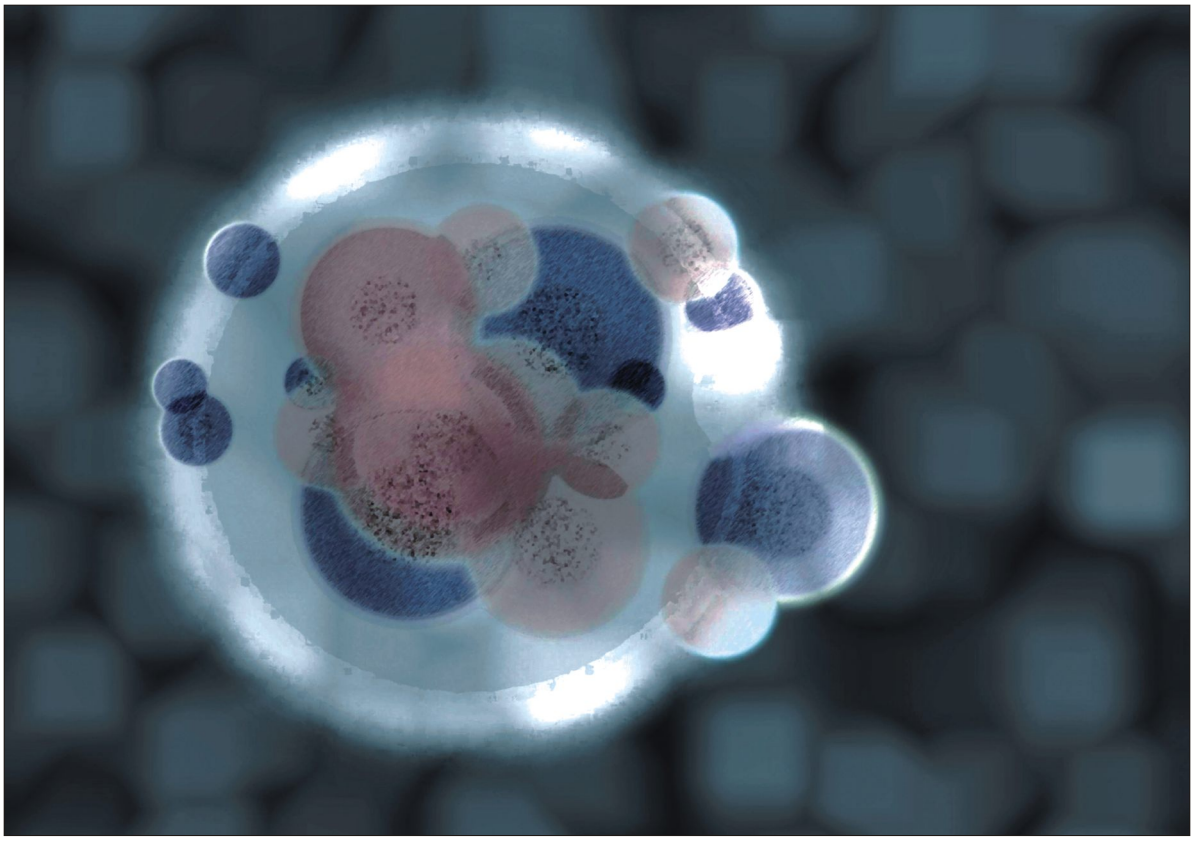

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Study of Ginger on Root-knot Disease of Brinjal

S.M.E. Hassan, M.Sq. Rahman, M.R. Amin, U.K. Majumdar and H.F.El Taj
Hajee Mohammad Danesh University of Science and Technology, Dianjpur-5200, Bangladesh

Abstract: Effect of ginger (*Zingiber officinale*) was evaluated as nematicide against root-knot disease of brinjal (*Solanum melongena*). Treatment of soil with ginger as raw and dry bark, powder as well as extract in lower concentration (S/100) inhibited the activity of *Meloidogyne javanica* in brinjal as evident with lower galling incidence. Better growth of plant with lower galling incidence was observed with powder, dry bark and extract of ginger. Ginger was found to be nematicidal both in the laboratory and glass house test.

