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Effect of BAU-biofungicide and BINA-biofertilizer on growth and root-knot (*meloidogyne javanica*) disease of mungbean

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Abstract: The effects of four treatments with BAU-Biofungicide, BINA-Biofertilizer and combination of BAU Biofungicide+BINA-Biofertilizer along with a control were tested against root-knot (*Meloidogyne javanica*) of three mungbean varieties (Binamoog-2, Binamoog-5 and Binamoog-6). The bio-agents were used as seed treatment. Both the bio-agents and also their combination significantly increased the plant growth in terms of length of shoot and root, fresh weight of shoot and root, nodulation and yield of pods and seeds plant^{-1} with reduced number of galls and adult females. The plants treated with BAU-Biofungicide performed better than those treated with BINA-Biofertilizer followed by their combination. Binamoog-2 showed higher length of shoot, maximum nodulation and number of pods with the lowest galling, eggmasses and adult females compared to other two varieties. Negative correlations were found between gall numbers and plant growth characters and also between gall numbers and yield components.

Key words: Bau-Biofungicide, BINA-Biofertilizer, Mungbean root knot.

Introduction

The mungbean, *Vigna radiata* (L.) Wilczek is an important pulse crop of Bangladesh contributing 6.65% of total pulse production of the country. It was cultivated in about 24,000 ha of land in the year 2006-07 in Bangladesh and the production was about 19,000 m. tons with an average yield of 0.79 m. tons ha^{-1} (BBS, 2008). Among the factors responsible for the low yield of mungbean, diseases pose a great threat and root knot is considered as a major constrain. Various plant parasitic nematodes including *Meloidogyne javanica* and *M. incognita* have been found to be associated with mungbean root knot in Bangladesh (Mian, 1986). So, to increase the yield and quality of produce the effective, economic and eco-friendly disease management deserves priority. Bio-control, a modern approach of disease management can play a significant role here. *Trichoderma* based BAU-Biofungicide has been found promising to control root knot diseases of French bean and soybean (Rahman, 2005 and Sultana *et al.*, 2006). Use of antagonist bacteria like *Rhizobium* and *Bradyrhizobium* also has significant effect in controlling root knot (Alyia-Khan *et al.*, 2006). In the light of the above background, the present study was undertaken to see the effect of BAU-Biofungicide (*Trichoderma harzianum*), BINA-Biofertilizer (*Bradyrhizobium* sp.) and their combination in controlling root knot disease caused by *Meloidogyne javanica*, and subsequent plant growth of mungbean.

Materials and Methods

Sixty earthen pots (30 cm diameter) were filled with sterilized soil (6 kg soil per pot) composing loamy soil, sand and well decomposed cowdung at a ratio of 2:1:1 to raise mungbean plants. Three varieties of mungbean (Binamoog-2, Binamoog-5 and Binamoog-6) were used in this study. Seeds of mungbean and BINA-Biofertilizer (the peat based inocula of *Bradyrhizobium* sp. for mungbean) were collected from Plant Breeding Division, Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh and BAU-Biofungicide (*Trichoderma harzianum)* was collected from Disease Resistance Laboratory, Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh. Four treatments used in the experiment are: T_0 = Control, T_1 = BAU-Biofungicide, T_2 = BINA-Biofertilizer and T_3 = BAU-Biofungicide + BINA-Biofertilizer. For seed treatment, rice forth was added each in case to moisten the seed coat and then bio-agents were thoroughly mixed with them. In case of $T_{1,}$ seeds were properly mixed with BAU-Biofungicide at a ratio of 1:40 w/w (Seed : BAU-Biofungicide). In case of $T_{2,}$ seeds were mixed thoroughly with BINA-Biofertilizer until proper coating of seeds and in T_3 i.e., seed treatment with both the agents, seeds were coated with BINA-Biofertilizer first and then again coated with BAU-Biofungicide. Thus the experiment was designed in two factors Randomized Complete Block Design (RCBD) with five replications. Mature egg masses of root-knot nematode (*Meloidogyne javanica*) were collected from severely galled root system of Brinjal (*Solanum melongena* L.) previously inoculated with the single egg mass of *M. javanica*. For inoculation, reddish brown mature egg masses were collected from infected roots with fine forceps and then placed in a petridish containing 5 ml of sterile water to avoid desiccation. After 41 days of planting, each mungbean plant was inoculated with the eight egg masses collected from brinjal plants. On each side of the plant, 4 egg masses were placed near the base (root-region) of the seedlings opening the soil. After 50 days of inoculation, plants were carefully uprooted from the pots, washed with tap water gently and carefully and different parameters were studied.

