

Effect of Mahogany (*Khaya senegalensis* L) Leaf Extract on Root-Knot Nematode of Tomatoes (*Lycopersicum esculentum* L.)

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ABSTRACT: A screen house experiment was conducted to test the efficacy of leaf extract of mahogany (*Khaya senegalensis* L) for the control of root-knot nematodes of tomato. The completely randomized design was used to test the materials. Results obtained showed that the leaf extracts of the mahogany plant significantly ($P < 0.05$) reduced the population of the nematodes compared to the untreated seedlings. It also indicated that there is significant difference ($P < 0.05$) on the effect of the extract on the test organism between the varying concentrations of the extract used. The study revealed that the higher the concentration of the extract the more its effect on the test organism. The result also showed a significant variation ($P < 0.05$) in the extent of galling, plant height and root length in tomato treated with different levels of concentrations of the leaves extracts. The implications of these findings were discussed.

Keywords: Mahogany (*Khaya senegalensis*), Root-knot Nematode, Tomato (*Lycopersicum esculentum*)

INTRODUCTION

The tomato plant (*Lycopersicum esculentum* Linn) is one of the most widely grown vegetables in the world. It belongs to the family solanaceae. It is essential for balanced diet and maintenance of good health as it plays an important role in neutralizing the acids produced during the digestion of meat and other fatty acids. It promotes gastric secretion, acts as blood purifier and keeps intestines in good condition. It contains lycopene; a powerful antioxidant that helps prevent prostate cancer. Its consumption has been associated with decreased risk of breast cancer as well as neurodegenerative disorders. It also improves skin's ability to protect against harmful UV rays (Parray *et al.*, 2007). Plant nematodes are very minute, active, wormlike creatures with representatives in almost every kind of environment. They are well defined group of invertebrates ranked as a phylum or a class in the animal kingdom. Nematode is a Latin word derived from nematoid meaning "like a thread" and is used with other common terms such as eelworm, threadworm or roundworm. Nematodes are widespread and often occur in great numbers where food and

moisture are present (Adesiyani *et al.*, 1990). They have a cosmopolitan distribution so numerous that Cobb (1913) remarked that if all matters in the world were to be swept away, our world would still be dimly recognizable; we would find that mountains, hills, valleys, lakes, and oceans are represented by a film of nematodes. Taylor (1977) showed that one gramme of soil may contain 30-50 nematodes out of which 10-15 are parasitic. Some of these nematodes are ectoparasites while others are endoparasites (Adesiyani *et al.*, 1990).

Many crops including tomato are highly susceptible to attack by quite a large number of nematodes. Bridge (1972) evaluated yield loss of a bean cultivar and found out that 45-63% yield loss was due to nematodes. *Meloidogyne* sp is known as one of the most serious agricultural pests, causing considerable damage to vegetables, field crops and fruit trees all over the world. Caveness (1978) and Olowe (1981) had evaluated yield loss of a bean cultivar; calima due to root-knot nematodes, *Meloidogyne incognita* and *M. javanica* by field infestation techniques. These researchers had reported that nematode

induced yield losses of 45-63% to calima and 26-32% to PVA 916, as determined by dry seed weight. Yield loss due to nematodes was greater than with concurrent leaf hopper damage. The plant *K. Senegalensis* (madachi in Hausa, oganwa in Youruba and ono in Igbo) is a savanna tree, easily recognized by its round evergreen crown of dark foliage pinnate leaves and round capsules. The stem bark and leaves of the plant have been implicated in the treatment of mucous diarrhoea, syphilis, pyrexia and malarial fever. Dried stem-bark is also used externally for the treatment of skin infections (Kubmarawa *et al.*, 2008). Therefore, the main objective of the study is to determine the efficacy of the leaf extract of *Khaya senegalensis* Linn on *Meloidogyne incognita* with a view to reducing the menace of this parasite on the yield of tomato.

MATERIALS AND METHODS

Sample collection and processing: The plant material screened for nematocidal effects was *Khaya senegalensis*. Leaves of the plant were obtained from mahogany trees in the Biological Garden of the Shehu Shagari College of Education, Sokoto and transported to the herbarium of the Department of Biological Science of Usmanu Danfodiyo University Sokoto (Nigeria) for identification and authentication. Soil and root samples were collected from an infested tomato farm in Kwalkwalawa area along the Usmanu Danfodiyo University main campus. Similarly some samples were collected in an infested farm behind Bursary area of the main campus by digging around the rhizosphere of the tomato to a depth of 3cm below the surface of the soil using a hand trowel. All the samples were then placed in a polythene bag and taken into the laboratory and kept under room temperature until it was due for isolation. The isolation was done after two days of collection.

