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EFFECT OF BAU-BIOFUNGICIDE, NEEM OIL AND A NEMATICIDE ON THE ROOT-KNOT (*Meloidogyne javanica*) OF PAPAYA (*Carica papaya*)

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Abstract

In a pot experiment, BAU-Biofungicide (*Trichoderma harzianum*) neem oil and curaterr (carbofuran) 5G were tested against root-knot (*Meloidogyne javanica*) of two papaya varieties Kashempuri and Deshi papaya. Seedlings were inoculated with second stage larvae of *M. javanica.* Neem oil (5 ml/ 10g seeds) and BAU-Biofungicide (1:4) were used as seed treatant and curaterr as side dressing. Both the bio-agents significantly increased the root and shoot growth of papaya plant and reduction of galls and eggmasses and suppressed the development of J_2, J_3, and J_4 and adult females of *M. javanica*. Efficacy of BAU-Biofungicide was to reduce the gall and nematode development and to increase plant growth was similar to nematicide curaterr. BAU-Biofungicide gave higher effect in most of the growth characters compared to neem oil and prevented the development of adult females and juveniles like nematicide curaterr.

Keywords: Papaya, root-knot, BAU-Biofungicide, neem oil, curaterr.

Introduction

Papaya (*Carica papaya*) is one of the most versatile fruits. It is also used as vegetable and available throughout the year in Bangladesh. The production of papaya in the country is not up to the mark due to the incidence of various diseases. Among those diseases, root-knot (*Meloidogyne* spp.) plays an important role against its successful cultivation (Page, 1979).

When populations of the plant parasitic nematodes reach the economic threshold levels that can cause considerable mechanical or physiological root damages which inhibit the growth and prevent the uptake of water and nutrients. As a result, yield is greatly affected (Mian, 1986). The common species of root-knot nematodes in Bangladesh are *M. incognita* and *M. javanica* which attack wide variety of field crops, vegetables, and fruit crops including papaya (Timm and Ameen, 1960; Mian, 1986). *Meloidogyne javanica* and *M. incognita* are important nematode species in Bangladesh (Page, 1979; Mian, 1986). As a result, enormous crop loss is incurred every year in Bangladesh. In order to control this

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disease, farmers are advised to use synthetic nematicides. But biological control of pathogens offers environmentally safe, durable and cost effective alternatives to chemicals (Papavizas and Lumsden, 1980). *Trichoderma* spp. are antagonists to plant pathogenic nematodes which have also been found to stimulate the growth of the plant (Inber *et al.*, 1994). *Trichoderma harzianum* showed better control of *Meloydogyne javanica* on tomato (Yang-XiuJuan *et al*., 2000). *Trichoderma harzianum* improved growth (leaves) and root of *M. javanica* infected plants and decreased the root galling index (adult 57%) and the number of eggmasses/g of root in tomato plant (Manuzca, 2001). Other than chemical agents, various organic amendments like neem and mustard oil cakes have been reported to show high nematicidal activity (Hossain, 2003). Carbofuran in different trade names is recommended to control nematodes (Vyas and Patel, 2001). Although, papaya is important in Bangladesh, little attention has been given for controlling the nemic disease through biological means. The present investigation was undertaken to test comparative efficacy of BAU-Biofungicide, neem oil and a nematicide curaterr to control root-knot of papaya.

Materials and Method

BAU-Biofungicide is *Trichoderma harzianum* based organic matters effective against fungal pathogens. Curatter 5G is a carbofuran based granular pesticides. BAU-Biofungicide and neem oil were used as seed treatants before sowing. Curatter 5G was applied as side dressing. The experiment was conducted in the glasshouse of the Seed Pathology Center, Bangladesh Agricultural University, Mymensingh, Bangladesh.

The pot soil was prepared by mixing sandy loam soil, fresh sand and well-decomposed cowdung @ 2:1:1 ratio. After thorough mixing, the pot soil was sterilized with formalin @ 30 ml/1000 ml water for each cubic feet soil. Forty earthen pots of 30 cm diameter were taken and each was filled with 5 kg sterilized dried soil. Healthy and mature seeds of variety Kashempuri and Deshi papaya were treated with 1% chlorox for 2 minutes and then washed thrice in sterilized water. Seeds of two varieties were treated with BAU-Biofungicide @ 1:40 w/w following the method of Biswas and Sen (2000). In separate petridishes seeds were treated with neem oil @ 5ml/10g seed (Guzman and Saxena, 1997). After coating, seeds were placed in a cool and dry place under shade for drying and were directly sown in the pots on the same day. One plant/pot was allowed to grow within the glasshouse providing necessary irrigation, loosening the soil, and weeding.

