3. The correlation showed various statistically significant interactions. Relationship which affects nematode population density and root corm damage include those between; corm damage + parasitic nematode population, yield + parasitic nematode + root production. The positive correlation between Root Necrosis Index (RNI) and number of Dead Roots (DR) is an indication that RNI increases with increasing number of DR.

Negative correlations between the nematodes, for example *Helicotylenchus multicinctus* and number of hands indicate, that as the population density of *Helicotylenchus multicinctus* decreases, the number of hands increases and vice versa.

CONCLUSION

A complementary relationship between paring and red acalypha leaves produced higher yielding plants with lower incidence of dead roots and very few lesions on the corm. This is as a result of the fact that they conferred some degrees of protection against infestation by parasitic nematodes thereby enhancing formation of healthy root system. This in return improved anchorage and made water and mineral nutrients available for optimum yield. Paring of suckers and subsequent dipping in red acalypha plant extract have the potential for nematodes control and promote healthy rooting system for better plant development and crop yield.

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