Isolation of *Meloidogyne incognita*: This was carried out according to the methods of Cobb (1913) using decantation and sieving techniques. The soil sample was poured into a bucket half-filled with water. The mixture of soil and water was then stirred gently to

remove any lump and allowed to settle for about 30 seconds. The supernatant liquid which contains most of the nematodes was decanted and poured through a series of sieves of varying mesh sizes (2.0mm, 1.00mm and 0.50mm). Some of the nematodes were trapped in the sieves. The suspension was collected in a basin and poured again for the second time over the sieves for maximum collection of nematodes. The residue from each sieve was collected in Petri-dishes. One thousand juveniles nematodes (inoculums) obtained were applied on to the tomato seedlings already raised (Abubakar, 1999).

Screening leaf extract of *Khaya senegalensis* for nematocidal activity: This was carried out in accordance with the methods described by Akhtar and Mahmoud (1994). The leaves of *Khaya senegalensis* obtained and identified were air-dried. The dried leaves were pounded using pestle and mortar and later sieved using sieves. Then 50g of dried powder was weighed and dissolved in 100ml of distilled water. This solution was then sieved using a muslin cloth, and labeled as the standard solution (100%). The solution is equivalent to 0.05mg/dl. In order to obtain varying concentration 35, 25 and 15g of the dried powder was measured and dissolved in 100ml of distilled water to obtained concentrations of 0.035mg/dl, 0.025mg/dl, and 0.015mg/dl respectively.

Thirty (30) plastic pots of 15cm diameter were obtained and divided into six groups of five pots each. Each pot was filled with 1kg of autoclaved soil and inoculated with 1000 juvenile nematodes earlier isolated from the soil sample except the first group of five pots which served as control. One week old seedlings of tomato raised separately in an autoclaved soil were uprooted and transferred in to the pots earlier inoculated with nematodes. 50mls of extracts of *K. senegalensis* was measured and applied to each of the pots earlier inoculated with nematodes using the various concentrations obtained, except the first control group and second group of five pots that were inoculated and left untreated to serve as another control. The tomatoes were watered regularly. Four weeks after the transplantation, one tomato

plant was removed from each pot (four plants were planted per pot) and growth was observed in terms of plant height, root length, and extent of galling. The extent of galling was established on a scale of 0- 5 (Sasser *et al.*, 1984) as follows; where 0= no galling; 1=1-10 galls; 2=11-20 galls; 3=21-30 galls 4=31-100 galls; and 5=more than 100 galls per root system. The final nematodes population was also taken using the Cobb's decantation method as described earlier.

Statistical analysis of data: The data obtained was subjected to Analysis of Variance (ANOVA) and means found to be significant were separated using the Duncan multiple range tests at 5% confidence limit ($p < 0.05$).

RESULTS AND DISCUSSION

The results (Table 1) showed that inoculated tomato treated with the extract of leaves of *K. Senegalensis* has resulted in an improved plant-height over the untreated seedlings at all the level of concentration of the extracts

(Table 1). The mean plant height of the uninoculated seedlings (28.40) was not significantly different ($P < 0.05$) from those of the seedlings treated with the highest concentration (0.050mg/dl) of leaf of *K. Senegalensis* (27.90). The plant height of all the other seedlings inoculated but treated with the diluted extracts 0.035mg (25.84) 0.025mg (24.94) and 0.015mg (21.94); vary significantly ($P < 0.05$) from those of the inoculated untreated seedlings (18.30). The plant height of the seedlings treated at different levels of dilution showed that the higher the concentration, the more effective they are in accelerating the plant growth. The same pattern of improved growth was also observed by the root length of tomato with an increase in the concentration of the leaves extracts. At lower concentration, 0.015mg the difference between the root length (7.17cm) and those of the inoculated but untreated (6.95cm) were significantly different ($P < 0.05$).

