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Effect of foliar application of gibberellic acid on different growth contributing characters of mungbean

MM Rahman, ABMMM Khan, MM Hasan, LA Banu, MHK Howlader*

Department of Agricultural Botany, Patuakhali Science and Technology University, Dumki, Patuakhali 8602, Bangladesh.

Abstract

The comparative growth and yield performances between two Mungbean (BARI Mung 6 and BARI Mung 5) varieties with foliar application of GA_3 (0, 50, 100 and 150 ppm) were studied to find out the suitable variety and optimum level of GA_3 application. The design of experiment followed was RCBD. Data on morpho-physiological characteristics were recorded at 15, 25, 35, 45and 55 days after sowing (DAS) and yield contributing parameters were recorded only at harvest stage. The results showed that application of GA_3 @ 100 ppm produced better performance on morpho-physiological characters namely, plant height (56.59cm), number of leaves per plant (10.75), branches per plant (4.75), length of root (24.73cm), total dry matter weight (12.67g)which were recorded from the variety BARI mung 6 with the foliar application of GA_3 @ 100 ppm. Yield contributing characters were also showed the highest performance in terms of number of pods per plant (23.40), pod length (6.67cm), number of seeds per pod (12.82), thousand seed weight (33.95 g), seed yield (7.53 g/plant and 1.92 t ha^{-1}), and harvest index (35.36%) which were the highest with the application of 100 ppm GA_3 in case of BARI Mung 6. Single and combined effects of treatments were found statistically significant. Between two varieties BARI Mung 6, among the treatments GA_3 @ 100 ppm as foliar application and interaction effect of GA_3 @ 100 ppm and BARI mung 6 showed the highest performance in respect of all growth and yield parameters.

Key words: GA_3, mungbean, physiology, *Vigna radiata* L

 ***Corresponding Author:** hhkabir63@gmail.com

Introduction

Mungbean *(Vigna radiata* L.) is an important pulse crop which has economic importance in Bangladesh. The Mungbean is one of the most important conventional pulses grown in Bangladesh. It is an important herbaceous, annual, self–pollinated pulse crop under the family Leguminosae. In Bangladesh, among pulses, Mungbean ranks the fourth in acreage production and the first in market price (BBS, 2012). Mungbean is one of the important pulse crops grown principally for its protein rich edible seeds. For developing country like Bangladesh, pulses constitute the major concentrated source of dietary proteins. Mungbean contributed 8.23 percent of the total pulse production in our country (BBS, 2012). A minimum intake of pulse by a human should be 80.0 g per day, whereas it is only 19.35 g per day in Bangladesh (BBS, 2011). Mungbean is an important source of protein and several essential micronutrients (kaul, 1982). The daily consumption of pules in Bangladesh is only 10 grams per head as compared with 45 grams in India (FAO, 1984).

Mungbean is potentially useful legume crop which can improve the existing cropping pattern. Mungbean can also fix atmospheric nitrogen through the symbiotic relationship between the host Mungbean roots and soil bacteria which can improves soil fertility. It may play an important role to supplement protein in the cereal-based low-protein diet of the people of Bangladesh, but the acreage and production of Mungbean is steadily declining (BBS, 2005). However, it is one of the least cared crops. Mungbean is cultivated with minimum land preparation and without fertilizer application even without insect, diseases or weed control. All these factors are responsible for low yield of Mungbean.

Inspite of its importance and well adaptability in the agroclimatic condition of Bangladesh, the acreage production of mungbean are decreasing gradually because of mounting competition from other profitable cereals, especially irrigated boro rice in medium high land (Ahmed, 1984). The crop has received very little attention of the researchers in comparison to other cereals and grain crops. Considering the significance of mungbean in the Bangladesh context, it is therefore, of utmost necessity to improve this pulse both in terms of its quantitative and qualitative values. Various practices may help to achieve this goal. Application of growth regulators seems to be the most significant one in view of convenience, cost, labour and efficacy.

