Agrosearch (2010 & 20011) 11 No. 1&2 31 - 38 Http://dx.doi.org/10.4314/agrosh.v11i1.4

EFFICACY OF AQUEOUS EXTRACT OF LEMON GRASS (*Andropogon citratus* L.) AGAINST ROOT-KNOT NEMATODE PESTS OF OKRA *(Abelmoschus esculentus* (L.) Moench).

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ABSTRACT

An experiment to determine the effects of lemon grass, *Andropogon citratus* L. extract on the root-knot nematodes (*Meloidogyne* spp.) of okra was conducted. Phytochemical analyses of the bioactive ingredients in lemon grass were carried out to determine the chemical compounds with nematicidal activities present in lemon grass.

Okra (var. Clemson 40) was planted in twenty four (24) experimental pots containing 5kg steam-sterilized loamy soil. Each plant stand was inoculated with 30ml of root-knot nematode egg suspension containing approximately150 eggs/ml. A set of 4 pots were left un-inoculated (control). The lemon grass extracts were 0, 25, 50, 75 and 100% concentrations. Two control trials were used: nematode uninoculated and untreated with leaf extract as control 1 and nematode inoculated but not treated as control 2. Each treatment was replicated four times. The experimental design was a completely randomized type.

The result of the phytochemical screening showed that lemon grass contained tannins, alkaloids, flavonoids and saponins. The result of the pot trials showed that lemon grass extract significantly ($P<0.05$) increased growth and yield of nematode-infected okra. At 5-6 weeks after planting, plant height and number of leaves/plant were significantly ($P<0.05$) higher in the treated plants than the control. At harvest, the shoot weight of plants treated with higher levels of extract (75 and100%) were significantly ($P<0.05$) higher than the other treatments and the control . Mean fruit weight was significantly ($P<0.05$) higher in all the treated plants than in the inoculated but untreated control. Root gall index was significantly lower in treated than in the inoculated but untreated control. The higher concentrations of lemon grass extract were significantly more effective than the lower concentrations in controlling the nematodes and consequently improving the growth and yield of treated okra plants.

INTRODUCTION

Okra, (*Abelmoschus esculentus* (L.) Moench) is an annual crop cultivated for its young fleshy pods and sometimes for its leaves in tropical and sub-tropical parts of the world. Okra belongs to the family Malvaceae. Okra is widely used in soups with vegetables and meat. Okra pods may be cooked or eaten raw in salads. It is a rich source of many nutrients including vitamins C

and $B_{6,}$ folic acid and fibre (Zook,2006). The seed oil which is greenish and edible has pleasant taste and odour and is high in unsaturated fats such as oleic acid and linoleic acid (Franklin, 1982). It also contains substantial amount of carbohydrate and protein (Schippers, 2000).

Profitable production of okra has been limited due to dangers of pests and diseases among which are the root-knot nematodes, *Meloidogyne* spp. (Ogbuji, 1981; Oyedunmade, 2000). In addition to the direct crop damage caused by nematodes, many species have also been shown to predispose plants to infection by fungal or bacterial pathogens or to transmit virus disease which contributes to additional yield reduction and occasional crop failure (Adesiyan et al., 1990).

Chemical control has proven to be the most effective method of controlling root-knot nematodes but the high cost, health hazards and non-availability of synthetic pesticides at the time of need discourage resource poor farmers from their use. This has led plant nematologists in the recent times to pay more attention to use of organic amendments because of their availability, reduced cost and non-residual effect on crops (Anjum *et al.,* 1996; Chitwood 2002; Izuogu and Oyedunmade 2009a).

This study was therefore conducted to investigate the nematicidal potentials of aqueous extract of lemon grass, *Andropogon citratus* in the control of root-knot nematode infection of okra.

MATERIALS AND METHODS

An experiment using potted plants was conducted for twelve weeks at the Crop Protection pavilion at the Faculty of Agriculture, University of Ilorin. Lemon grass was collected from the University of Ilorin G.R.A quaters, air-dried at room temperature of 25-27^{0}C and ground into powder that pass through a 500 mesh sieve. The active compounds present in the ground lemon grass were determined using the methods described by Trease and Evans (1989) at the Ladoke Akintola University of Technology, Ogbomosho in Oyo state.