Table 1: Effect of leaf extract of *K. senegalensis* on tomato plants inoculated with root-knot nematode (*Meloidogyne incognita*)

Treatment	Concentration (mg/dl)	Plant height(cm)	Root length(cm)	Extent of galling	Nem. Pop.
Uninoculated untreated	-	28.40 ^a	8.49 ^a	0.00 ^d	0.00 ^f
Inoculated untreated	-	18.30 ^f	6.95 ^e	3.00 ^a	550 ^a
Inoculated treated	0.050	27.9 ^b	8.15 ^b	0.00 ^d	188 ^e
Inoculated treated	0.035	25.84 ^c	7.89 ^c	1.00 ^c	233 ^d
Inoculated treated	0.025	24.94 ^d	7.89 ^c	1.00 ^c	245 ^c
Inoculated treated	0.015	21.94 ^e	7.17 ^d	2.00 ^b	254 ^b
M.S.E		0.6643	0.2941	0.2531	21.07

NB: Values are means of triplicate samples Means with the same letter within each column are not significantly different ($P < 0.05$).
mg/dl: milligrams per decilitre, cm: centimetre

The result showed a significant reduction ($P < 0.05$) in the number of nematodes obtained from the surrounding roots of tomato treated with the varying concentration of the extracts. The inoculated but untreated seedlings has the highest number of nematodes (550) which was observed to be significantly higher than those seedlings treated at all levels of concentrations ($P < 0.05$). Those seedlings treated with the highest concentration' (0.05mg/dl) recorded a lower number of nematodes (188) than those of the other concentrations of 0.035mg/dl

(233), 0.025mg/dl (245) and 0.015mg/dl (254).

The result also showed a significant variation ($P < 0.05$) in the extent of galling in tomato treated with different levels of concentrations of the leaves extracts. All the levels of dilution displayed significantly lower number of galls over the inoculated untreated control (3.00). It has been observed that among the treated seedlings, as the concentration of the extracts decreased, the extent of galling also increases i.e. 0.050mg/dl (0.00), 0.035mg/dl (1.00), 0.025mg/dl (1.00) and 0.015 (2.00).

The reduction in the number of nematodes recorded in the various tomato plants inoculated with root-knot nematodes and treated with different concentration of *K. senegalensis*, may be accounted for by the presence of some substances in the test plants which may be deleterious or harmful to the nematodes. The observed decrease in number of nematodes may be responsible for the increase in growth of the seedlings. Such decrease means fewer disturbances to the seedlings resulting in an unhindered growth (Vander-Borgett *et al.*, 1994). This also confirms the works of various workers who investigated the activities of these extracts by showing a reduction in the population level of nematodes. For example Sangwin *et al.* (1985), and Akhtar and Mahmood (1994), reported that these substances reduce the population of nematodes species by over 50%. The fewer number of galls may be indicative of an acquired resistivity conferred on the plant by the extracts. The result therefore establishes the nematocidal potential of the extracts obtained from *K. senegalensis*.

Bunt (1975) explained that the extracts rendered the roots of a susceptible plant highly unfavorable to the root-knot nematode, as a result of which there is poor penetration and later reduction in the biological activities of the nematodes, such as feeding and/or reproduction or both. It has been shown that the potential for treatment by the tested plant extract is observed as directly proportional to their concentrations and that at lower concentration, the active ingredient with the nematocidal effect takes longer period to accumulate to the point of potency. This is in conformity with the work of Mahmood and Siddiqui (1993) on the effects of phenols on the growth of tomato and reproduction of *Rotylenchulus reinformis*.

Conclusion: From the results obtained, it can be concluded that, the extracts of leaves of *K. senegalensis*, may contain some active substances which are deleterious or harmful to nematodes and hence it could be used as a nematocides. In this regard, farmers may be encouraged to use the leaves either by mixing them with the soil through proper tilling method, or by applying them directly to the

susceptible crops. There is also the need to identify and isolate the active ingredients present in this plant, with a view to commercializing them for use by farmers especially where such plants do not occur. Proper investigations and research on the root-knot nematodes affecting crops will gradually lead to the development of profitable and practical control method and yield increase of susceptible crops. Similarly, if root-knot nematodes problems on any susceptible crop e.g. tomato could be minimized then there is actually a need for treatment with plant extracts especially the above-mentioned, which can either be sprayed on the leaves of susceptible crops or just applied directly to the vicinity of a particular plant found to be affected by root- nematodes.

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