Results and Discussion

The mungbean varieties (Binamoog-2, Binamoog-5 and Binamoog-6) showed significant differences based on their growth characteristics (length of shoot and root, fresh weight of shoot and root), nodulation, yield components (no. of pods plant^{-1}, weight of pods plant^{-1} and no. of seeds plant^{-1}), galling incidence and number of egg masses plant^{-1} (Table 1). V_1 (Binamoog-2) was the best variety as it showed better performance in most cases including the lowest incidence of galling and egg mass number plant^{-1}. The variety Binamoog-2 also showed the best response after inoculation with *Meloidogyne javanica* as it had significantly lower number of female nematodes plant^{-1} while nonsignificant responses were found in other three parameters concerned (Table 2).

Table 1 Response on the growth, nodulation, yield, galling and egg masses in three mungbean varieties inoculated with *Meloidogyne javanica*

Variety	Length of shoot (cm)	Length of root (cm)	Fresh weight of shoot (g)	Fresh weight of root (g)	Number of nodules plant^{-1}	Number of pods plant^{-1}	Weight of pods plant^{-1} (g)	Number of seeds plant^{-1}	Number of galls plant^{-1}	Number of egg masses plant^{-1}
Binamoog-2 (V_1)	21.92 a	7.49 ab	3.35 b	0.43 c	3.45 a	3.20 a	1.01	15.15	1.30 c	4.20 c
Binamoog-5 (V_2)	18.62 b	8.57 a	3.93 a	0.82 a	2.55 b	2.90 ab	1.12	13.70	2.55 a	8.20 a
Binamoog-6 (V_3)	17.29 b	7.08 b	2.40 c	0.64 b	2.10 b	2.10 b	0.78	10.50	1.85 b	6.65 b
LSD ($P \geq 0.05$)	2.652	1.234	0.530	0.144	0.792	0.840	NS	NS	0.519	1.121

Each value is an average of five replications, NS = Not significant
Values in the column having same letter(s) do not differ significantly at $P \geq 0.05$ level by DMRT

Table 2 Response of three mungbean varieties Binamoog-2 (V_1), Binamoog-5 (V_2) and Binamoog-6 (V_3) on the development of adult females and juveniles of *Meloidogyne javanica*

Variety	Number of adult females plant^{-1}	Number of J_2 juveniles plant^{-1}	Number of J_3 juveniles plant^{-1}	Number of J_4 juveniles plant^{-1}
Binamoog-2 (V_1)	1.15 b	1.55	1.30	1.65
Binamoog-5 (V_2)	1.90 a	1.60	1.60	1.65
Binamoog-6 (V_3)	1.45 ab	1.55	1.45	1.70
LSD ($P \geq 0.05$)	0.552	NS	NS	NS

Table 3 Effect of different treatments on the plant growth, nodulation, yield, galling and egg masses in mungbean varieties inoculated with *Meloidogyne javanica*

Treatments	Length of shoot (cm)	Length of root (cm)	Fresh wt. of shoot (g)	Fresh wt. of root (g)	No. of nodules plant^{-1}	No. of pods plant^{-1}	Wt. of pods plant^{-1} (g)	No. of seeds plant^{-1}	No. of galls plant^{-1}	No. of egg masses plant^{-1}
T_0	15.63 b	6.31 c	1.74 d	0.37 c	0.53 d	1.93 b	0.50 c	7.40 c	2.93 a	10.60 a
T_1	21.65 a	9.12 a	5.30 a	0.86 a	3.53 b	3.33 a	1.47 a	18.93 a	1.13 c	3.00 d
T_2	20.30 a	8.33 ab	3.38 b	0.71 ab	4.60 a	3.00 a	1.03 ab	14.73 ab	1.53 bc	4.73 c
T_3	19.53 a	7.07 bc	2.48 c	0.57 b	2.13 c	2.67 ab	0.88 bc	11.40 bc	2.00 b	7.07 b
LSD ($P \geq 0.05$)	3.062	1.425	0.611	0.166	0.914	0.969	0.469	4.584	0.599	1.294