Steam sterilized soil was weighed into 24 perforated plastic buckets at the rate of 5kg per pot. Before planting the okra seeds, basal fertilizer application of N.P.K 20:10:10 at the rate of 6g was done to each pot to replace the lost nutrient during sterilization. Seeds of okra, (variety Clemson 40) were planted thereafter. Seedlings were thinned down to one vigorous plant per pot. Root-knot nematode eggs were extracted from galled roots of *Corchorus olitorus* following the technique described by Southey (1986). The egg suspension was standardized to contain approximately150 eggs/ml. Where necessary, the plants in twenty pots were inoculated with 30ml of nematode egg suspension each, one week after planting while the plants in 4 pots were left uninoculated and these served as the uninoculated control. Aqueous extract of lemon grass was prepared by soaking one kilogram of the ground test plant in five litres of distilled water for twenty-four hours. The content was filtered and the filtrate was concentrated to 100ml by heating in waterbath to remove excess solvent. The concentrated solution was taken as stock solution (100%). Serial dilutions from this aqueous stock solution were made with distilled water to obtain the following concentrations:

25%=1ml concentrated plant extract + 3ml distilled water

50%=2ml concentrated plant extract + 2ml distilled water
75%=3ml concentrated plant extract + 1ml distilled water
100%=concentrated plant extract(stock solution)
Two weeks after planting, different levels (0, 25, 50, 75 and 100%) of aqueous leaf extract of lemon grass were applied as appropriate. Control trials were two sets; nematode uninoculated and untreated with extract (control 1), and nematode inoculated but not treated (control 2) giving a total of six treatments replicated 4 times each. The design of the experiment was a completely randomized.

Weekly data were recorded on the following parameters: plant height, number of leaves and number branches. At harvest, data were collected on shoot weight, fruit weight, root weight using a beam balance and final soil nematode population was done by adopting the Whitehead and Hemming (1965) extraction process. Root gall index was also determined using the rating scale of Taylor and Sasser (1978).

All data collected were subjected to analysis of variance using SAS (1997) package and where appropriate, the means were separated using Duncan Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

The growth and yield of untreated okra plants was significantly reduced as manifested in the plant height, number of leaves and fruit weight as compared with treated plants (Tables 1 - 3). The plants treated with 100% and 75% extracts showed significantly ($P<0.05$) higher vegetative growth. This is as a result of relatively nematode free environment which aided efficient nutrient uptake. Babatola, (1986) reported that the massive root galls shown in nematode affected plants prevent normal uptake of food and water. This led to loss of vigour, low level of leaf production and small sized leaves. The superior growth observed in the plants treated with lemon grass extract was accompanied by an observed reduction in the population of root-knot nematode, *Meloidogyne* spp. in the treated soil (Table 3). This result is in agreement with earlier work of Oyedunmade, (2000) who reported that African marigold (*Targetes erecta*) and carbofuran improved the vegetative growth of okra and significantly reduced the soil nematode population. Similar result was reported by Abid et al.,(1995) who demonstrated the effects of the derivative of neem in the control of root-knot nematode, *Meloidogyne javanica* on okra cultivation. The fact that leaves are the main organs of photosynthesis implies that increase in the leaf number resulted in an increase in fruit yield and consequent fruit weight of treated plants, hence treated plants assimilated more dry matter than the control plants. This corroborates the findings of Kelany, (2001).

Lemon grass treatments suppressed the nematode population and root gall index, (Table 4) while they increased the growth and yield of treated okra plants. The negative relationship observed between the parameters of soil nematode population/root galling index and those of growth/yield suggests that the reduction in growth and yield was due to nematode density in the soil and their activities in the plant tissue. Sasser *et al.,* (1975) reported that high population of

nematode species brought about high negative correlation for density versus index and yield factor.

