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Growth Pattern of Mungbean at Different Planting Distance

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Abstract: An experiment was conducted at the Agricultural Botany Field Laboratory, Sher-e-Bangla Agricultural University, Dhaka during the Kharif-2 season to investigate the effect of cultivar and plant spacing on growth patteren of mungbean. The experiment comprised five varieties *viz*. BARI Mung-2 (M_2), BARI Mung-3 (M_3), BARI Mung-4 (M_4), BARI Mung-5 (M_5) and BARI Mung-6 (M_6) and three plant spacings viz. 20×10 cm (D_1), 30×10 cm (D_2) and 40×10 cm (D_3). The experiment was laid out in a randomized complete block design with three replications. Results revealed that among these varieties BARI Mung-4 reached the highest plant height (47.23 cm) at 60 days. For interaction effect M_4D_2 produced the highest plant height of 47.01 cm at 60 days. Among the varieties BARI Mung-3 produced the highest number (9.53) of leaf per plant and BARI Mung-6 produced the lowest number (6.66) of leaf at 60 DAS. At 30 DAS (Days after sowing) BARI Mung-2 (7.4) and M_2D_3 (8.60) produced the highest leaf number. At 40 DAS BARI Mung-4 (8.91) and M_3D_3 (9.6) produced the highest leaf number.Total dry matter (TDM) per plant was the highest and lowest in BARI Mung-6 (12.32 g) and BARI Mung-2 (10.72 g) at 60 DAS. Among the plant distance at 40×10 cm spacing produced the highest total dry matter of 11.85 g plant^{-1}. Among the interaction of variety and plant spacing M_6D_3 produced the highest TDM of 12.81 gm per plant

Key words: Growth · Planting distance · Dry matter

INTRODUCTION

Mungbean (*Vigna radiata* Lin.) is one of the most important pulse crops which can be grown in three seasons and it has wide acceptability for growing in wide range of soil type throughout the country [1]. In Bangladesh, total production of pulses is only 0.65 million ton against 2.7 million tons requirement.In Bangladesh the shortage of pulse crop to its demand is almost 80% of the total requirement [2]. One of the reasons for this is low yield [3] that is due to low yielding capability of varieties and cultural practices. Improper spacing reduced the yield of mungbean up to 20-40% [4] due to competition for light, space, water and nutrition and higher plant spacing than the optimum reduces the yield due to less number of plant per unit area. That is optimization of plant spacing is needed. The experimental evidences of the effect of plant spacing on the growth pattern of Bangladesh's mungbean cultivars are limited. Therefore, present study was undertaken to observe the effect of plant spacing on growth mungbean varieties in Bangladesh.

MATERIALS AND METHODS

The experiment was conducted at the experimental field of Agricultural Botany Department, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh from the period of August, 2009 to October, 2009 (kharif-2 season). Five Mungbean varieties namely BARI Mung-2 (M_2), BARI Mung-3 (M_3), BARI Mung-4 (M_4), BARI Mung-5 (M_5) and BARI Mung-6 (M_6) were used in the experiment to observe growth pattern in different plant spacings viz. 20×10 cm (D_1), 30×10 cm (D_2) and 40×10 cm (D_3). The experiment was laid out with randomized complete block

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design and with three replications. The unit plot size was 2.5×1.5 m. The land was prepared properly with ploughing and laddering. The fertilizers were given during the final land preparation at the dose of 20 kg N ha^{-1}, 40 kg P_2O_5 ha^{-1} and 20 kg K_2O ha^{-1} in the form of Urea, Tripple Supper Phosphate (TSP) and Muriate of Potash (MP). Other intercultural operations were performed as per requirement and recommendation [5]. Data on different parameters were taken according to the maturity time of different varieties. To measure the growth pattern data on leaf number, plant height and total dry matter were taken at definite days interval. The data were analyzed by MSTAT program and mean differences were tested by Duncan's Multiple Range Test (DMRT) [6].

