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INFLUENCE OF MANURES AND PLANT SPACING ON THE YIELD OF BINAMOOG- 4

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ABSTRACT

The experiment was conducted at Office farm of Bangladesh Institute of Nuclear Agriculture, Gopalgonj from November 2018 to January 2019 to study the effects of manures and plant spacing on the yield of mungbean. The treatments comprised of five levels of manures r: T_1= no manures control, T_2 = 0.5, T_3 = 1.0, T_4 = 1.5 and T_5 = 2.0 kg ha^{-1} manures and three plant spacing: 10, 20 and 30 cm within rows at 30 cm apart. The experiment was laid out in a split plot design with three replications. The results indicated that highest level of manures 2.0 kg ha^{-1}) performed better than other lower levels in respect of plant height (53.41 cm), dry matter $plant^{-1}$ at 40 days after sowing (DAS) (0.89 g) and 65 DAS (2.79 g), and number of nodules $plant^{-1}$ at both 40 DAS (11.27) and 65 DAS (16.39). On the other hand, plant population m^{-2} (25.33), and dry matter $plant^{-1}$ at both 40 DAS (0.886 g) and 65 DAS (2.87 g) were found highest for the plant spacing of 10 cm. However, plant height (54.06 cm), number of nodules $plant^{-1}$ at 40 DAS (11.00) and 65 DAS (16.56) were found to be highest only in 30 cm plant spacing. Yield and yield contributing characters like number of branches $plant^{-1}$, number of pods $plant^{-1}$, pod length, seed weight $plant^{-1}$, seed yield, stover yield, biological yield and harvest index were significantly influenced by 2.0 kg ha^{-} manures A plant spacing of 20 cm performed better for seed yield (1419.3 kg ha^{-1}). The interaction effect of 2.0 kg ha^{-1} manures with a plant spacing of 20 cm showed better performance for yield and yield contributing characters.

Key words: manures, yield, plant spacing etc.

INTRODUCTION

Mungbean *(Vigna radiata L.* Wilczek) is one of the most popular leguminous crops which originated in South Asia. It is an important pulse crop of global economicimportance principally for its seeds with high protein content that are used as human food. In the Indian sub-continent specially in Bangladesh mungbean is mainly used as Dal or vegetable soup. It serves as vital source of vegetable protein, minerals, and vitamins particularly in developing countries, having 22-28% protein, 60-65% carbohydrate, 1-1.5% fat, 3.5-4.5% fibers, 4.5-5.5% ash, 4% minerals and 3% vitamins in the seed. It holds the fourth position in area (22.26 thousand hectares) and third position in production (17 thousand tons) among the pulse crops in Bangladesh (BBS, 2006). In Bangladesh, the main form of protein readily available to the bulk of the population is plant protein. The daily per capita consumption of pulses in Bangladesh is only 13.29 grams (BBS, 2001), while the World Health Organization (FAO, 1999) suggested 45 grams per capita per day for a balanced diet. Increase in pulse production is urgently needed to meet up the demand and to minimize the shortage of feed. Mungbean is one of the leading pulse crops in Bangladesh. Cultivation of mungbean can improve the physical, chemical and biological properties of soil as well as increase soil fertility status through biological nitrogen fixation with symbiont *Bradyrhizobium* from the atmosphere. The production of mungbean has been steadily decreasing due to reduction in area under mungbean cultivation because of mounting competition from other profitable crops, poor management and use of low yielding local varieties. Therefore, to meet the situation, it is necessary to boost up the production of mungbean through varietal development and proper management practices.

Seed inoculation with effective *Bradyrhizobium* can play a vital role in the formation of nodules to fix atmospheric nitrogen by symbiotic process in the root system of legume crops making the nutrient available to the plants. Franco (1978) revealed that Rhizobium strains in association with the host plant were able to fix approximately 20 percent atmospheric nitrogen throughout the world annually.
Bradyrhizobium inoculation increased mungbean seed yield from 4.3% to 162% as reported by Vaishya *et al.* (1983). In Bangladesh, inoculation with *Bradyrhizobium* increased 57% effective nodules, 77% drymatter production, 64% grain yield and 40% hay yieldover uninoculated control in mungbean cultivation (Chanda *et al.,* 1991).

In Bangladesh very few studies have been made on the effect of *Bradyrhizobium* biofertilizer and spacing on mungbean yield. Keeping all these in view, the present study was undertaken with the following objectives:

i) To study the effect of *Bradyrhizobium* biofertilizer on the yield ofmungbean.
ii) To find out optimum plant spacing for obtaining higher yield ofmungbean.
iii) To study the combined effect of *Bradyrhizobium* biofertilizer andplant spacing on the yield of mungbean.