Izuogu, 2009 (Unpub.) in an *in vitro* trial on the effect of selected plant extracts on the survival of *Meioidogyne incognita* in methanolic and aqueous media observed that at higher levels(10- 20%),there were no significant differences in juvenile mortality. Egg hatching was completely inhibited in both media at the highest level of lemon grass extract (20%). The inhibition of the egg hatch of the root-knot nematode is of significant importance agriculturally in that it reduces the initial nematode population and subsequent build-up of infective second stage juvenile (J_2). The effectiveness of lemon grass extract to reduce root galling as a result of reduced activities of nematode was due to nematicidal substances that lemon grass contains. Lemon grass was found to contain tannins, alkaloids, saponins and flavonoids (Table 5). These bioactive compounds in 10-20% aqueous and methanolic extracts of the test plant have been found to exhibit strong nematicidal activity (Izuogu 2009; Izuogu and Oyedunmade 2009b).

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Table 1: Effects of Lemon Grass Extract on Mean Number of Leaves of Okra

Treatments	Mean number of leaves/plant at weeks after treatment					
	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Control 1 (No nematode, no extract)	5.5	4.8	5.3	7.0	11.3^{a}	12.0^{bc}
Control 2 (Nematode + 0% extract of Lemon grass)	5.3	4.7	5.0	5.7	6.7^{c}	8.0^{d}
Nematode + 100% extract of Lemon grass	5.5	5.0	5.3	6.5	11.0^{a}	14.8^{a}
Nematode + 75% extract of Lemon grass	5.3	5.3	5.8	7.5	10.3^{ab}	12.3^{bc}
Nematode + 50% extract of Lemon grass	6.0	5.0	5.8	6.5	9.3^{b}	12.5^{b}
Nematode + 25% extract of Lemon grass	5.5	5.0	5.3	6.8	8.8^{b}	10.0^{cd}
S E	0.4	0.4	0.3	0.8	0.6	0.7
	N.S	N.S	N.S	N.S		

S.E = Standard Error
Mean in the same column followed by different letter(s) are significantly different at P = 0.05.

Table 2: Effects of Lemon Grass Extract on Mean Plant Height of Okra.

Treatments	Mean plant height at weeks after treatment (cm)					
	Week 1	Week 2	Week 3	Week 4	Week 5	Week 7
Control 1 (No nematode, no extract)	10.8^{b}	16.2	21.5	25.3	30.0^{b}	38.3^{bc}
Control 2 (Nematode + 0% extract of Lemon grass)	11.6^{ab}	17.3	22.0	26.0	30.8^{b}	33.5^{c}
Nematode + 100% extract of Lemon grass	14.1^{a}	19.5	25.0	30.0	44.0^{a}	50.5^{a}
Nematode + 75% extract of Lemon grass	12.5^{ab}	19.9	23.4	27.8	34.3^{b}	42.0^{b}
Nematode + 50% extract of Lemon grass	13.2^{ab}	18.0	22.1	27.8	35.5^{b}	41.5^{b}
Nematode + 25% extract of Lemon grass	13.09	20.4	25.6	28.0	31.0^{b}	37.0^{bc}
S E	1.0	1.5 N.S	1.7 N.S	1.7 N.S	1.8	1.6

N.S. = Not significant
S.E = Standard Error
Mean in the same column followed by different letter(s) are significantly different at P = 0.05 according to Duncan's multiple range test.

Table 3 Effects of Lemon Grass Extract on Mean Root Gall Index at Harvest

Treatments	Final nematode count/100ml soil	Root gall index
Control 1 (No nematode, no extract)	0^{a}	0^{a}
Control 2 (Nematode + 0% extract of Lemon grass)	31^{c}	4.1^{c}
Nematode + 100% extract of Lemon grass	10^{b}	2.2^{b}
Nematode + 75% extract of lemon grass	10^{b}	2.0^{b}
Nematode + 50% extract of lemon grass	16^{b}	2.5^{b}
Nematode + 25% extract of lemon grass	22^{bc}	3.3^{bc}
S.E.	0.7	0.3

SE Mean in the same column followed by different letter(s) are significantly different at P = 0.05.

Table 4: Phytochemical Screening Bioactive Ingredients in Lemon Grass Leaf

CONSTITUENTS	OBSERVATION
Tannins	+
Flavonoids	+
Alkaloids	+
Saponins	+
Steroids	-
Glycosides	-

Keys: + shows the presence of the investigated constituted/active Ingredients
- shows the absence of the investigated constituted/active ingredients