After 15 days of sowing, each papaya plant was inoculated with eight eggmasses of *M. javanica* collected from infected brinjal plant. The eggmasses were placed around the base of the seedlings over exposed roots. BAU-

Biofungicide and granular curaterr (Carbofuran) was applied as side-dressing @ 200 mg and 500 mg/plant, respectively, around the root region of seedlings after 10 days of inoculation with eggmasses.

Four treatments viz., seed treatment with BAU-Biofungicide, seed treatment with neem oil, side dressing with nematicide Curaterr and control were used in the experiment and each was replicated five times (pots). The pots were arranged on the floor of the nethouse following randomized complete block design with two varieties. Seventy five days after inoculation, the plants were removed from pots and root systems were washed with running tap water and data on length (cm) and fresh weight (g) of roots and shoots, number of galls per root system and number of eggmasses per nodules. Populations of J_2, J_3, J_4, and adult female per 10 g galls of each plant were also recorded. Data were analyzed statistically following MSTAT-C programme.

Results and Discussion

Plant growth

Seed treatment with BAU-Biofungicide and neem oil, and side dressing of curaterr resulted significant increase in length and fresh weight of shoot and root of papaya over control. The highest increase in both shoot and root growth was achieved with curaterr followed by BAU-Biofungicide and neem oil (Table 1).

The maximum of 28.3 galls per root system and 49.5 egg masses per 10 galls were found under control. All the treatments significantly reduced both number of galls and egg masses over control. Gall number was reduced to 1.70, 3.60, and 7.10 per root system, and egg masses per 10 galls was reduced to 10.9, 15.8, and 30.1 due to treatments with BAU-Biofungicide, neem oil and curaterr, respectively (Table 1).

Table 1: Effect of different treatments on the growth, galling and eggmass development in papaya infected with *M. javanica.*

Treatments	Length of shoot (cm)	Length of root (cm)	Fresh wt of shoot (g)	Fresh wt of root (g)	No. of galls/ root system	No. of eggmasses/10 galls
Control	31.6 d	19.8 d	28.5 d	19.5 d	28.3 a	49.5 a
BAU-Biofungicide	64.5 b	41.3 b	114.9 b	34.6 b	3.60 b	15.8 b
Neem oil	51.9 c	34.6 c	98.4 c	29.9 c	7.10 b	30.1 c
Curaterr	80.6 a	55.7 a	161.6 a	53.7 a	1.70 b	10.9 d

Each value is an average of five replications and those within a column having a common letter(s) do not differ significantly (P = 0.05) by DMRT

Table 2. Interaction effects of treatments and varieties of papaya on the growth, galling and eggmasses.

Treatment combination	Length of shoot (cm)	Length of root (cm)	Fresh wt of shoot (g)	Fresh wt of root (g)	No. of galls/plant root system	No. of eggmasses/10 galls
T_0 x V_1	30.44	20.11	25.84	19.69	30.60	49.00
T_0 x V_2	32.86	19.86	31.25	19.38	26.00	50.00
T_1 x V_1	61.47	41.16	106.44	34.48	3.40	15.80
T_1 x V_2	67.60	41.03	123.51	34.73	3.80	15.80
T_2 x V_1	50.68	34.72	93.47	29.90	9.20	29.80
T_2 x V_2	53.14	34.57	103.40	29.89	5.00	30.40
T_3 x V_1	76.22	55.69	157.81	53.45	3.00	11.00
T_3 x V_2	85.04	55.88	165.46	54.04	0.40	10.80

Each value is an average of five replications; T_0= Control, T_1= BAU-Biofungicide, T_2= Neem oil, and T_3= Curaterr and V_1= Kashempuri, V_2= Deshi variety.

Nematode development

Significant reduction in population of J_2, J_3, J_4 and adult female were achieved with all treatments treated in the experiment. The lowest populations of the nematode under different developmental stages were found under the treatment with curaterr followed by BAU- Biofungicide and neem oil. The efficacy of curaterr and BAU- Biofungicide to reduce nematode populations in roots of papaya was statistically similar and significantly higher compared to neem oil (Table 3).