Key words: Ginger, root-knot, brinjal

Introduction

Brinjal (*Solanum melongena*), is an important, popular, cheap and common vegetable in Bangladesh. The hot and humid climate of Bangladesh has made it a suitable bed of various plant parasitic nematodes. In a preliminary survey, 15 genera of plant parasitic nematodes were associated with commercial crops in Bangladesh (Timm and Ameen, 1960). The nematode population in the soil of Bangladesh is increasing day by day (Chowdhury, 1976). Ahmad *et al.* (1975) and Page (1979) also revealed that 22 different crops, mostly vegetables were attacked by root-knot nematode. Brinjal is affected at various stages of growth by root-knot disease caused by *Meloidogyne* spp. (Mian, 1986). Existing practice of chemical control is very expensive, particularly, for poor farmers of Bangladesh. In addition, their harmful effect is responsible for soil, air and water pollution (Alam, 1987). Various organic amendments have been reported to have nematicidal properties (Mahmood *et al*., 1982; Mian and Rodriguez-Kabana, 1982; Sartaz *et al*., 1985; Pathak *et al*., 1989; Ahmad *et al*., 1990; Hassan *et al*., 2000). Hence, the research program is undertaken to determine the effect of ginger (*Zingiber officinale*) on root-knot disease of brinjal caused by *Meloidogyne javanica.*

Materials and Methods

The experiment was conducted in Plant Pathology, Bangladesh Agricultural University (BAU) and glass house of Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh during the period ranged from the 25th April, 1996 to 20th October 1996.

The collected rhizome of ginger was washed with water and chopped. About 25 g was macerated in an electric blender and was soaked separately in 100 ml distilled water. The filtrates (extracts) arbitrarily termed as standard (S). Subsequent dilutions S/2, S/10, and S/100 were also prepared in distilled water. About 100 freshly hatched, second stage juveniles were transferred separately to petri dishes containing 10 ml of the various aforesaid dilutions. Petri dishes containing distilled water served as control. Altogether five treatments were taken. The number of dead and surviving nematodes were counted after 12, 24 and 48 hours and mean % mortality was calculated.

Sandy loam soil was mixed with sand and cow dung uniformly at the ratio of 1:1. The soil was then treated with 3% formalin solution for sterilization. The sterilized soil was placed in respective pots. One month old seedlings of brinjal CV. "Singnath" grown in sterilized soil in two earthen pots treated as seed beds. Seedlings were transplanted on the 14th July 1996. At first, healthy and uniform size of seedlings at the age of 30 days were uprooted from the seed bed and were planted in pots. Every morning, seedlings were watered up to one week. The soil of the pot around the base of the plant was loosened from time to time up to the third month of growth.

Eggmass was collected from roots of brinjal plants which were previously inoculated with a single eggmass of *Meloidogyne javanica*. Eggmass was surface sterilized with 0.1% mercuric chloride solution for about one minute and then placed in small nylon sieves. The sieves were placed in watch glasses containing distilled water with the water level just touching the mesh. The second stage juveniles were collected from the total quantity of the suspension of the larvae and diluted in such a way that each ml suspension contained approximately 500 larvae as counted with the help of a sterio-binocular microscope. One ml of larval suspension was applied in each pot in equal proportion in two holes (2.5 cm deep), one on each side of the plant. Inoculation was done on the 21st July 1996.

Raw bark (T_2), dry bark (T_3) and powder form ginger (T_4) were applied to the pot plant at 2g per pot and extract at concentration S/100 (T_5) was applied to the pot at 250 ml per pot. Four replications of five different treatments including control (T_1) were maintained. Similar treatments were done after 15 days of the first application.

During the experiment, average air temperature (26°C) and relative humidity (75.85%) were recorded in the glass house. Length of shoot and root, fresh weight of shoot and root and no. of gall/g of root were measured. Plants were uprooted from pots after 30, 60 and 90 days of inoculation to evaluate the growth parameters like length of shoot and root, fresh weight of shoot and root and number of galls per gram of fresh root. To measure the growth characters, the soil of the pot was watered and the whole plant along with the soil attached to its root was lifted from the pots and dipped in a bucket of water. Then, with gradual and slow movement of roots in water, the roots were separated from the soil. It was further washed out with water. The root portion was separated. Length of shoot was measured from the base of the stem up to the growing point of the youngest leaf. Similarly, length of the root was measured from the starting point of the root to the largest available lateral root apex. Shoot and root portions were blotted dry and fresh weight was recorded by sensitive balance before the materials could get desiccated. After washing, the roots were cut into small pieces and randomly one gram of root was taken from the bulk to count the number of galls formed.