REVIEW OF LITERATURE

Research on mungbean is being carried out extensively in many countries including Bangladesh and the South East Asian countries for its improvement of yield and quality. More recently, the Pulse Research Centre at Ishurdi, under Bangladesh Agricultural Research Institute (BARI), and Bangladesh Institute of Nuclear Agriculture (BINA) have started research for improvement of this crop.

The effects of *Rhizobium* inoculation and spacing on the yield of mungbean

(Vigna radiata L. Wilczek) have been reviewed below in th Effect of Rhizobium inoculation

Chowdhury and Rosario (1992) carried out an experiment to determine the effect of Rhizobial inoculation on the growth and yield performance of mungbean at Los Banos, Philippines in 1988. They observed that seed inoculation with *Rhizobium* increased seed yield and dry matter of munghean.

Bhuiyan *et al.* (1984) carried out a field experiment at Bangladesh Agricultural University farm and observed that the inoculation of mungbean gave higher dry matter weight of nodules and shoot per plant compared to control. They also reported that larger sized nodules were produced due to inoculation.

Ali and Chandra (1985) observed that *Rhizobium* inoculum increased the seed yield of most of the pulse crops from 10 to 15 per cent but the legume required a specific group of Rhizobia.

Iswarna and Marwaha (1982) observed marked increase in seed yield of mungbean *(Vigna radiata)* due to *Rhizobium* inoculation in pot culture ex In a 4 year trial with sodium molybdate at 14 g ha^{-1} applied by mixing with *Rhizobium* culture or as a soil slurry for treating *Vigna radiata* seed, Kler *et al.* (1983) observed increased growth and seed yield**,** *Rhizobium* showed an additive effect in 1 year only, and higher concentration of sodium molybdate was toxic.

Vaishya *et al.* (1983) reported that the seed inoculation with *Rhizobium* strain significantly increased the number of nodules and seed yield of 12 *Vigna radiata* cultivars. The yield increase was 42.3% on an average and ranged from 4.3% in Pusa Baishakhi to 162% in cv J-10.

Boruah and Borthakur (1984) observed with mungbean *(Vigna radiata)* that inoculation gave the yields similar to that of recommended N, P rates for uninoculated seeds.

Srivastava and Singh (1984) found that inoculation of *Rhizohium* in virus diseased plant of mungbean reduced the N and P, but that of K. Ca. Mg and S were higher compared to untreated plants.

Chowdhury *et al.* (1985) reported that amino acid concentration was highest in leaves, followed by root and stem of mungbean. When the crop was grown on sand amino acid concentration was higher in plants not treated with *Rhizobium.*

Gill *et al.* (1985) reported that inoculation significantly increased number of branches plant^{-1}, pods plant^{-1}, seeds pod^{-1}, stover yield, seed yield and harvest index of mungbean .

Patel *et al.* (1985) reported that treatment of mungbean seeds with Dithane M-45 (mancozeb), Brassicol (quintozene), Captan and Thiram followed by inoculation with a *Rhizobium sp.* increased the number of nodules and their fresh weight and Dithane M-45 was the most effective treatment.

periment. Patel *et al.* (1986) found that response of *Rhizobium* inoculation in respect of nodulation and seed yield of mungbean was found to be significantly high.

Chahal and Chahal (1987) reported that *Rhizobium* strain R-1 produced the greatest yield of mungbean plants but MM incognita multiplied at a greater errata when the seedlings were inoculated with *Rhizobium.* They suggested thisdue to the better development of the plant in a supply of fixed N.

Gupta *et al.* (1988) in pot trials with *Vigna radiata* grown in a P-deficient soil found that seed inoculation with *Rhizobium* and or application of 40 kg P ha^{-1} increased the plant dry weight, nodulation and seed yield plant^{-1}.

Maiti *et al*. (1988) found in trials with green gram *(Phaseolus radiatus)* and lentil grown in soils given (a) 60 o r (b) 100 k g h a $^{-1}$ each of P_2O_5 and K_2O, that seed inoculation with *Rhizobium* increased nodule nitrogenase activity *by 36-54% in Phaseolus radiatus* and 28-34% in lentils. Nitrogen and seed inoculation increased the *Phaseolus radiatus* seed yields by 15-20 and 5-10%, respectively, but had no significant effect on lentil seed yields.