RESULTS AND DISCUSSION

Plant spacing directly affects the physiological activities through intra-specific competition [7]. That ultimately effects the vegetative and reproductive development of plant. Optimum plant population is necessary to obtain maximum yield. Optimum population or optimum plant spacing depends on size of plant elasticity, foraging area, nature of the plant, capacity to reach optimum leaf area at an early date and seed rate used [8]. Thus due to different plant spacing the plant produce different total dry matter (TDM), different plant height, leaf character etc. The variation in different plant characters due to different verity, plant spacing and their interaction was observed in the present experiment and discussed in the article below.

Plant Height: Different varieties released by BARI are different in plant height. In the study the significant varietal differences were found in most of the cases. But at the early life stages of life these differences were not significant in some cases. As for example at 10 and 20 days after sowing no significant differences were found among the varieties considering plant height. The rate of increase of plant height was higher at 20 and 30 days after sowing and it is true for all the varieties. Among these varieties BARI Mung-4 reached the highest plant height (47.23 cm) at 60 days which is statistically at per with the BARI Mung-3. The other varieties did not show any differences significantly and BARI Mung-5 produced the lowest plant height. The research findings also revealed that BARI Mung-4 produced the highest plant height and BARI Mung-3 produced the second highest plant height [1].

Plant spacing significantly affected the plant height 40 days after sowing. It was found that with the increase of plant spacing the plant height also increased. This trend was found in all the cases. For interaction effect M_4D_2 produced the highest plant height of 47.01 cm at 60 days that is statistically not higher than the M_3D_2 (46.88 cm) and M_4D_3 (46.21 cm). The lowest plant height was found in M_6D_1 and it was 35.52 cm and it is similar statistically with M_6D_2 (plant height of 36.52 cm) and M_5D_1 (plant height of 35.69 cm). The difference between the highest and the lowest plant height is 24.44%. If we compare the plant height of different varieties at different plant spacing it can be seen that a variety is producing taller plant when the plant distance is more. At 60 days and 20×10 cm spacing BARI Mung-2 was 37.43 cm, it reached at a height of 38.88 cm and 41.28 cm in 30×10 cm and 40×10 cm plant spacing. At 20×10 cm plant distance BARI Mung-3 was 44.52 cm, it reached at a height of 46.88 cm and 45.68 cm in 30×10 cm and 40×10 cm plant spacing. At 20×10 cm plant distance BARI Mung-4 was 45.51 cm, it reached at a height of 47.01 cm and 46.21 cm in 30×10 cm and 40×10 cm plant spacing. At 20×10 cm plant distance BARI Mung-5 was 35.69 cm, it reached at a height of 36.16 cm and 38.31 cm in 30×10 cm and 40×10 cm plant spacing. At 20×10 cm plant distance BARI Mung-6 was 35.52 cm, it reached at a height of 36.52 cm and 39.39 cm in 30×10 cm and 40×10 cm plant spacing. This interesting trend was found in all the cases that with the increase of planting distance. Studies revealed that plant height increases when the plant density is very high which can help the plants to survive more by reducing the harmful effect of light competition. Again due to nutrient competition the height can be reduced also [8, 9]. In the experiment the plants were not so densely planted that they faced light competition. So, here it was found that with the increase of plant distance the plant height increased and it may be due to less competition of nutrient.

Number of Leaves per Plant: Leaf is one of the most important parts of plant body which is responsible for photosynthesis. The more the leaf area the more the photosynthetic area and more the leaf number the more the photosynthetic area. Up to 30 days after sowing the number of leaf per plant did not varied significantly among the varieties. The number of leaf per plant did not varied in different plant spacing also. Among the varieties BARI Mung-3 produced the highest number (9.53) of leaf per plant and BARI Mung-6 produced the lowest number (6.66) of leaf at 60 DAS (Table 1).