Gibberellic acid (GA_3) is a phytohormone that is needed in small quantities at low concentration to accelerate plant growth and development. So, favorable condition may be induced by applying growth regulator exogenously in proper concentration at a proper time in a specific crop by GA_3. Gibberellic acid is such a plant growth regulator, which can manipulate a variety of growth and development phenomena in various crops. GA_3 enhances growth activities to plant, stimulates stem elongation and increases dry weight and yield (Deotale *et al.,* 1998; Abd et el., 1996). Moreover growth regulators are used in appropriate concentrations, these substances influence the plant architecture in a typical fashion and improve the yield potential. Substances are now available that modify plant organs differently and influence final plant form. Such substances therefore, are potentially useful in agriculture, because when applied at appropriate time, and at appropriate concentration increase the yield either by altering dry matter distribution in the plant or by regulating growth.

The challenge is to find ways of improving Mungbean productivity, where varietal improvement, modified cropping systems and use of plant growth regulators (PGRs) may improve Mungbean yield .Therefore, the current research work was undertaken to evaluate the effect of various concentrations of GA_3on growth and yield of Mungbean.

A very limited works have been carried out regarding the use of growth regulators especially in mungbean in our country. Although studies, in other countries of the world provided useful information, those may not be applicable directly to our cultivars because of varied weather and soil conditions. Therefore, on the effects of growth regulators in our climatic condition could provide useful information in the improvement of yield of Mungbean. The objectives of the present study are to assess the effect of Gibberellic Acid (GA_3) on the growth and yield of Mungbean and to determine the optimum doses of GA_3 for better yield of Mungbean.

Materials and Methods

Two varieties of Mungbean namely BARI Mung 6 (V_1) and BARI Mung 5 (V_2) collected from Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur were used in this study.

The land of the experimental site was first opened with a power tiller. After ploughing and laddering all stubbles and uprooted weeds were removed to make the land ready for sowing and the basal dose of fertilizers was incorporated thoroughly before planting. The whole experimental land was divided into three blocks maintaining 0.5 m space between two blocks and each block was divided into eight plots maintaining 0.25 m space between them. The size of unit plot was 3 m × 2 m (6.0 m^2). The plots were spaded one day before planting and the basal dose of fertilizers were incorporated thoroughly before planting.

The experiment was laid out in Randomized Complete Block Design (RCBD). There were three replications. Each treatment was randomly accommodated once in each block. Total number of plots = 24, Individual plot size = 3 m × 2 m (6.0 m^2) Plot to plot distance = 0.5 m, Row to row distance = 30 cm, Plant to plant distance = 10 cm, Block to block distance = 1.0 m

Urea, Triple superphosphate (TSP) and Muriate of potash (MP) was applied at the following doses Total amount of TSP, MP and urea were applied uniformly at the time of final land preparation. The seeds of Mungbean were sown in the research field on January 2015. Seeds were sown in rows by hand plough. The distances between row to row and seeds to seeds were 30 and 10 cm, respectively and 2–3 cm depth from the soil surface. Germination of seeds started from 7 days after sowing. On the 14th day the percentage of germination was more than 80 percent and on the 15th day nearly all plants came out of the soil. Seedlings were transferred to fill in the gaps where seeds failed to germinate. The gaps were filled in within two weeks after emergence of seedlings. First weeding was done at 30 DAS and then weeding was done as and when necessary to keep the plots free from weeds and to keep the soil loose and aerated. The irrigation was done after first weeding. Irrigation was provided as and when needed. Proper drainage system was also developed for draining out excess water.

At the early stage of growth, few plants were infested with root rot disease. Hairy caterpillars attacked the young plants and accumulated on the lower surface of leaves where they usually sucked juice of green leaves. To control these pests, the infected leaves were removed from the stem and destroyed together with the insects by hand picking. The insecticide was sprayed three times at seven days interval to control the insects. The first crop sampling was done on 15 days after sowing (DAS) and it was continued till physiological maturity of 60 DAS and at harvest. Five plants were selected randomly in such a way so that the border effect could be avoided. For this reason, the outer two lines and the outer plants of the middle lines in each unit plot were avoided. Data were recorded periodically from the sample plants at 15 days interval. Yield data were also collected after harvest. The plants were separated into shoot and roots and then their dry weight were recorded after drying them in oven at 80 ± 2^0C for 72 hours.