Padmakar *et al. (1988)* reported that UV radiation (exposure *15-180s)* and/or inoculation of *Vigna radiata L.* Wilczek seeds increased the chlorophyll content in leaves, N content in different plant parts and protein in seeds; inoculation of seeds followed by 15 seconds exposure to UV radiation produced the highest increases. Both these treatments increased the soil N content.

Pandher *et al. (1988)* reported that five *Rhizobium* strain isolates varied in their polysaccharide production ability.

Badole and Umale (1995) carried out a field experiment during the rainy season of 1990 with green gram *(Phaseolus radiatus) cv.* TAP 7, were application of no fertilizers (not specified) gave seed yields of 0.92, 1.04, 1.17, 1.13 and 1.99 t ha^{-1}, respectively. Seed treatment in a magnetic field (200 gauss) or with ammonium molybdate + Iron oxide + Potassium dihydrogen phosphate or seed inoculation with *Rhizobium* gave seed yields of 1.26, 1.01 and 1.02 t ha^{-1} respectively.

Sattar and Ahmed (1995) conducted a field experiment at the farm of Rajbari Testing Station, BARI, Dinajpur on mungbean inoculated with *Bradyrhizobium* and reported significant increase in hay and total protein yield.

Thakur and Panwar (1995) carried out an experiment where cv. Pusa-105 and PS-16 were given the following treatments; seed inoculation with *Bradyrhizobium,* soil inoculation with VAM fungus *(Glomus fascicula*) or combination of both. Inoculation, either singly or combined increased plant height, leaf area, photosynthetic rate and total dry matter (DM) production compared with no inoculation.

Deka and Kakati (1996) carried out a field experiment in Rabi 1986/87 at Jorhat, Assam; India. *Vigna radiata cv.* K-851 was given seed or soil

Ahmed *(1989)* studied the response of inoculation with *Rhizobium* inoculant incorporating BINA *403,* BINA *407.* RCR *3824* and RCR *3825* strain as single and mixed cultures and *4* levels of phosphorus (0, *30, 60* and *90* kg ha^{-1} from triple superphosphate) with a basal dose of potassium *30* kg K_2O ha^{-1} from muriate of potash on growth, root nodulation, yield and yield contributing characters and protein and phosphorus content of mungbean. *Rhizobium* inoculation increased significantly the number of nodules, nodule weight,

Effect of spacing:

EI-Habbasha *et al.* (1996) reported that increasing plant density decreased plant height, branch and leaf number plant^{-1}, dry weight of shoots and number of pods plant^{-1} of mungbean.

Mimber (1993) carried out a field trial on *Vigna radiata* cultivar Walet using 4,00,000, 600,000 or 8,00,000 plant populations ha^{-1}, with 20 cm rows pacing, variable infra row spacing or two plants hill^{-1} and found that yield increased with increasing plant population, while within a given plant population there was no significant effect of spacing and plant number hill^{-1}

Singh *et al.* (1991) carried out a field experiment to study the effect of spacing and seed rate on yield of green gram. They reported that plant population increased with increasing seed rate and seed yields were 0.32,0.48 and 0.55

t ha^{-1} Chinamung in Bidar, Karnataka, India, during Rabi season 1991 and 1992 to evaluate the response of green gram to row spacing and weed management practices and reported that seed yield of green gram differed significantly due to row spacing, whereas it was not affected by the weed management practices during both years. The closer row spacing of 30 cm recorded significantly highest seed yield (1214 kg ha^{-1}) than 45 and 60 cm (987 and 817 kg ha^{-1}, respectively).

Khan *et al.* (2001) carried out an experiment during the summer season of 2000, in Peshawar, Pakistan to study the effect of planting geometry on yield and yield components of mungbean cv. M-92. Emergence seedling m^{-2} , days to flowering, days to maturity, number of seeds pods^{-1}, number of branches plant^{-1} , plant height (cm), thousand seeds weight (g), percent hard grain (%), biological yield (kg ha^{-1}) and seed yield (kg ha^{-1}) were significantly affected by row and plant spacing, while pod number plant^{-1} and harvest index were not significantly affected. A spacing of 50 cm between rows and 10 cm within rows produced the maximum number of pods plant^{-1} and seeds pod^{-1}, highest thousand seeds weight, low percent hard seed and highest biological yield, harvest index and seed yield (kg ha^{-1}).

