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Comparative Efficacy of Some Organic Amendments and a Nematicide (Furadan-3G) Against Root-knot on Two Local Varieties of Groundnut

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Abstract: Six treatments with organic amendments like neem oil, mustard oil cake, til oil cake, garlic extract and a chemical Furadan-3G including control were tested against root-knot on two local varieties of groundnut caused by *Meloidogyne javanica*. Treatment with Furadan-3G as side-dressing after 7 and 14 days of inoculation gave the best response in plant growth characters including nodulation correspondingly with the lowest number of galls, adult females and different juvenile stages of the nematode within the treated plants. Neem oil gave better effect with the reduction of galls and nematode population like that of Furadan-3G. Garlic bulb extract showed comparatively higher response in promoting plant growth and suppressing the nematode. Good effects were observed with the oil cakes of mustard and til.

Key words: Comparative efficacy, organic amendments, nematicide, root-knot (*Meloidogyne javanica*), groundnut (*Arachis hypogaea*)

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) belonging to the family papilionaceae is one of the principal economic crops of the world and ranks 13 among the food crops^[1]. In Bangladesh, groundnut is the second important oil seed crop after rape and mustard on the basis of annual production, but it ranks third on the area basis. There are many constraints responsible for low yield of groundnut. The world record indicates that groundnut has been suffering from 60 different diseases 121 of which 21 are known to occur in Bangladesh^[3-5]. The groundnut plant is subject to attack by various plant parasitic nematodes. Yield losses caused by these parasites are such that in some areas of the world, cultivation of the crop cannot be maintained without nematode control. The disease can be controlled effectively by using nematicides, organic amendments and use of plant extracts^[6,7]. But use of nematicides may cause vulnerable effect on beneficial microorganisms and create health hazard and environmental pollution. Use of organic amendments may be alternative to nematicides. Presently, treatment of soil with oil cake and other organic amendments is the most dependable method to control root-knot nematodes all over the world^[8]. Application of neem oil has been found to be effective against root-knot nematode. Mustard seed contain phenolic and other toxic compounds. Extracts of garlic, mustard and til oil cake are also found to be toxic in nature which are found to be lethal to many nemic

pathogens including root-knot nematode, *Meloidogyne arenaria*^[9]. Among the organic amendments, oil cakes have been found to be the most prospective because they do not only reduce nematode development but also stimulate plant growth supplying plant nutrients of some sorts^[6,10-12]. Keeping all these records in view the present study was undertaken to find out the effect and comparative efficacy of neem oil, oil cakes of mustard and til, garlic extract and Furadan-3G on root-knot (*Meloidogyne javanica*) of groundnut.

MATERIALS AND METHODS

The experiment was conducted both in the glasshouse and laboratory of the Department of Plant Pathology, Bangladesh Agricultural University (BAU), Mymensingh. The efficacy of neem oil, mustard oil cake, til oil cake, garlic extract and a chemical nematicide, Furadan-3G was tested in the pot experiment to control the root-knot nematode (*Meloidogyne javanica*) of groundnut. The control treatment did not receive any amendment or nematicide.

Pot soil was prepared by mixing sandy loam soil, sand and well decomposed cowdung at the ratio of 2:2: 1. Earthen pots (25 cm diameter) were filled with 5 kg sterilized and dry soil. Healthy, mature and disease free seeds of two local varieties of groundnut, Dhaka-I (V₁) and Jhinga badam (V₂) were collected from the Bangladesh Agricultural Research Institute (BARI) and Bangladesh

Agricultural Development Corporation (BADC), respectively. Mustard and til oil cake @ 20 g/pot were placed on the individual pots and were mixed thoroughly with the soil followed by proper spreading at a depth of 4-6 inches. Soil in the pot was mulched properly. Before sowing of seeds in the earthen pots, surface sterilization was done. Thirty of surface sterilized seeds from each variety were taken in two separate petri dishes and neem oil were poured on respective petri dish until these seeds were dipped in oils for 1-2 min and then sown. Garlic extract as paste was collected from fresh garlic bulbs after pressing them in a pestle mortar. Then the paste was compressed in a cheese cloth to get fine garlic extract. Thirty surface sterilized seeds, 15 from each variety, were taken in two separate petri dishes each having 10 g of garlic fine extracts as paste. Seeds were dipped in extract for 5 min. After 5 min seeds were properly dried and then sown. Amendment of pot soil with decomposed oil cakes @ 20 g/pot, the seeds of groundnut varieties (V_1 and V_2) were directly sown in the pot. Each treatment was replicated five times. There were altogether 60 pots for two varieties, each variety having 30 pots. The experiment was carried out in Randomized Complete Block Design (RCBD). For inoculation with nematode, egg-masses were collected from pure culture maintained in the roots of brinjal plant Cv. Singnath. Egg-masses were surface sterilized with 0.001% mercuric chloride solution for 1 min. Eight such surface sterilized egg-masses were placed in each pot in two holes (2.5 cm deep), four on each side of the plant. The first split with 170 mg of Furadan-3G was applied as side dressing after 48 h of inoculation. The second split with 170 mg of Furadan-3G was applied after 15 days of first application in the same way. After 60 days of inoculation, plants were uprooted carefully from respective pots to study the following parameters in relation to plant and pathogen: Length of shoot and root, fresh weight of shoot and root, number galls/g of root, number of egg-masses/g of root, number of nodules/g of root, number of adult females, J_2 , J_3 and J_4 population in 10 galls/treatment. The root systems were washed carefully under gently running tap water and data on the plant growth characters, nodulation and nematode populations were analyzed statistically to find out the level of significance.

