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Toxicity of some plant extracts to *Meloidogyne incognita*

J. O. AMOSU
Department of Plant Science
Obafemi Awolowo University
Ile-Ife, Nigeria

Abstract

The effect of water soluble extracts of the roots of siam weed *(Chromolaena odorata), castor (Ricinus communis),* tomato *(Lycopersicon esculentum* cv. Ife 1) and cowpea *(Vigna unguiculata* ssp *unquiculata* cv. Ife Brown) on root-knot nematode, *Meloidogyne incognita* was studied *in vitro.* All the concentrations of the root extracts tested were toxic to the nematode larvae. The extracts also inhibited the hatching of the eggs into larvae, extracts from *C. odorata* being particularly effective. Extracts from roots of *R. communis* were most toxic followed by *C. odorata* while those from tomato and cowpea were less toxic.

It is suggested that water soluble root extracts of *C. odorata* could be used to control root-knot nematodes in nursery beds in raising vegetable crops that are to be transplanted to the field later.

Introduction

Aqueous extracts of several plants are known to have antihelminthic properties. Roots or other parts of these plants contain chemicals which when present in sufficient concentrations exert toxic effects on plant parasitic nematodes in the soil. Such plants that have antihelminthic properties that have been investigated include *Asparagus officinalis,* L. (Rohde & Jenkins, 1958) *Tagetes* spp. (Toida, 1972; Belcher & Hussey, 1977; Rajvanshi, Varma & Yadav, 1985), 1972; Belcher & Hussey, 1977; Rajvanshi, Varma & Yadav, 1985), *Azadirachta indica,* A. Juss (Alam, Masood & Hussain, 1975; Egunjobi & Afolami, 1976; Egunjobi & Onayemi, 1981) *Ricinus communis,* L., (Hackney & Dickerson, 1975) and *Indigofera hirsuta,* L., (Rhoades, 1976).

Chromolaena odorata (L.) King & Robinson is a highly competitive noxious weed found widely distributed throughout the country. Plant and soil samples from areas where *C. odorata* and *R. communis* thrived show very little nematodes population and in some cases are non-existent (Hackney & Dickerson 1975). In the present study, an attempt was made to ascertain whether the toxicity of water soluble extracts of roots of non-host plants such as *C. odorata* and *R. communis* to root-knot nematodes, *Meloidogyne incognita* (Kofoid & White 1919) Chitwood 1949 is significantly high as to justify the possible utilization of the plants for nemic control. It was also to compare toxicity of water soluble root extracts of root-knot nematode susceptible crops, *Vigna unguiculata* (L.) Walp. ssp *unguiculata* cv. Ife Brown and *Lycopersicon esculentum,* Mill cv. Ife 1 (Amosu, 1974; Amosu & Babatola, 1976) with the toxicity of water soluble root extracts of *C. odorata.*

Materials and Methods

In vitro studies were conducted with aqueous extracts from roots of siam weed *(C. odorata),* castor *(R. communis)* tomato *(L. esculentum* cv. Ife 1) and cowpea *(V. unquiculata* cv. Ife Brown) on root-knot nematodes in two separate trials.

Larvae of root-knot nematodes were obtained by treating roots of root-knot nematode-infected Ife 1 tomato plants with a 10% Clorox solution (sodium hypochlorite) and passing the suspension through 200-mesh sieve nested in a 500-mesh sieve (Hussey & Barker, 1973). The eggs from the 500-mesh sieve were rinsed into a 500ml beaker. The larvae were obtained from the eggs by an adaptation of Christie & Perry method (1951).

In the first experiment, castor oil plants were raised from seeds while siam weed was raised vegetatively from stem cuttings in wooden trays in the greenhouse for nine weeks. The roots of the test plants were harvested and washed. 25 percent solution by weight of each extract was prepared by chopping 40g of the root in 160 ml. of water using Warring blender. The extracts were filltered through Whatman No. 1 filter paper. 16 percent solution by weight of the extract was made by introducing 25 ml. of nematode solution containing 750 freshly hatched larvae of *M. incognita* into 50 ml of each root extract solution. Control treatment was 25ml. of nematode solution added to 50 ml of distilled water. Five drops of 0.1 percent aqueous solution of streptomycin sulphate was added to each treatment to avoid contamination. Percentage mortality of larvae in three-1 ml. aliquot samples of the solution was recorded as viewed under a dissecting stereomicroscope at intervals of 0, ½, 1, 2, 4, 8, 24 and 48 hrs.

In the second test, extracts from three test plants: siam weed, tomato cv. Ife 1 and cowpea cv. Ife Brown were used. Twenty grams of roots of each one-month old test plant were ground in 300 ml. of sterile distilled water using a Warring blender. The extract solution was filtered through Whatman No. 1 filter paper and the solution was made up to 500 ml. From the standard solution, two dilutions, half and one-quarter, were prepared. The root-knot nematode eggs and larvae were extracted as described earlier. Four ml. of standard solution and its dilutions (S/2, S/4) were introduced into 50 ml petri dishes, with sterile distilled water serving as control. 500 freshly hatched larvae of *M. incognita* in 2 ml suspension were introduced into each petri dish.

The percentage of dead and moribund nematodes were recorded at intervals of 1, 5, 10, 20, 30, 70 hrs. as in the previous experiment. To test the effect of the various extracts on the hatching of root-knot nematode eggs, 2 ml. of egg suspension containing 4,00 eggs was introduced into petri dishes containing 4 ml. root extract of each test plants. Total number of hatched larvae was recorded after 60 hrs. Each treatment had 3 replicates.