Mitra and Bhattacharya (2005) reported that a row spacing of 25 cm recorded more biomass, lesser weed growth, higher water-use efficiency and 40 - 52 % highest seed yield of mungbean compared to 45 cm row spacing.

Kotwal and Prakash (2006) reported that a row spacing of 40 cm recorded the highest number of branches plant^{-1} (5.47), leaf area (532.00 cm^2), dry matter accumulation plant^{-1} (32.83 g) and 1000-seed weight (36.33 g),whereas a spacing of 20 cm registered the highest number of pods plant^{-1} (17.0) and seed yield (12.50 quintal ha^{-1}).

MATERIALS AND METHODS

The experiment was conducted at Office farm of Bangladesh Institute of Nuclear Agriculture, Gopalgonj from November 2018 to January 2019 to study the effect of biofertilizer and plant spacing on the yield of mungbean. Materials used and methodologies followed in the present investigation have been described in this chapter.

Experimental site and soil

The experimental field was located at 24.75° North latitude and 90.50^{0} East longitude at an altitude of 18 m from the sea level. The topography of the experimental field was medium high belonging to the Sonatala soil series having under the Agroecological Zone-9 (AEZ-9) named Old Brahmaputra Floodplain calcareous dark grey floodplain soil. The soil was sandy loam in nature with a pH value of 6.8 (UNDP and FAO, 1988). The physical and chemical properties of the soil are presented in Appendix I.

Climate and weather

The climate of the locality was sub-tropical. It was characterized by high temperature and heavy rainfall during April to September and low rainfall associated with moderately low temperature during October to March. During the experimental period, the maximum (29.05°C) and minimum (23.45°C) average temperature were recorded in the month of November 2013 and January 2014 whereas maximum relative humidity (82.40%) and total rainfall (207.9 mm) were measured in November 2013. The prevailing weather condition i.e. temperature, rainfall, relative humidity and daily sunshine hours during the period of study is presented in

Experimental treatments

The study consisted of two factors viz. (A) Biofertilizer and (B) plant spacing.

Factor A: Biofertilizer

There were five levels of biofertilizer as follows: T_1=0 (control)

T_2=0.5 kg ha^{-1} T_3=1 kg

ha^{-1} T_4=1.5 kg ha^{-1}

T_5=2 kg ha^{-1}

Factor B: Plant spacing

The following three levels of plant spacing were used:

i) 10 cm = S_1

ii) 20 cm = S_2

iii) 30 cm = S_3

(with constant 30 cm row spacing)

Experimental design and layout

The experiment was laid out in a split-plot design. There were three replications. Different levels of biofertilizer were placed in the main plots and three plant spacing in the subplots. All the treatments were randomly allocated to the experimental plots. The subplot (unit plot) size was 12m^2 (4m×3m). The distance between main plot was 1m and that between sub plot was 0.5 m. The total number ofunit plot was 45.

Fertilizers application

The subplot were uniformly fertilized with urea, triple super phosphate and murite of potash at the rate of 35, 75 and 40 kg ha^{-1} respectively during final land preparation.

Seed inoculation and sowing

The quantity of seed required for each plot was weighed on the basis of experimental specification and kept in polythene bags. The seeds were mixed with molasses for adhering to the biofertilizer. Then the biofertilizer was mixed thoroughly with the seed as per treatments and the seeds were placed in a cool dry place to avoid sticking together. Three seeds per hill were sown on 5th November 2013 by

maintaining a row spacing of 30 cm and plant spacing of 10, 20 or 30 cm as per experimental treatments. The sowing depth was maintained at about three centimeters from the soil surface. After sowing, the seeds were covered with soil to preserve moisture.

Intercultural operations

Thinning was done after 15 days of sowing to maintain a uniform stand one plant per hill. First weeding was done at the time of thinning and second weeding was done on 4th December 2013. Irrigation was not given at the early stages of crop growth, as there was no symptom of moisture stress. Drainage was done to remove the excess water from the field at that time. The insecticide Malathion 57EC was sprayed @ 1.5 l ha^{-1} at the time of 50% pod formation stage to control pod borer.

Biological yield = (Seed yield +Stover yield.)

x) Harvest index:

Harvest index was calculated with the followingformula:

$$\text{Harvest index} = \frac{\text{Seed yield}}{\text{Seed yield + Stover yield}} \times 100$$

Analysis of data

The collected data were compiled and analyzed statistically using then analysis of variance technique and the differences among treatment means were adjudged by Duncan's Multiple Range Test (Gomez and Gomez, 1984) with the help of a computer based package programmed MSTAT-C.

