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Effectiveness of Neem Leaf Extract and Ethoprop in Controlling Sugarcane Root-Knot Nematode

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ABSTRACT

Comparative effectiveness of neem *(Azadirachta indica* A. Juss) leaf extract used as soil amendment and a chemical nematicide (ethoprop) singly and in combination in controlling sugarcane root-knot nematode *(Meloidogyne incognita)* was investigated. Neem extract amendment alone considerably suppressed root-knot development. Neem extract in combination with ethoprop at the rate of 2-4 kg ai/ha were as effective as ethoprop at the rate of 5-8 kg ai/ha in controlling the root-knot nematode of sugarcane. Neem leaf extract amendment was not toxic to sugarcane. Sugarcane plants was found healthy and vigorous.

INTRODUCTION

Root-knot nematode *(Meloidogyne* spp.) are serious pest of sugarcane (Goodey *et al.* 1965). Two species, *M. incognita* and *M. Javanica* are known to be associated with the roots of sugarcane in Nigeria (Caveness, 1967). Salawu (1985, 1986) reported seventeen sugarcane cultivars including Co 1001 and Co 957, which are popular commercial varieties in the Nigerian Sugar Estates are susceptible to *M. incognita* infection.

Although chemical nematicides have been the most effective method of controlling parasitic nematodes of agricultural crops ; the use of organic amendments found to be equally toxic, comparatively cheaper and less harmful to man (Singh and Sitaramaiah, 1970 ; Sayre, 1971 ; Alam *et al*, 1980 ; Egunjobi and Ekundare, 1981). Neem *(Azadirachta indica* A. Juss) leaf extract was effective in controlling *Pratylenchus brachuurus* of maize *(Zea mays* L.) in Nigeria (Egunjobi and Afolani, 1971). Similar studies on neem leaf in Western Germany (Roessner and Zebitz, 1986) also found effective in controlling a root-knot nematode *(M. incognita)* of tomato.

Ethoprop (O-ethyl S, S-dipropyl phosphordithiodate) is an organophosphate nematicide and less systemic (Bunt, 1979). In Java, Handojo and Legowo (1980) demonstrated that ethoprop at the rate of 22.5 kg/ha suppressed considerably the population of *Helicotylenchus, Pratylenchus, Meloidogyne and Criconemoides* species.

Apart from the hazards associated with the application of chemical nematicides, the prohibitive costs of the chemicals have greatly discouraged many farmers. Therefore, the aim of the present investigation is to determine the effectiveness of neem leaf extract amendment alone and in combination with ethoprop at rates much lower than 5 kg ai/ha recommended, in controlling *Meloidogyne incognita* attacking sugarcane.

MATERIALS AND METHODS

Neem leaves were collected from Ilorin area of Nigeria. One kilogram of neem leaves were boiled for 10 minutes in one litre tap water, sieved and allowed to cool, and then the solution was preserved in a 2.5 litre glass container.

Sugarcane cultivar Co1001 highly susceptible to *M. incognita* was used as the planting material. Single-bud setts were surface sterilized in 1.5% sodium hypochlorite (NaOCl) solution contained in a plastic container. Later, the setts were planted in perforated 5 litre plastic pots containing steam-sterilized top soil mixed with pure sand in ratio 2:1. The second stage juveniles of *M. incognita* were taken from the stock culture maintained on *Celosia argentia* and used as inoculum. Infected roots were macerated for 30 seconds and the juveniles were extracted using a modified extraction tray method of Whitehead and Hemming (1965).

Two weeks after emergence, seedlings were inoculated with approximately 5000 second stage juveniles of the nematode, while uninoculated plants served as control. Immediately after inoculation, ethoprop was applied alone and in combination with the neem leaf extract (NE) to the root zone of young seedlings.

There were nine treatments :

1) Plant alone (Control)
2) Plant + nematode + 100 ml NE
3) Plant + nematode + 100 ml NE + 2 kg ai/ha Ethoprop
4) Plant + nematode + 100 ml NE + 3 kg ai/ha Ethoprop
5) Plant + nematode + 100 ml NE + 4 kg ai/ha Ethoprop
6) Plant + nematode + 5 kg ai/ha Ethoprop
7) Plant + nematode + 6 kg ai/ha Ethoprop
8) Plant + nematode + 7kg ai/ha Ethoprop
9) Plant + nematode + 8 kg ai/ha Ethoprop

Each treatment was replicated thrice. The plants were randomly arranged on the bench in the screenhouse, and irrigated with tap water daily. At four-week intervals, 8g NPK fertilizers was added to each plant for normal growth.

One hundred and forty days after inoculation and the addition of amendments, the plants were carefully harvested from the pots. The roots were gently washed in tap water to remove adhering soil particles. The fresh millable cane, root and shoot weights, the stalk length (from ground level to the topmost visible dewlap, TVD) and the total soluble solids (TSS) using a hand refractometer, were recorded.

Roots were examined carefully and galls were counted. Five gramme root samples were randomly taken and macerated for 30 seconds. The second stage juveniles of the nematodes were extracted from the roots as described before.