Data on the length of shoot and root, fresh weight of shoot and root and number of galls per gram of root was analyzed statistically followed by DART (Gomez and Gomez, 1984).

Table 1: Effect of ginger on the juvenile mortality of root-knot nematode

Exposure hours	Control	S	S/2	S/10	S/100
12	0d	100 a	28 b	27 b	10 c
24	0d	100 a	86 b	84 b	18 c
48	0d	100 a	93 b	89 b	30 c

S = Standard solution; Values within the same column with common letter (s) are not significantly (p = 0.05) different

Table 2: Effect of ginger on the growth and galling of brinjal (First month)

Treatment	Length of shoot (cm)	Length of root (cm)	Fresh weight of shoot (g)	Fresh weight of root (g)	No. of gall/g of root
T_1	26.50 c	24.25 b	40.75 b	6.50 b	2.68 a
T_2	39.50 b	33.75 ab	47.50 b	5.40 b	2.25 ab
T_3	47.45 a	29.37 b	57.25ab	6.15b	1.30abc
T_4	52.00 a	39.37 a	123.30 a	13.40 a	0.48 c
T_5	48.37 a	36.87 ab	95.75 ab	10.70 ab	0.96 bc

Values within the same column having common letter(s) do not differ significantly at 5% level

Table 3: Effect of ginger on the growth and galling of brinjal (Second month)

Treatment	Length of shoot (cm)	Length of root (cm)	Fresh weight of shoot (g)	Fresh weight of root (g)	No. of gall/g of root
T_1	63.60 c	26.25 b	82.25 b	11.25 c	8.27 a
T_2	76.75 b	52.12 a	186.00 ab	22.25 b	0.99 b
T_3	85.75 a	38.37 ab	199.30 ab	22.00 b	0.80 b
T_4	89.37 a	53.25 a	288.00 a	28.75 a	0.74 b
T_5	77.22 b	38.87 ab	168.00 ab	22.00 b	1.78 b

Values within the same column having common letter(s) do not differ significantly at p = 0.05

Table 4: Effect of ginger on the growth and galling of brinjal (Third month)

Treatment	Length of shoot (cm)	Length of root (cm)	Fresh weight of shoot (g)	Fresh weight of root (g)	No. of gall/g of root
T_1	60.25 c	26.75 c	59.50 c	14.75 c	16.22 a
T_2	79.50 b	33.75 b	105.80 b	25.75 b	5.66 b
T_3	99.75 a	47.25 a	148.00 a	27.00 ab	3.73 b
T_4	90.63 a	47.75 a	151.50 a	30.00 a	3.26 b
T_5	93.88 a	50.00 a	166.30 a	25.00 b	5.46 b

Values within the same column having common letter (s) do not differ significantly at 5% level

Results and Discussion

In the laboratory test, extracts of ginger gave the highest (100%) mortality of juveniles of *Meloidogyne javanica* in treatment S in all test periods. While S/2 gave 28-93%, S/10 gave 27-89% and S/100 gave 10-30% mortality during 12-48 hours time (Table 1). At the highest concentration, the mortality was 100% even after 48 hours, but in lower concentrations, the percentage of mortality was found almost directly proportional to the exposure period. Thakar *et al.* (1988) observed that fresh extract of *Ajolla pinnata* reduced egg hatching of *Meloidogyne javanica* and *Meloidogyne incognita*. Sartaz *et al.* (1985) found that standard extracts of *Plumeria rubra* (leaf and bark) and *Ipomoea fistulosa* caused 100% mortality within 12 hour and Ahmad *et al.* (1990) found that S, S/10, S/100 extracts of *Gaillardia picta* and *Tithonia diversifolia* showed high mortality rate of the second stage juveniles which are in consonance with our findings. Hassan *et al*. (2000) working with extracts of seed, bark and leaf of neem and Kashem (1992) with garlic extract found that even at lower concentration (S/100) of the organic extracts suppressed the nematode activity as was evident with our findings.