RESULTS

The experiment was conducted to evaluate the effect of biofertilizer and plant spacing on the yield of mungbean (cv. Binamoog-4). The analyses of variances for different crop parameters have been presented in Appendices III and IV. The effects of biofertilizer and plant spacing were significant for plant height, dry matter $plant^{1}$, number of nodules $plant^{-1}$, number of branches plant $^{-1}$, number of pods plant $^{-1}$, seed weight plant $^{-1}$, seed yield, stover yield, biological yield and harvest index. Plant spacing was found to have significant effect on weight of 1000 seeds. The effect of interaction of plant spacing and biofertilizer was significant on dry matter $plant^{-1}$ at 40 DAS, number of nodules $plant^{-1}$, number of branches $plant^{-1}$, number of pods $plant^{-1}$, number of seeds pod^{-1}, seed weight $plant^{-1}$, seed yield, stover yield, biologicalyield and harvest index.

Growth parameters

Plant population m^{-2}

Plant population m^{-2} after plant emergence was completed at 9 DAS which did not vary significantly due to different levels of biofertilizer (Table 4.1) but plant spacing had significant effect on plant population m^{-2} (Table 4.2).

The closest spacing of 10 cm had the highest number of plants m^{-2} (25.33) and the lowest number (8.53) was found in plant spacing of 30 cm (Table 4.2). There was no significant effect on plant population m^{-2} due to interaction of biofertilizer and plant spacing as can be observed in (Table 4.3).

Plant height

Biofertilizer significantly increased plant height (Table 4.1). Plant height was increased with increasing level of biofertilizer. Highest plant height (53.41 cm) was attained when 2.0 kg ha^{-1} biofertilizer was used which was followedby 1.5 kg ha^{-1} and 1.0 kg ha^{-1}. This could be attributed to favorable effect of *Bradyrhizobium* inoculation on plant height. Similar results were obtained by Ardeshna *et al.* (1993), Shukla discussion

Plant height differed significantly with plant spacing. Table 4. 2 shows that the tallest plant (54.06 cm) was obtained from 30 cm and the shortest one (50.89 cm) from 10 cm plant to plant distance. Plants in closer spacing became shorter probably due to competition for sunlight and other related factors. The results of other researches (El-Habbasha *et al.,* 1996 and Hoq and Hossain, 1981) were similar to the present findings. The interaction effect of biofertilizer and plant spacing did not show significant effect on plant height (Table 4. 3).

Dry matter production was significantly differed among plant spacing at different growth stages (40 and 65 DAS) (Table 4.2). From Table 4.2, it is evident that 10 cm plant spacing produced the highest dry matter $plant^{-1}$ (0.88 g and 2.87 g at 40 and 65 DAS, respectively), whereas the lowest (0.65 g and 2.40 g) were recorded from 30 cm plant spacing. This finding is in conformity with those of Tomar *et al.* (1995) and Trung and Yoshida (1985).

Table 4.3 shows that the interaction effect of biofertilizer and plant spacing was significant on dry mater $plant^{-1}$ at 40 DAS when the highest amount of 0.96 g dry matter was obtained from the highest level of biofertilizer application (2.0 kg ha^{-1}) with the lowest plant spacing (10 cm), and the lowest of 0.52 g was found in the control treatment with a plant spacing of 30 cm. No significant effect was found at 65 DAS.

The effect of plant spacing was highly significant on nodule production (Table 4.2). Table 4.2 shows that the highest number of 11.00 nodules $plant^{-1}$ was produced at 40 DAS when 30 cm plant spacing was maintained, whereas the second highest of 9.54 and the lowest of 8.93 nodules $plant^{-1}$ were found in the plant spacing of 20 and 10 cm, respectively. On the other hand, at 65 DAS, the highest number of 16.56 nodules $plant^{-1}$ was observed in 30 cm plant spacing and the lowest of 12.22

nodules in the plant spacing of 10 cm. In general, number of nodules plant^{-1} increased at wider plant spacing and it was probably due to availability of more space, nutrition, air, water and light to the plant.

Table 4.3 shows that the interaction effect between biofertilizer and plant spacing on nodule production was significant. From Table 4.3, it is revealed that highest of 13.11 nodules plant^{-1} was obtained from the highest level of biofertilizer application with 30 cm plant spacing and the lowest of 8.00 nodules plant^{-1} was observed in no biofertilizer treatment with 10 cm plant spacing at 40 DAS. At 65 DAS, the highest number of 19.11 nodules plant^{-1} was observed in the highest level of biofertilizer application with plant spacing of 30 cm and the lowest of 11.33 nodules plant^{-1} was found in the control biofertilizer treatment with 10 cm plant spacing which was identically followed by control treatment with 20 cm plant spacing.