RESULTS AND DISCUSSION

Six treatments with neem oil, mustard oil cake, til oil cake, garlic extract and a chemical nematicide Furadan-3G including control were used to assess their effect on different plant growth parameters, galling incidence and development of adult females, J_2 , J_3 and J_4 juveniles of

root-knot nematode (*Meloidogyne javanica*) on two local varieties of groundnut. After 60 days of inoculation, effect of the treatments was found to be significant ($p=0.05$) on different growth parameters, galling incidence and stages of nematode development within plants.

Furadan-3G gave the best response with increased plant growth characters (shoot and root length, shoot and root weight, number of nodules/g of root) and reduced the galling incidence as well as nematode development within the treated plants (Table 1). Furadan is a carbamate and systemic in action, this chemical inhibited the growth and activities of the nematode inside the plants. Consequently, plant metabolism was less disturbed and allowed better plant growth. Results obtained in this experiment with Furadan-3G support the result of the studies made by Gerwal *et al.*^[13], Katalon Gateva *et al.*^[14] and Chand^[15] who stated that pre-planting as well as post planting treatment of Furadan (carbofuran) granules in tobacco field infected with *Meloidogyne incognita* decreased greatly the nematode number and hindered the gall formation. Among the organic amendments, neem oil gave better plant growth and nodulation with lower galling incidence followed by garlic bulb extract (Table 2). Akhtar and Mahmood^[16] reported that Nimin' an industrial product containing neem triterpene and oil from castor (*Ricinus communis*), mustard (*Brassica juncea*), neem (*Azadirachta indica*) and rocket lettuce (*Eruca sativa*) significantly suppressed populations of some ectoparasitic nematodes and reduced the increase of *Meloidogyne incognita* of chilli (*Capsicum annum*). The biological control of root-knot disease caused by *Meloidogyne javanica* by using different plant extracts (garlic extract, neem oil) and organic amendments like mustard oil cake, til oil cake etc. had been practiced by many authors. On decomposition of the plant products like oil cakes, garlic bulb extracts etc. in the soil, toxic substances are released which are directly lethal or harmful to the soil nematodes. Khan *et al.*^[17] reported that ammonia liberated on the decomposition of oil cakes (mahua, castor, mustard, neem and groundnut) was found to be highly toxic to several species of plant parasitic nematodes. They also reported about the better principles of neem V_1 , nimbidin and thionimone which were found highly effective in killing the nematodes and inhibiting the larval hatch of *Meloidogyne javanica*. In the present study, treatment with neem oil was found to give better response by giving higher shoot and root length, fresh weight of shoot and root and nodulation with corresponding lower galling incidence in groundnut plants. Moreover, the population of adult females and different juvenile stages of *M. javanica* were also reduced to a greater extent with neem oil like that of chemical

Table 1: Effect of different treatments on the growth and galling incidence of groundnut infected with *Meloidogyne javanica*

Treatments	Length of shoot (cm)	Length of root (cm)	Fresh weight of shoot (g)	Fresh weight of root (g)	No. of nodules/g of root	No. of galls/g of root
T ₁ (Control)	19.9500g	12.100g	5.080g	0.7900f	4.000e	15.800a
T ₂ (Neem oil)	50.2000b	18.800b	18.030b	1.9400ab	12.000b	7.600be
T ₃ (Mustard oil cake)	40.4500d	16.500d	14.940d	1.4500cd	7.500d	9.300b
T ₄ (Til oil cake)	39.0500e	15.350e	14.100e	1.1900de	6.500d	8.300be
T ₅ (Garlic extract)	44.0000c	17.550c	16.040c	1.6900be	9.500c	5.500ed
T ₆ (Furadan-3G)	53.5000a	20.550a	26.280a	2.1800a	15.500a	4.500d
LSD (p = 0.05)	0.5626	0.4142	0.4791	0.2595	-1.984	2.691

Each value is an average of five replications. Values in the column having common letter(s) do not differ significantly at P = 0.05 level by DMRT

Table 2: Effect of different treatments on the number of eggmasses, adult females, J₂, J₃ and J₄ juveniles of *Meloidogyne javanica*