Table 1: Plant height of mungbean varieties at different days after sowing

	Plant height at different DAS after sowing					
Treatments	10	20	30	40	50	60
Variety						
M_2 (BARI Mung-2)	7.79a	11.11a	21.06a	35.18b	37.61b	39.60b
M_3 (BARI Mung-3)	6.96a	10.73a	23.82b	35.28a	40.16a	46.24a
M_4 (BARI Mung-4)	6.95a	11.84a	25.96a	33.70a	42.42a	47.23a
M_5 (BARI Mung-5)	7.83a	11.28a	21.32c	31.80ab	32.34c	36.05b
M_6 (BARI Mung-6)	8.20a	11.26a	22.69bc	30.22c	33.54c	36.14b
lsd	1.5	1.2	2.1	2.3	3.5	3.7
Level of significance	NS	NS	0.01	0.01	0.01	0.01
Spacing						
D_1(20×10 cm)	7.42a	10.76a	18.06a	32.80b	33.46b	35.76b
D_2(30×10 cm)	7.32a	10.54a	17.42a	31.47b	34.72b	37.43b
D_3(40×10 cm)	7.90a	11.23a	19.02a	35.44a	36.28a	39.13a
lsd	1.1	1.2	2.2	2.4	2.5	2.8
Level of significance	NS	NS	NS	0.01	0.01	0.01
Variety × Spacing						
M_2D_1	7.94abc	10.46cde	17.72bcde	32.37cde	35.23cde	37.43cd
M_3D_1	7.29bc	11.13bc	19.13abcd	37.00ab	38.31bc	44.52ab
M_4D_1	7.60abc	10.81bcd	18.35bcde	38.40a	43.43a	45.51ab
M_5D_1	7.93abc	11.57bc	19.57abc	34.43bc	32.37e	35.69d
M_6D_1	8.77a	12.21b	20.35ab	35.00bc	32.07e	35.52d
M_2D_2	7.48bc	10.72bcde	18.43b-e	36.37abc	37.17bcd	38.88cd
M_3D_2	6.78cd	10.80bcd	19.17a-d	34.77bc	40.47ab	46.88a
M_4D_2	6.90bcd	9.23e	14.49e	31.20e	39.47b	47.01a
M_5D_2	8.00ab	11.75bc	19.77abc	33.67cde	35.20cde	36.16d
M_6D_2	7.96abc	11.33bc	18.50bcde	28.03f	33.97de	36.52d
M_2D_3	7.95abc	15.17a	23.03a	36.83ab	40.43ab	41.28bc
M_3D_3	6.82bcd	10.27b-e	18.17bcde	34.10bcd	39.73b	45.68ab
M_4D_3	6.37d	9.49de	15.07de	31.50de	40.37ab	46.21a
M_5D_3	7.56bcd	10.55cde	15.63cde	27.30f	33.47e	38.31cd
M_6D_3	7.89abc	10.27cde	17.23bcde	27.63f	34.60de	39.39cd
lsd	1.2	1.5	4.2	3.1	3.3	4.5
Level of significance	0.01	0.01	0.01	0.01	0.01	0.01
%CV	9.41	8.73	15.62	11.60	15.95	14.08

The values in a column having common letters do not differ significantly; NS= non-significant

Table 2: No. of leaves of mungbean varieties at different days after sowing

	No. of leaves at different DAS after sowing					
Treatment	10	20	30	40	50	60
Variety						
M_2 (BARI Mung-2)	3.06a	5.16a	7.4a	8.55a	8.62ab	8.88a
M_3 (BARI Mung-3)	3.13a	5.15a	7.02a	9.02a	9.51a	9.53a
M_4 (BARI Mung-4)	3.04a	4.95a	6.88a	8.91a	9.26a	8.33a
M_5 (BARI Mung-5)	3.08a	4.77a	6.22a	7.33b	7.04b	6.84b
M_6 (BARI Mung-6)	3.08a	4.93a	6.42a	7.17b	7.04b	6.66b
lsd	0.9	1.2	1.3	1.2	1.4	1.3
Level of significance	NS	NS	NS	0.01	0.01	0.01