T_0 = Control, T_1 = BAU-Biofungicide, T_2 = BINA-Biofertilzer, T_3 = BAU-Biofungicie + BINA-Biofertilizer

Table 4 Effect of different treatments on the development of adult females and juveniles of *Meloidogyne javanica* in infected mungbean varieties

Treatments	Number of adult females plant^{-1}	Number of J_2 juveniles plant^{-1}	Number of J_3 juveniles plant^{-1}	Number of J_4 juveniles plant^{-1}
T_0 (control)	2.27 a	1.93	1.67	2.00
T_1 (BAU-Biofungicide)	1.00 b	1.27	1.20	1.27
T_2 (BINA-Biofertilzer)	1.33 b	1.40	1.40	1.60
T_3 (BAU-Biofungicie + BINA-Biofertilizer)	1.40 b	1.67	1.53	1.80
LSD ($P \geq 0.05$)	0.637	NS	NS	NS

The effects of four different treatments on different plant growth characters, nodulation, yield components, galling incidence and number of egg masses plant^{-1} were found to be significant ($P \geq 0.05$) (Table 3). T_1

performed the best in most the cases compared to other three treatments followed by T_2. Sharon *et al.* (2001) similarly observed increased fresh weight of shoot and reduction of galling incidence in tomato infected with *Meloidogyne javanica* following soil pretreatment with *Trichoderma* peat bran preparations. Senthilkumar and Rajendran (2004) reported that fungal agent *Trichoderma harzianum* appeared as egg parasitic or opportunistic to root-knot nematode. Yang-Xiu Juan *et al.* (2000) also reported that *Trichoderma harzianum* showed better control of *Meloidogyne javanica* in tomato. It is suggested that improved proteolytic activity of the antagonist may be important for the biological control of the nematode. Tverdyukev *et al.* (1994) observed that *Trichoderma* produces Trichodermin, which render its antagonistic activity against various diseases. Hoffmann-Hergarten *et al.* (1998) found that seed treatment with *Rhizobium* significantly decreased root galling and enhanced biomass. This is due to the fact that biofertilizer helps the Biological Nitrogen Fixation (BNF) through symbiotic relationship which enhances the plant growth. Similar results were found in this experiment where BINA-Biofertilizer (*Bradyrhizobium* sp.) gave maximum nodulation with comparatively 1ower galling incidence, adult females and juvenile growth stages than control.

The treatments effects were also found to be significant compared to control on the population development of adult female nematodes in mungbean varieties Binamoog-2 (V_1), Binamoog-5 (V_2) and Binamoog-6 (V_3) inoculated with *Meloidogyne javanica* (Table 4). Rahman (2005) also reported that seed treatment with BAU-Biofungicide reduced the number of adult females, J_2, J_3 and J_4 juveniles of *Meloidogyne javanica.* Li-Bin *et al.* (2005) similarly observed that rhizobacteria suppressed the root-knot nematode (*Meloidogyne javanica*). This rhizobacteria exhibited strong nematicidal activity by killing the second stage larvae of *Meloidogyne javanica*.

Correlation study revealed significant and negative correlations between gall number and plant growth characters as well as gall number and yield components (Figures 1, 2 and 3). It is evident from the study that control of *Meloidogyne javanica* with antagonistic bio-agents like BAU-Biofungicide (*Trichoderma harzianum*) and BINA-Biofertilizer (*Bradyrhizobium* sp.) used as seed treatments are quite effective. Therefore, control of root-knot disease of mungbean caused by *Meloidogyne javanica* may be explored through use of BAU-Biofungicide and BINA-Biofertilizer for eco-friendly management of this nemic disease avoiding chemical nematicides. However, field trials are essential before recommendation for the farmers.