Treatments	No. of eggmass/10 galls	No. of adult female/10 galls	No. of J ₂ juvenile/10 galls	No. of J ₃ juvenile/10 galls	No. of J ₄ juvenile/10 galls
T ₁ (Control)	11.2000a	15.000a	14.800a	15.0000a	11.8000a
T ₂ (Neem oil)	5.5000d	3.270b	4.000d	4.2000e	4.3000e
T ₃ (Mustard oil cake)	7.8000b	9.300b	7.500c	7.3000c	7.7000c
T ₄ (Til oil cake)	8.2000b	10.200b	10.500b	9.5000b	9.5000b
T ₅ (Garlic extract)	6.5000c	5.500c	7.300c	6.0000d	6.5000d
T ₆ (Furadan-3G)	3.8000e	2.200c	3.200d	2.7000f	2.8000f
LSD (p = 0.05)	0.9757	1.303	1.365	0.7478	0.7782

Each value is an average of five replications. Values in the column having common letter(s) do not differ significantly at P = 0.05 level by DMRT

Table 3: Responses of two local varieties on the growth and galling incidence of groundnut infected with *Meloidogyne javanica*

Variety	Length of shoot (cm)	Length of root (cm)	Fresh weight of shoot (g)	Fresh weight of root (g)	No. of nodules/g of root	No. of galls/g of root
Variety-1 (V ₁)	39.0	15.9	14.6	1.39	9.57	8.0
Variety-2 (V ₂)	38.9	16.8	14.9	1.54	9.14	8.9
LSD (p = 0.05)	NS	NS	NS	NS	NS	NS

Each value is an average of five replications

Table 4: Responses of two local varieties on the number of eggmass, adult female, J₂, J₃ and J₄ juveniles of *Meloidogyne javanica*

Variety	No. of eggmass/10 galls	No. of adult female/10 galls	No. of J ₂ juvenile/10 galls	No. of J ₃ juvenile/10 galls	No. of J ₄ juvenile/10 galls
Variety-1 (V ₁)	7.7	7.1	8.4	8.5	7.7
Variety-2 (V ₂)	7.5	8.9	8.9	7.1	7.5
LSD (p = 0.05)	NS	NS	NS	NS	NS

Each value is an average of five replications

Furadan-3G (Table 1 and 2). This might be due to nematocidal products of neem as already stated by Khan *et al.*^[17]. Similar observations of increased growth of plants and reduction of nematode populations were also reported by Prot and Kronprobes^[18], Guzman and Saxena^[19], Kashem^[20], Akhtar and Mahmood^[15] and Nanjgowda *et al.*^[21]. Guzman and Saxena^[19] reported that derivatives from the neem tree (*Azadirachta indica*, *A. juss*) namely neem oil, neem extract and neem cake showed high nematocidal activity against the root-knot nematode, *Meloidogyne incognita* in both laboratory and greenhouse tests. *In vitro* test showed a progressive significant increase in mortality of second stage larvae of the test nematodes with increased rates of neem oil or extract. Mustard oil cake was also found to give comparatively better effect in respect of plant growth characters with improved length of shoot and root and fresh weight of shoot and root and high nodulation correspondingly with reduced galling incidence and different stages of nematode population as similarly reported by Siddiqui *et al.*^[22], Ali^[23], Saifullah *et al.*^[24]. They also reported that oil cake amendments reduced plant parasitic nematode populations, the most common

of which were *Hoplotaimus indicus*, *Tylenchorynchus brassicae*, *Helicorylenchus* spp. and *Meloidogyne incognita*. Mustard oil cake was most effective in tomato, carrot and potato fields. On sugarbeet, reddish groundnut cake was most effective and on turnip, castor oil cake and mustard oil cake gave the highest plant yields. Mahua cake adversely affected the yield of all crops. Saifillah *et al.*^[25] also stated that all amendments greatly suppressed nematode (*Meloidogyne* spp.) populations with mustard and linseed oil cake having the best effect. In the present study, comparatively higher plant growth with improved length of shoot and root and fresh weight of shoot and root and higher nodulation correspondingly with reduced galling incidence and number of adult females and different juvenile stages with mustard oil cake (Table 1 and 2) corroborate with the findings of the above mentioned studies^[22-24]. Responses of two local varieties (V₁ and V₂) inoculated with *Meloidogyne javanica* on the growth parameters length of shoot and root, fresh weight of shoot and root, nodulation and galling incidence are presented in Table 3 and 4. From the over all study, it was revealed that the highest plant growth characters on two local varieties

of groundnut in respect of length of shoot and root, fresh weight of shoot and root including nodulation and reduced incidence of galling with lower number of adult females, J₂, J₃ and J₄ juveniles of *M. javanica* were obtained with chemical Furadan-3G. Among the organic amendments, neem oil gave better plant growth and nodulation with lower galling incidence followed by garlic bulb extract. Mustard oil cake and til oil cake had more or less good effect in plant growth characters and nodulation with corresponding lower galling incidence and nematode development in the treated plants.

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