Table 3. Effect of different treatments on the development of adult females and juveniles of *M. javanica* in papaya.

Treatments	No. of adult females/ 10 galls	No. of J_2 juveniles/ 10 galls	No. of J_3 juveniles/ 10 galls	No. of J_4 juveniles/ 10galls
Control	8.50 a	7.20 a	8.70 a	6.10 a
BAU-Biofungicide	2.40 c	2.60 c	3.00 c	2.40 b
Neem oil	3.40 b	3.70 b	5.40 b	2.40 b
Curaterr	1.60 c	2.10 c	3.80 c	1.60 b

Each value is an average of five replications and those within a column having a common letter(s) do not differ significantly (P = 0.05) by DMRT.

Table 4. Interaction effects of treatments and varieties of papaya on the development of adult females and juveniles of Meloidogyne javanica.

Treatments Combination	Number of adult females/ 10 galls	Number of J_2 juveniles/ 10 galls	Number of J_3 juveniles/ 10 galls	Number of J_4 juveniles/ 10galls
T_0 x V_1	8.40	7.40	8.60	6.40
T_0 x V_2	8.60	7.00	8.80	5.80
T_1 x V_1	2.40	2.60	3.00	2.40
T_1 x V_2	2.40	2.60	3.00	2.40
T_2 x V_1	3.40	3.80	5.60	2.40
T_2 x V_2	3.40	3.60	5.20	2.40
T_3 x V_1	1.80	2.00	3.80	1.60
T_3 x V_2	1.40	2.20	3.80	1.60

Each value is an average of five replications; T_0= Control, T_1= BAU-Biofungicide, T_2= Neem oil and T_3= Curaterr and V_1= Kashempuri, V_2= Deshi variety.

Response of papaya varieties inoculated with *M. javanica*

Shoot length was 54.7 cm in Papaya variety Kashempuri and 59.60 in variety Deshi. The difference was significant.

Root length, fresh shoot weight, root weight, gall/root system, number of egg masses, J_2, J_3, J_4 and adult females were 37.9 cm, 34.3 g per plant, 95.8g, 115, 26.7, 4.00, 3-95, 5.25, and 3.20 per 10 galls in variety Kashempuri and 37.8 cm, 105.9g, 34.5g per plant, 8.80, 2.67, 3.95, 3.85, 5.20 and 3.05 per 10 galls, respectively. Their differences were not significant.

Findings of the present investigation reveal that seed treatment with BAU-Biofungicide @ 1:4 (w/w), neem oil @ 5 ml/ 10g papaya seeds, and side dressing with curaterr @ 500 mg/plant are effective to control root-knot disease of Papaya and to increase plant growth. Similar results have also been reported by other investigators.

Poornima and Vadivelu (1990) reported that carbofuran was one of the most effective chemicals in checking development and reproduction of *M. javanica* in the roots of aubergine plant. Khan and Alam (1985) also reported that carbofuran is highly toxic to *M. incognita* and inhibited larval hatching in tomato seedlings.

The effectiveness of BAU- Biofungicide contained *Trichoderma* spp. may be attributed to the fact that the fungi occupy the niche before nematode infection and thereby hinder the establishment of the plant parasitic nematode pathogen as

stated by Bettiol, 1996. Similar observations were also made by El-Moity *et al*., (1998) and Khan *et al*. (2001).

Guzman and Saxena (1997) showed that neem oil, neem extract, and neem cake had high nematicideal activity against the root-knot nematode (*M. incognita*) in both laboratory and greenhouse. Reddy *et al.* (1993) showed that neem oil cake significantly reduced root-knot severity and increased fruit yield of okra compared to control. Nimin, a neem product significantly reduced the root-kont and soil populations of *M. inognita* and increased the plant growth parameters (Mojumder *et al*., 2004).

It is evident form the study that control of *M. javaanica* with BAU-Biofungicide prepared with antagonistic fungus *T. harzianum* and neem oil as seed treating agents are quite effective. Therefore, control of f root-knot disease of papaya caused by *M. javanica* through the use of BAU-Biofungicide and neem oil may be explored for eco-freindly management of root-knot nematode.

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