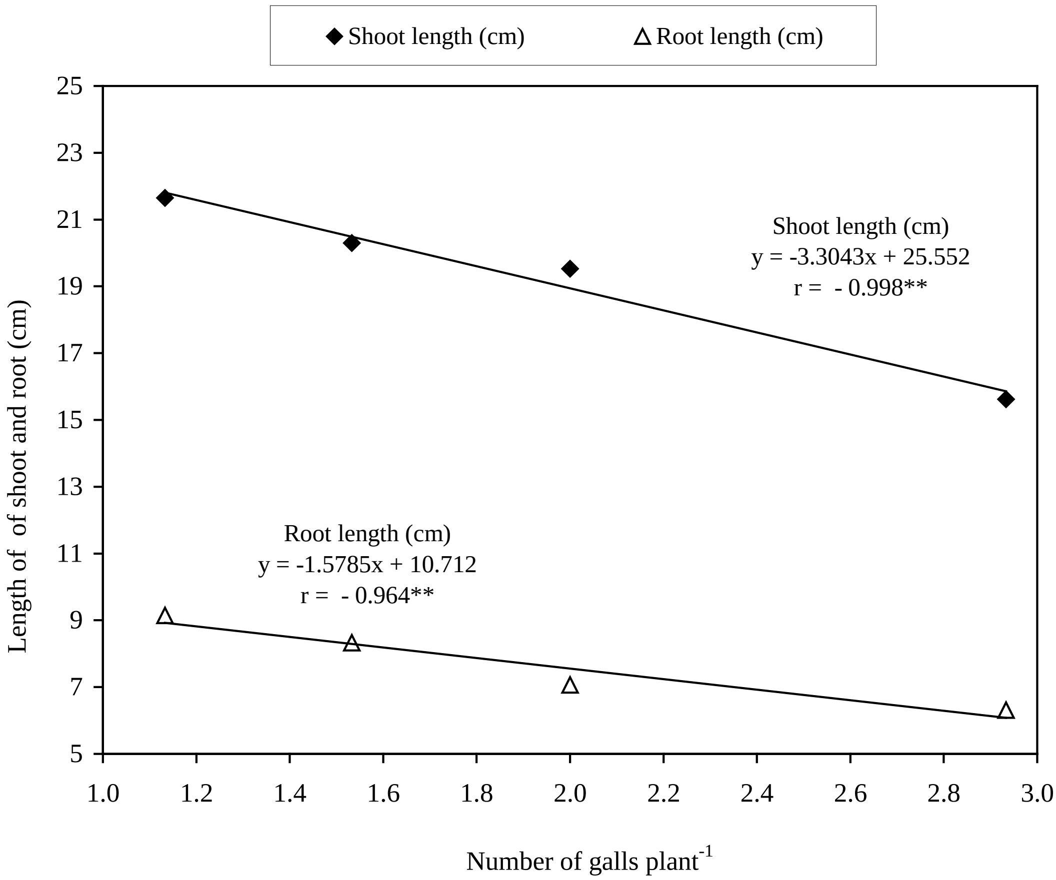

Fig. 1 Relationship between gall number and shoot and root length (cm)