The data obtained from this experiment on various parameters were analyzed by MSTAT–C computer program (Russell, 1986). The mean values for all the parameters were calculated and the analysis of variance for the characters was accomplished by Duncan's Multiple Range Test (DMRT) and the significance of difference between pair of means was tested by the Least Significant Differences (LSD) test at 5 % levels of probability (Gomez and Gomez, 1984).

Results and Discussion

This chapter includes the experimental results along with discussion. Results of the research work were conducted to investigate the effect of Gibberellic Acid (GA_3) as foliar application on the growth and yield of Mungbean. A detailed discussion on the present results and possible interpretations have been given in this chapter.

Effect of GA_3 on the leaf area of plant was found statistically significant for both varieties of Mungbean used in the experiment. The results of leaf area of plant at 15, 25, 35, 45 and 55 days after sowings have been presented in Table 1. The maximum leaf area of plant (14.91 cm^2, 105.1 cm^2, 150.8, 357.0 cm^2 and 425.1 cm^2) and lowest leaf area of plant (14.52 cm^2, 102.8 cm^2, 143.6 cm^2, 343.8 cm^2 and 405.8 cm^2) at 15, 25, 35, 45 and 55 DAS, respectively were recorded with BARI Mung 6 variety and the BARI Mung 5.

Significant variation was found on leaf area production due to various treatments of GA_3 as foliar application in this study in Table 2. Among the different types of treatments, 100 ppm GA_3 as foliar application had produces highly significant for obtaining the more leaf area (15.29, 114.4, 158.7, 410.6 and 576.4 cm^2) comparatively than that of other foliar treatments at 15, 25, 35, 45 and 55 DAS, respectively. It was also found the without GA_3 (control treatment) obtained the minimum leaf area (13.98, 89.43, 129.0, 299.4, and 331.4 cm^2) at 15, 25, 35, 45 and 55 DAS, respectively.

Table 1. Differences of mungbean varieties on leaf area of plant at different growth stage.

Variety	Leaf area (cm^2)				
	15 DAS	25 DAS	35 DAS	45 DAS	55 DAS
V_1	14.91a	105.1a	150.8a	357.0a	425.1a
V_2	14.52b	102.8b	143.6b	343.8b	405.8b
$LSD_{0.05}$	0.092	0.321	2.02	6.19	7.23
CV (%)	0.72	0.35	1.57	2.02	1.99

Table 2. Effect of foliar application of GA_3 on Leaf area of plant at different days after sowing (DAS).

Concen-tration	Leaf area (cm^2)				
	15 DAS	25 DAS	35 DAS	45 DAS	55 DAS
C_0	13.98d	89.43d	129.0d	299.4d	331.4d
C_1	14.57c	100.0c	145.9c	317.3c	358.8c
C_2	15.29a	114.4a	158.7a	410.6a	576.4a
C_3	15.03b	111.9b	155.4b	374.4b	395.3b
$LSD_{0.05}$	0.129	0.455	2.85	8.76	10.24
CV (%)	0.72	0.35	1.57	2.02	1.99

Significant variation due to varieties was also obtained in respect of total dry matter (TDM) at all the data recording stages except 15 DAT where both varieties were produced statistically similar TDM (Table 3). As a result, the TDM was highest (0.1252, .6375, 1.283, 3.362 and 11.38 g $plant^{-1}$) in BARI Mung 6 than BARI Mung 5 (0.1193, 0.6025, 1.13, 3.135 and 10.50 g $plant^{-1}$) at 15, 25, 35, 45 and 55 DAS respectively.

Table 3. Differences of mungbean varieties on total dry matter of plant at different growth stages.

Variety	Total dry matter (TDM)/plant (g)				
	15 DAS	25 DAS	35 DAS	45 DAS	55 DAS
V_1	0.125a	0.6375a	1.283 a	3.362a	11.3a
V_2	0.119b	0.6025b	1.133b	3.135b	10.50b
$LSD_{0.05}$	0.00123	0.00193	0.061	0.078	0.083
CV (%)	1.16	0.36	5.89	2.79	0.85

Significant variation due to foliar application of GA_3 was also obtained in respect of total dry matter (TDM) at all the data recording stages except 15 DAS. At 15 DAS highest TDM was found in GA_3 @ 100 ppm and lowest TDM was received in control. The highest TDM (1.550, 3.955 and 12.39 g $plant^{-1}$) was obtained from the @ 100 ppm foliar application GA_3 and the lowest TDM (0.980, 2.630, and 9.210 g $plant^{-1}$) was observed in control at 35, 45 and 55 DAS, respectively (Table 4).