Results

The results showed that water soluble extracts of roots of *C. odorata* and *R. communis* were toxic to the larvae of root-knot nematodes. This was indicated by increasing death rates with time (Table 1). Within the first 4 hrs. of suspension of the larvae in castor extract, 72 percent died while 56 percent death was recorded in siam weed. Castor extract appeared to be more toxic to the larvae than the siam weed extract. There was positive correlation of 0.85 between the siam weed and castor extracts.

In the second experiment, the toxic effect of siam weed was greater than those of tomato and cowpea with mortality increasing with an increase in the

concentration of extract as well as period of exposure (Table 2). Extracts from the roots of cowpea were less toxic than those of tomato.

In the hatching test, the extracts of the different plants irrespective of concentration caused marked suppression of larval hatching in comparison to the control and expressed a linear relationship between concentration of the extract and number of larvae hatched.

The larval hatch that occurred in the water soluble root extracts of siam weed was significantly different from the larval hatch in the other two root extracts at $P = 0.01$ (Table 3).

Discussions

The toxicity of water soluble root extracts of *C. odorata, R. communis, L. esculentum* cv. Ife 1 and *V. unguiculata* cv. Ife Brown to *M. incognita* had been demonstrated. The direct relationship between mortality of larvae and exposure time, mortality of larvae and dilution and between larval hatch and dilution agree with the findings of earlier workers (Yadav, 1970; Miller, Turner & Tomlinson 1973; Alam *et al.* 1975; Hussain & Masood, 1975; Egunjobi & Afolami 1976; Egunjobi & Onayemi 1981; Rajvaushi *et al.* 1985; Goswami & Vijaya-lakshmi, 1986; and Jain, Datta, Trivedi & Tiagi 1986). There was a direct linear relationship between the extracts of *C. odorata* and *R. communis* on the death rate of root-knot larvae. Extracts from roots of *R. communis* were most toxic followed by those of *C. odorata* and those from tomato and cowpea were less toxic. Under field conditions, *L. esculentum* cv. Ife 1 and *V. unguiculata* cv. Ife Brown are both susceptible hosts of *M. incognita* (Amosu, 1974; Amosu & Babatola, 1976). The toxic property of their root extracts *in vitro* may be due to reaction of crushed cellular materials resulting in the formation of substances that were toxic to *M. incognita*. Kuc (1963) reported that in mechanically injured leaves of certain apple trees, a rapid hydrolysis of phloridzin by b-glycosidase to phloretin takes place; and the latter was oxidised by a phenol oxidase to a compound highly fungitoxic to the apple scab fungus, *Venturia inaegualis* (Cke) Wint., 1875. The ability to produce the series of reactions that produces the inhibitor was present in resistant as well as susceptible hosts.

The toxic properties of root extracts of siam weed and castor plant to root-knot nematode larvae point to their suitability for controlling the nematode population in the soil. Castor extract is more lethal to the root-knot nematodes than siam weed extract suggesting that castor may be used as a rotation crop or intercrop to control *Meloidogyne* spp. in infested soil. Siam weed is commonly and widely distributed throughout the country. Application of its root extracts on root-knot nematode infested beds prior to seeding of vegetable crops such as tomato and pepper may likely prove to be an effective and cheap method for the control of root-knot nematode. This possibility of utilising plant extracts for nemic control warrants further investigation.

Many active principles like thiophene from marigold and mimbidine and thionnemone from neem have been extracted (Gommers, 1973). These substances have been shown to be highly toxic to plant parasitic nematodes. Further work is required to identify the nematicidal materials in the root extracts of siam weed and castor.

Table 1. MEAN PERCENT MORTALITY OF *MELOIDOGYNE INCOGNITA* LARVAE IN ROOT EXTRACTS FROM *CHROMOLAENA ODORATA* AND *RICINUS COMMUNIS*

Exposure time (hr.)	(a) Percentage Mortality	
	Chromolaena odorata	Ricinus communis
0	0.0	0.0
½	0.0	0.0
1	11.1	12.5
2	20.0	20.5
3	25.0	33.3
4	56.0	75.0
8	80.9	93.3
24	100.0	100.0
48	100.0	100.0

(a) Each value is a mean of 3 replicates.
No mortality occurred in distilled water.

TABLE 2 MEAN PERCENT MORTALITY OF *MELOIDOGYNE INCOGNITA* LARVAE IN DIFFERENT CONCENTRATION OF EXTRACTS FROM SOME PLANT ROOTS

Exposure time (hr.)	a) Percentage mortality in different concentration									Distilled water
	Siam Weed			Tomato			Cowpea			
	S	S/2	S/4	S	S/2	S/4	S	S/2	S/4	
1	13.3	10.6	8.2	10.0	8.0	7.0	9.0	6.0	0.0	0.0
5	38.0	18.0	16.0	16.0	10.0	9.0	13.0	9.0	8.0	0.0
10	71.0	27.0	21 0	36.0	17.0	12.0	26.0	22.0	12.0	0.0
20	90.0	40.0	29.0	50.0	33.0	19.0	38.0	30.0	17.0	0.0
30	97.0	43.0	35.0	58.0	40.0	26.0	48.0	35.0	24.0	2.0
70	100.0	49.0	38.0	65.0	45.0	32.0	60.0	40.0	30.0	3.0

a) Each value is a mean of 3 replicates

TABLE 3. MEAN NUMBER OF *MELOIDOGYNE INCOGNITA* LARVAE HATCHED IN 60 HOURS IN DIFFERENT CONCENTRATIONS OF EXTRACTS FROM SOME PLANT ROOTS

	a) Conc. of root extracts			Distilled water
Treatments	S	$S/2$	$S/4$	
Siam Weed	324	560	600	906
Tomato	456	588	661	906
Cowpea	589	720	752	906
LSD 0.01	11.7	35.1	33.0	0.0

a) Each value is a means of 3 replicates.

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