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RESULTS AND DISCUSSION

The results of the investigation are presented in Tables 1 & 2. Significant difference was not obtained in stalk length, fresh weight of millable cane and total soluble solids (TSS) of plants treated with nematode plus soil amendments compared with the control. Differences in shoot and root weights in treated soils compared with the control varied. Plants treated with ethoprop at the rate of 4 kg ai/ha plus neem extract were greater in shoot weight than the control and those treated with same chemical at the rate of 8 kg ai/ha (Table 1). There was, however, no difference was obtained in shoot weights among those plants treated with ethoprop alone at the rate of 5, 6 and 7 kg ai/ha. This result suggests that neem extract in combination with ethoprop at 2-4 kg ai/ha were as effective as ethoprop alone at the rate of 5-8 kg ai/ha. The growth of plants were vigorous, the leaves were green and healthy.

Differences in root proliferation of plants treated with neem extract alone and in combination with ethoprop were not significant (P=0.05). Similarly plants treated with ethoprop alone at the rate of 5, 7 and 8 kg ai/ha (except plants that received 8 kg ai/ha) were not significantly different. Although root proliferation of control plants was significantly greater than those plants treated with ethoprop at the rate of 6 kg ai/ha, and those that received neem extract plus ethoprop at the rate of 2-4 kg ai/ha respectively but decrease in top growths as a result of poor root porliferation of these plant was not evident (Table 1).

In this investigation, roots of plants treated with neem extract alone were moderately galled. This result is in accord with Roessner and Zebitz (1986) who reported that neem extract amendment was not phytotoxic to tomato plant and significantly suppressed root galls caused by *M. incognita*. The root galls also decreased considerably when, neem exract in combination with ethoprop at the rates of 2-4 kg ai/ha were applied to the root zones. The plant roots were completely free of galls as the concentration of ethoprop alone increased (Table 2). Ethoprop is less systemic (Bunt, 1979), and when applied at the rate of 22.5 kg/ha considerably suppressed the population of *Meloidogyne Criconemoides* and *Helicotylenchus* species attacking sugarcane in Java (Handojo and Legowo, 1980). In the present study, however, it was evident that neem extract in combination with ethoprop at concentrations lower than 5 kg ai/ha effectively controlled *M. incognita* and this was accompanied by increased top growth of sugarcane.

Table 1. Effects of neem leaf extract amendments singly and in combination with ethoprop on fresh shoot, root and millable cane weights, stalk length and total soluble solids (TSS) of sugarcane cultivar Co 1001 inoculated with *M. incognita* (Mean of three replications).

Treatments	140 days after application of amendments				
	Fresh weight/Plants				
	Shoot (g)	Root (g)	Stalk length (cm)	Each milleable cane weight (g)	TSS
Plant alone (control)	285.4 a	224.6 d	97.0 a	236.4 a	5.3 a
Plant + nematode + 100 ml neem extract (NE)	329.8 abc	181.2 abcd	107.0 a	220.1 a	5.3 a
Plant+nematode+100 ml NE+2 kg ai/ha, Ethoprop	295.6 ab	158.9 ab	108.0 a	235.3 a	6.3 a
Plant+nematode+100 ml, NE+3 kg ai/ha, Ethoprop	372.8 bc	180.9 abcd	102.7 a	263.4 a	5.0 a
Plant+nematode+100 ml, NE+4 kg ai/ha, Ethoprop	387.6 c	167.0 abc	104.3 a	254.2 a	5.7 a
Plant+nematode+5 kg ai/ha, Ethoprop	329.2 abc	217.8 bcd	107.0 a	254.9 a	5.7 a
Plant+nematode+6 kg ai/ha, Ethoprop	346.9 abc	146.4 a	103.0 a	276.5 a	5.3 a
Plant+nematode+7 kg ai/ha, Ethoprop	345.4 abc	217.7 bcd	103.7 a	242.8 a	6.7 a
Plant+nematode+8 kg ai/ha, Ethoprop	283.1 a	178.6 abcd	105.3 a	208.2 a	4.3 a

Means followed by same letter in the same column are not significantly different according to DMRT (p=0.05).

Table 2. Effect of neem leaf extract amendment singly and in combination with ethoprop on root gall development and nematode population in root of sugarcane cultivar Co 1001 inoculated with *M. incognita*.

Treatments	140 days after application of amendments	
	Root Gall/ root system	Mean Nematode number/5 g root
Plant alone (Control)	—	—
Plant + nematode + 100 ml. neem extract (NE)	20±4.5	1,200±34.6
Plant + nematode + 100 ml. NE + 2 kg ai/ha Ethoprop	10±3.2	987±31.4
Plant + nematode + 100 ml, NE + 3 kg ai/ha, Ethoprop	10±3.2	812±28.5
Plant + nematode + 100 ml, NE + 4 kg ai/ha, Ethoprop	8±2.8	1,001±31.6
Plant + nematode + 5 kg ai/ha, Ethoprop	0±0.0	0±0.0
Plant + nematode + 6 kg ai/ha, Ethoprop	0±0.0	0±0.0
Plant + nematode + 7 kg ai/ha, Ethoprop	0±0.0	0±0.0
Plant + nematode + 8 kg ai/ha, Ethoprop	0±0.0	0±0.0

± Standard Error of mean

Neem *(A. indica* A. Juss) is widely cultivated in Nigeria as an ornamental plant. According to Ukponu (1985) all the parts of the plant contain some better principles composed of nimbin, nimbinin and desacetyllimbin. It appears likely that these active principles enhanced effectiveness of ethoprop at extremely lower concentrations for the control of the nematode.

Further investigation is required to prepare a package for local sugarcane growers.

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