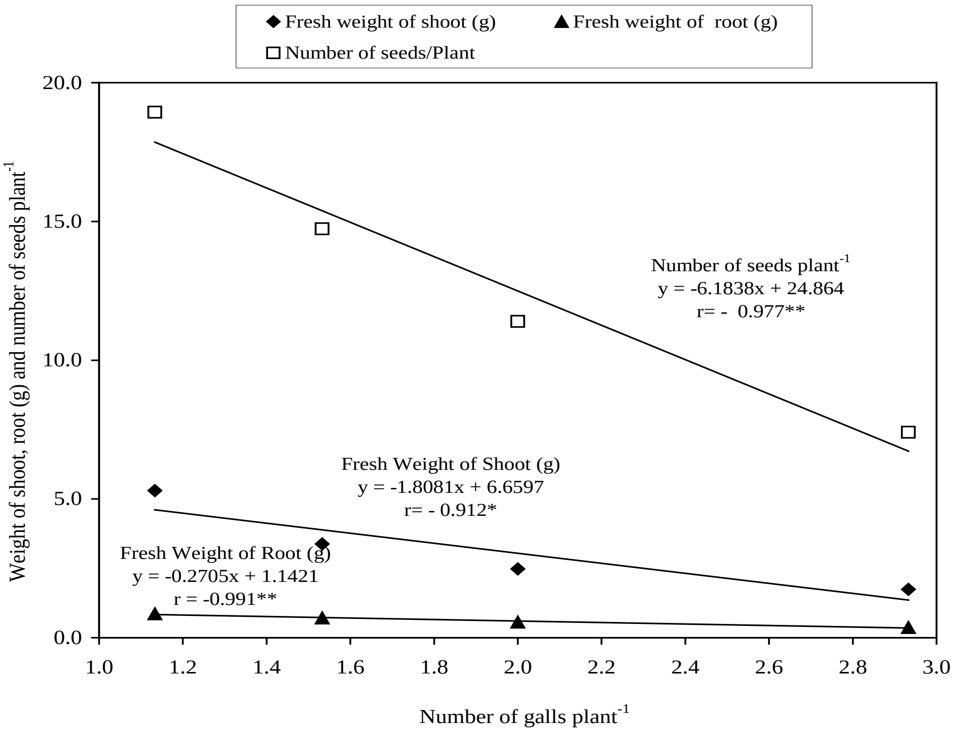

Fig. 2 Relationship between gall number and fresh weight of shoot, root (g) and number of seeds plant^{-1}

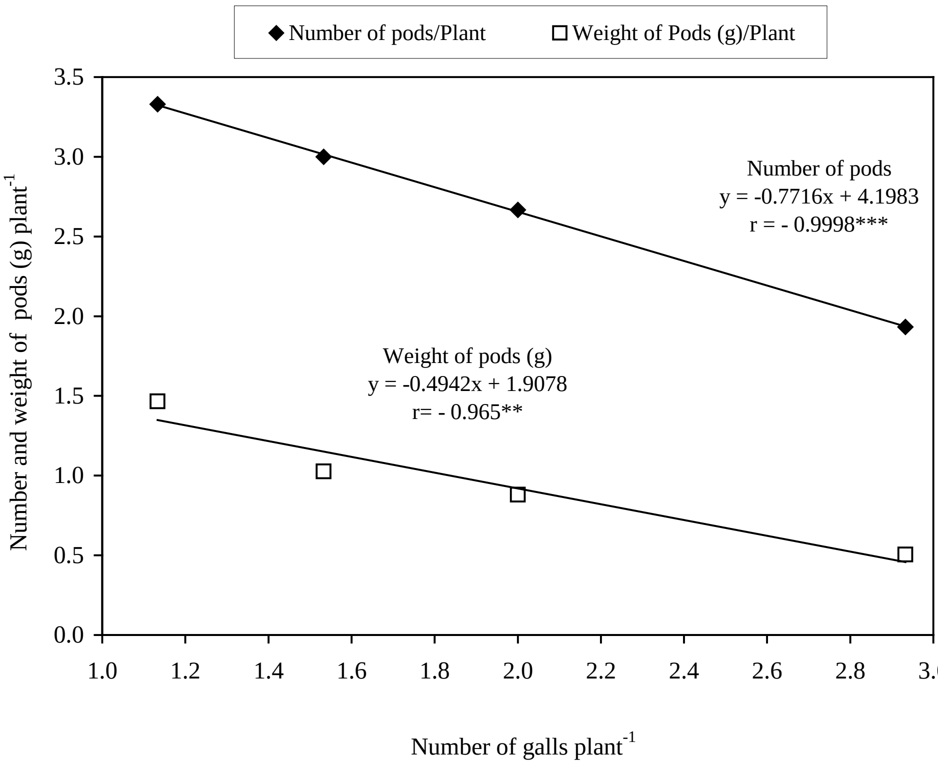

Fig. 3 Relationship between gall number and number of pods and weight of pods plant^{-1} (g)

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