Table 2:Continued

Treatment	No. of leaves at different DAS after sowing					
	10	20	30	40	50	60
Spacing						
D_1(20×10 cm)	3.09a	5.02a	6.74a	8.13a	8.12a	7.30a
D_2(30×10 cm)	3.10a	4.86a	6.75a	7.93a	7.96a	7.72a
D_3(40×10 cm)	3.05a	5.09a	6.88a	8.53a	8.81a	8.42a
lsd	0.25	0.8	0.9	0.9	1.1	1.2
Level of significance	NS	NS	NS	NS	NS	NS
Variety × Spacing						
M_2D_1	2.93b	4.86b	6.66bc	7.53cde	7.73def	7.13de
M_3D_1	3.33a	5.26ab	7.06b	8.93ab	8.73bcd	8.13bcd
M_4D_1	3.00b	5.06ab	7.13b	9.40ab	9.6abc	8.20bcd
M_5D_1	3.06ab	4.93ab	6.40bc	7.60cde	7.06ef	6.33e
M_6D_1	3.13ab	5.00ab	6.46bc	7.20e	7.46def	6.73de
M_2D_2	3.06ab	4.93ab	6.93b	8.46a-e	8.13c-f	7.93cde
M_3D_2	3.13ab	4.93ab	7.06b	8.53abc	9.26abc	8.93abc
M_4D_2	3.00b	4.80b	6.86bc	8.20b-e	8.53b-e	7.93cde
M_5D_2	3.20ab	4.86b	6.46bc	7.40cde	7.26def	7.33cde
M_6D_2	3.13ab	4.80b	6.40bc	7.06b	6.60f	6.46e
M_2D_3	3.20ab	5.66a	8.60a	9.66a	10.00ab	9.60ab
M_3D_3	2.93b	5.26ab	6.93b	9.60a	10.53a	10.00a
M_4D_3	3.13ab	5.00ab	6.66bc	9.13ab	9.66ab	8.86abc
M_5D_3	3.00b	4.53b	5.80c	7.00e	6.80f	6.86de
M_6D_3	3.00b	5.00ab	6.40bc	7.26de	7.06ef	6.80de
lsd	0.32	0.73	0.98	1.2	1.5	1.6
Level of significance	0.01	0.01	0.01	0.01	0.01	0.01
%CV	6.21	8.75	8.70	9.22	11.36	11.52

The values in a column having common letters do not differ significantly; NS=non-significant

The leaf during the reproductive phase specially during the pod formation stage plays an important role as during that translocation of assimilates from leaf to reproductive part is very important. So, the number of leaf at 30 to 40 days after sowing when the pods are started to mature should be taken under consideration. At 30 DAS (Days after sowing) BARI Mung-2 (7.4) and M_2D_3 (8.60) produced the highest leaf number. At 40 DAS BARI Mung-4 (8.91) and M_3D_3 (9.6) produced the highest leaf number (Table 2). Considering the interaction of variety and plant spacing M_5D_1 produced the lowest leaf number of 6.33 which is 36.7% lower than the highest value 10.00 of M_3D_3 at 60 days after sowing. It is revealed after comparing the data of 50 and 60 DAS it can be seen that the leaf number reduced a little bit in 60 DAS than the 50 DAS. It is due to leaf senescence and shedding which is a common phenomena at later stage of life cycle of mungbean plant [4].

Total Dry Matter per Plant: Total dry matter or biological yield and economic yield are inter-related. When the data of these two parameters are plotted on the same graph, it can be seen that the level of population at which biological yield reaches at a plateau is the level of plant population at which maximum economic yield is obtained. In young plants, most of the assimilates are used for the production of stem and leaves. As the plant enters the reproductive stage, assimilates are partitioned to stem, leaves and inflorescence [8]. Once the seeds are set, most of the assimilates move to the seed. At that time there exists an internal competition within the individual plant between vegetative and reproductive parts. The similar trend in dry matter production was observed in the present experiment also. Up to 30 DAS the plant height increased at a rapid rate and at later stage the plant height did not increased in rapid rate (Table 1). But after 30 DAS the dry matter per plant increased significantly.