In the first month, maximum shoot length was 52.00 cm withT_4 treatment which was followed by T_5, T_3, T_2 and T_1 having 48.37, 47.45, 39.50 and 26.50 cm, respectively (Table 2). The lowest response in shoot length was observed with T_1. Treatment T_4 was recorded with maximum root length having 39.37 cm followed by T_5, T_3, T_2 and T_1 with 36.87, 33.75, 29.37 and 24.25 cm, respectively. All treatments were statistically identical in response . Maximum shoot weight was 123.30 g with the treatment T_4 and this was followed by T_5, T_3, T_2 and T_1 having 95.75, 57.25, 47.50 and 40.75 g, respectively. Effect of all the treatments were statistically equal. Treatment T_4 was recorded with maximum 13.40 g root weight which was followed by T_5, T_1, T_3 and T_2 having 10.70, 6.50, 6.15 and 5.40 g, respectively. Treatments are equal in effect. The highest number 2.68 of gall was recorded with T_1. This was followed by 2.25, 1.30, 0.96 and 0.48 number of gall in the treatments T_2, T_3, T_5 and T_4, respectively. Identical response was observed in all the treatments (Table 2).

In the second month (Table 3), the highest shoot length was 89.37and 85.75 cm was observed in the treatments T_4 and T_3, respectively. This was followed by 77.22 and 76.75 cm in the treatments T_5 and T_2, respectively. The lowest shoot length was recorded with T_1. The highest root length 53.25 cm was in T_4 followed by 52.12, 38.87, 38.37 and 26.25 cm in T_2, T_5, T_3 and T_1, respectively. Treatment T_4 was recorded with 288.00 g of shoot weight which was followed by T_3, T_2, T_5 and T_1 having shoot weight 199.30, 186.00, 168.00 and 82.25 g, respectively. The highest root weight 28.75 g was in T_4 which was followed by T_2, T_3 and T_5 having 22.25, 22.00 and 22.00 g, respectively. The lowest response in root weight was with T_1 having 11.25 g. Treatment T_1 was noted with the highest number 8.27 of gall. This was followed by the rest treatments.

In the third month (Table 4), maximum shoot length was 99.75, 93.88 and 90.63 cm in the treatments T_3, T_5 and T_4, respectively. T_2 is recorded with higher shoot length (79.50 cm), while, the lowest response was in T_1 (60.25 cm).The highest root length was observed in the treatments T_5, T_4 and T_3 with 50.00, 47.75 and 47.25 cm, respectively. T_2 is recorded with higher (33.75 cm) root length. The lowest root length was with T_1 (26.75 cm). T_5, T_4 and T_3 were recorded with the highest shoot weight having 166.30, 151.50 and 148.00 g, respectively. But the lowest response was with T_1 (59.50 g). Higher shoot weight was in T_2 with 105.80 g. Identical effect was followed in root weight where the treatments T_4, T_3, T_2 and T_5 with 30.00, 27.00, 25.75 and 25.00 g, respectively. But, T_1 was with the lowest 14.75 g. Treatment T_1 was recorded with the highest 16.22 number of gall, while the rest treatments were identical. Prot and Kornprobst (1983, 1985) reported that pre-treatment with crude seed extracts of *Azadirachta indica*, *Hannoa undulata* and *H. klaineana* inhibited the penetration of *M. javanica* into tomato roots. In 1985, they also found that soil amendment with crude powder of *Hannoa undulata* seeds fully inhibited the reproduction of *M. javanica* in tomato roots. Hameed (1970) observed that addition of decomposed leaves of *Chrysanthemum coronarium*, *Melia azadirachta*, *Tagetes patula*, *Datura fastuosa*, *Nerium indicum* and pressmud to the soil reduced the incidence of *Meloidogyne javanica* in tomato and increased plant growth. Goswami and Vijaylakshmi (1986) also reported that number of galls per gram of root was reduced by nine different plant extracts especially with *Eclipta alba*, *Shorea robusta* and *Datura metel*. They also observed that the shoot and root length and the shoot weight of tomato CV. "Pusa ruby" infected with *M. incognita* were increased by all extracts especially with *Amaranthus* spp., *Calotropis procera*, D*atura metel* and *E. alba*.

As the existing practice of chemical control is too costly, particularly for poor farmers of Bangladesh, as well as its harmful effect is responsible for environmental pollution; the use of ginger (*Zingiber officinale*) has been found promising in the control of root-knot of brinjal caused by *Meloidogyne javanica* in vitro test. Further research with ginger should be carried out under the field conditions before a recommendation is made to the farmers.

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