Table 4. Effect of foliar application of GA_3 on total dry matter of plant at different days after sowing (DAS).

Concen-tration	Total dry matter (TDM)/plant (g)				
	15 DAS	25 DAS	35 DAS	45 DAS	55 DAS
C_0	0.1050d	0.4900d	0.9800c	2.630d	9.210d
C_1	0.1150c	0.6050c	1.125b	3.065c	10.88c
C_2	0.1390a	0.7300a	1.550a	3.955a	12.39a
C_3	0.1300b	0.6550b	1.175b	3.345b	11.30b
$LSD_{0.05}$	0.00175	0.0027	0.087	0.110	0.117
CV (%)	1.16	0.36	5.89	2.79	0.85

Figure followed by different letter (s) within a column differ significantly (DMRT), C_0 = Control, C_1 = 50 ppm GA_3, C_2 = 100 ppm GA_3, C_3 = 150 ppm GA_3, V_1 = BARI 6,V_2 = BARI 5, CV = Coefficient of variation.

The data on CGR at different growth stages were statistically identical between varieties. However BARI Mung 6 had maximum (0.905, 1.023, 3.310 and 13.65

g m^{-2} day^{-1}) than BARI Mung 5 (0.745, 0.6825, 2.855 and 10.69 g m^{-2} day^{-1}) at 15 -25 DAS, 25–35, 35 - 45 and 45 -55 DAS, respectively (Table 5).

The growth regulator applied in the present study significantly regulated crop growth rate at different growth stages. The data revealed that C_2 (100 ppm) maintained a higher CGR at all stages of growth at 55 DAS, it had the highest crop growth rate (13.63 g/m^2/day). C_3 (50 ppm of GA_3) had the lowest CGR (10.53 g/m^2/day) at 55 DAS. However, C_2 (100 ppm) was statistically identical with C_1 (50 ppm) at this time.

Table 5. Differences of mungbean varieties on crop growth rate (CGR) at different growth stages.

Variety	CGR/plant (g m^{-2} day^{-1})			
	25-15 DAS	35-25 DAS	45-35 DAS	55-45 DAS
V_1	0.905a	1.023a	3.310a	13.65a
V_2	0.745b	0.6825b	2.855b	10.69b
$LSD_{0.05}$	0.047	0.073	0.110	0.404
CV (%)	7.07	9.64	4.15	3.79

The data on RGR at different growth stages were statistically identical between varieties. However BARI Mung 6 had maximum (0.670, 0.5940, 0.4452 and 0.3723 g cm^{-2} day^{-1}) than BARI Mung 5 (0.6557, 0.5722, 0.4398 and 0.3590 g cm^{-2} day^{-1}) at 25 DAS, 35, 45 and 55 DAS, respectively.

Table 6. Relative growth rate (RGR) of different mungbean varieties at different days after sowing (DAS).

Variety	RGR/plant (g cm^{-1} day^{-1})			
	25 DAS	35 DAS	45 DAS	55 DAS
V_1	0.670a	0.5940a	0.4452a	0.3723a
V_2	0.6557b	0.5722b	0.4398b	0.3590b
$LSD_{0.05}$	0.0067	0.0057	0.0039	0.0047
CV (%)	1.16	1.52	0.88	1.41

Figure followed by different letter (s) within a column differ significantly (DMRT), C_0=Control, C_1=50ppm GA_3, C_2=100ppm GA_3, C_3=150ppm GA_3, V_1 = BARI 6, V_2 = BARI 5, CV = Coefficient of variation.

A significant variation was also obtained in respect of relative growth rate (RGR) due to the different level of GA_3 at 25, 35, 45, and 55 DAS respectively. Among the data recording stage, the higher RGR was recorded at the stage of 25 DAS and lowers at the stage of 55 DAS (Table 6).

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