Table 3: Total dry matter of mungbean varieties at different days after sowing

	Total dry matter (g) at different days after sowing					
Treatment	10	20	30	40	50	60
Variety						
M_2 (BARI Mung-2)	0.34a	1.2ab	5.54ab	7.21b	10.02c	10.72c
M_3 (BARI Mung-3)	0.56a	1.31ab	5.65a	6.97bc	10.51bc	11.3b
M_4 (BARI Mung-4)	0.64a	1.72a	6.2a	8.86a	9.43d	11.01bc
M_5 (BARI Mung-5)	0.46a	0.97b	4.92bc	6.41cd	10.62b	11.92a
M_6 (BARI Mung-6)	0.51a	1.12ab	4.45c	5.77d	11.01a	12.32a
lsd	0.51	0.63	0.7	0.65	0.31	0.55
Level of significance	NS	0.01	0.01	0.01	0.01	0.01
Spacing						
D_1(20×10 cm)	0.29b	0.97b	3.85b	6.46b	10.11a	10.82c
D_2(30×10 cm)	0.42ab	1.14b	4.33a	6.71b	10.71a	11.12b
D_3(40×10 cm)	0.49a	1.66a	4.54a	7.42a	10.92a	11.85a
lsd	0.17	0.22	0.32	0.35	0.51	0.22
Level of significance	0.01	0.01	0.01	0.01	NS	0.01
Variety × Spacing						
M_2D_1	0.42c	0.91e	4.44f	5.81d	10.41cd	11.02de
M_3D_1	0.59abc	1.11c	5.2d	6.82a-d	9.4f	11.04cd
M_4D_1	0.62abc	1.5a-d	6.13ab	7.01abc	9.84ef	10.23e
M_5D_1	0.48bc	1.71a-d	4.8e	6.41a-d	10.81c	11.33bcd
M_6D_1	0.51abc	1.23bcd	4.7ef	6.3bcd	12.01ab	12.52a
M_2D_2	0.48bc	1.2cd	4.52ef	5.94cd	10.6cd	11.43bcd
M_3D_2	0.55abc	1.14d	5.6bc	7.13ab	10.4cd	11.43bcd
M_4D_2	0.67ab	1.8abc	5.82ab	7.22ab	9.7ef	10.26e
M_5D_2	0.52abc	1.77a-d	5.12d	6.61a-d	10.91c	11.66b
M_6D_2	0.49bc	1.25bcd	4.9de	6.42a-d	12.4a	12.71a
M_2D_3	0.49bc	1.4bcd	4.61ef	6.5a-d	10.7c	11.45bc
M_3D_3	0.61abc	1.22bcd	5.8b	7.3ab	10.6	11.63b
M_4D_3	0.72a	2.1a	6.2a	7.5a	10.1de	10.33e
M_5D_3	0.55abc	1.85ab	5.3cd	6.6a-d	11.6b	11.92b
M_6D_3	0.53abc	1.37bcd	5.25.2	6.5a-d	12.7a	12.81a
lsd	0.21	0.63	0.31	1.1	0.53	0.42
Level of significance	0.01	0.01	0.01	0.01	0.01	0.01
%CV	9.44	5.47	12.15	6.82	4.52	5.33

The values in a column having common letters do not differ significantly; NS= non-significant

So, it can be said that this increase in dry matter due to the increase in pod size or translocation of assimilates to reproductive parts.

Total dry matter (TDM) per plant was the highest and lowest in BARI Mung-6 (12.32 gm) and BARI Mung-2 (10.72 gm). Among the plant distance at 40X10 cm spacing produced the highest total dry matter of 11.85 gm per plant. Among the interaction of variety and plant spacing M_6D_3 produced the highest TDM of 12.81 gm per plant and it is statistically at per with M_6D_1 (12.52 gm). The lowest TDM was found in M_4D_1 that is 10.23 gm only. The difference between the highest and the lowest value is 20.14%. As the plant density increases, changes may occur in the allocation of assimilates to different parts of the plant and grain yield and dry matter production shows a decline. In the study it is revealed that with the increase of plant distance or decrease of plant population the total dry matter production per plant increased. The similar trend was described by Reddy and Reddi [8] and Usharani *et al.* [10].

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