Interaction effect of biofertilizer and plant spacing was significant on weight of seeds plant^{-1}. The highest weight of seeds plant^{-1} (8.66 g) was found in the plant spacing of 30 cm with 1.5 kg ha^{-1} of biofertilizer, and the lowest (3.81 g) seed weight plant^{-1} was observed in the plant spacing of 10 cm with no biofertilizer (Table 4.6).

The effect of plant spacing was highly significant for seed yield (Table 4.5). From Table 4.5 it is revealed that an increase in plant spacing from 10 to 20 cm

SUMMARY

The experiment was conducted at Office farm of Bangladesh Institute of Nuclear Agriculture, Gopalgonj from November 2018 to January 2019 to study the effect of biofertilizer and plant spacing on the yield of mungbean. The treatments comprised of five levels of biofertilizer. T_1= no biofertilizer control, T_2 =0.5, T_3 = 1.0, T_4 =1.5 and T_5 = 2.0 kg ha^{-1} biofertilizer and three plant spacing : 10, 20 and 30 cm within rows at 30 cm apart.

Bradyrhizobium strains viz. BINA-MB-441, BINA-MB-169 and BINA-MB-301 were used as biofertilizer. Urea, triple superphosphate and muriate of potash (35, 75 and 40 kg ha^{-1}) were applied with each level of biofertilizer. The experiment was laid out on a split plot design with three replications with biofertilizer in the main plots and plant spacing in the subplots. The size of each unit plot was (4.0m x 3.0m). The seeds were shown on 5 November 2013. Intercultural operations were done as and when necessary. Data on growth parameters, and yield and yield contributing characters were recorded. The collected data were analysed statistically and the means were adjudged by DMRT.

Results revealed that different levels of biofertilizer application influenced significantly the growth parameters like plant height at maturity, dry matter plant^{1} and number of nodules plant^{-1} at 40 and 65 DAS (days after sowing). Significantly highest plant height, dry matter plant^{-1} and number of nodules plant^{-1} at 40 and 65 DAS were observed in the highest level of biofertilizer application (2.0 kg ha^{-1}) compared to other lower levels of biofertilizer application (1.5,1.0 and 0.5 k g ha^{-1}) and the control.

Plant spacing also significantly influenced the growth parameters. The highest plant population m^{-2} and dry matter plant^{-1} at 40 and 65 DAS were observed in the plant spacing of 10 cm, whereas the number of nodules plant^{-1} at 40 and 65 DAS were found to be the highest in the plant spacing of 30 cm, the seed yield

CONCLUSION

Yield and yield contributing characters, except number of seeds pod^{-1} and weight of thousand seeds, were significantly influenced by biofertilizer application. The highest levels of biofertilizer application (2.0 kg ha^{-1}) showed superiority in respect of yield and yield contributing characters over other lower levels of biofertilizer application (1.5, 1.0 and 0.5 kg ha^{-1}) and the control treatment**.** The highest number of branches plant^{-1}, pods plant^{-1}, pod length^{-1}, seeds pod^{-1}, seed weight plant^{-1}, seed yield, stover yield, biological yield, and the harvest index were found at 2.0 kg ha^{-1} biofertilizer application.

Yield and yield contributing characters were significantly influenced by different plant spacing. The highest number of grain yield, biological yield and harvest index were found in the 20 cm plant spacing whereas the number of branch plant^{-1}, number of pod plant^{-1}, pod length nodule, thousand seed weight, dry matter weight were highest at the 30 cm plant spacing.

The highest dry matter plant^{-1} was obtained from the highest level of biofertilizer (2.0 kg ha^{-1}) with a plant spacing of 10 cm, whereas the highest number of nodules plant^{-1} at both 40 and 65 DAS were found in the interaction of the highest level of biofertilizer (2.0 kg ha^{-1}) with 30 cm plant spacing.

From the above result it is revealed that yield and yield attributes differed with different levels of biofertilizer application and plant spacing. The highest grain yield was obtained from the highest level (2 kg ha^{-1}) of biofertilizer application with a plant spacing of 20 cm.

The results obtained in this experiment have also indicate that there is a scope to increase the yield of mungbean by applying biofertilizers and using proper plant spacing.

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