Bangladesh Agron. J. 2022, 25(2): 57-65

EFFECT OF ADDED UREA FOLIAR SPRAY AND LEAF CLIPPING ON GROWTH AND YIELD RESPONSE OF MUNGBEAN

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(**Received**: 07 October 2022, **Accepted**: 20 January 2023)

Keywords: Leaf clipping, foliar spray, growth, yield, mungbean

Abstract

An experiment was conducted at Sher-e-Bangla Agricultural University, Dhaka, during March to May 2018 to study the impact of added urea foliar spray and leaf clipping on growth and yield of mungbean. The experiment was laid out in Split-plot Design with three replications and composed of four levels of urea foliar spray *viz.* F_0 = Recommended Fertilizer (RF) + No Foliar Spray (FS), F_1 = RF + 1% Urea FS at Flower Initiation (FI), F_2 = RF + 2% Urea FS at FI, F_3 = RF + 3% Urea FS at FI and four levels of Leaf clipping *viz.* C_0 = No leaf clipping, C_1 = Clipping 1 basal leaf, C_2 = Clipping 2 basal leaves, C_3= Clipping total apical leaves having no inflorescence. Results indicated that foliar spray and leaf clipping had significant effect on most of the growth and yield contributing parameters. In case of foliar spray of urea, the maximum plant height, nodules plant^{-1}, highest above ground dry matter plant^{-1}, pods plant^{-1}, pod length, seeds pod^{-1}, 1000 seed weight, seed yield, stover yield and biological yield were recorded from F_0. In case of leaf clipping, all growth and yield attributes were recorded highest from C_1. Regarding combined effect, the highest growth and yield parameters were recorded from the treatment combination of F_0C_1. So, F_0 along with C_1 is suggested for yield improvement in mungbean cultivation.

Introduction

Pulses are the cheapest source of high quality proteins, minerals and energy in human diet. With the development of irrigation facilities, the area of cultivation of HYV cereal crops has been increased significantly, while pulses have been pushed to marginal lands of low yield potential. The area under pulse production has been decreasing continuously in Bangladesh alarmingly (Shahjahan, 2001). In Bangladesh, a large number of people are suffering from malnutrition. Pulses are cheaper sources of protein than animal proteins (Singh and Jambunathan, 1989). A minimum per capita intake of pulse should be 80 g day^{-1}, whereas it is 8.72 g day^{-1} in Bangladesh. The total production of mungbean in Bangladesh during 2016-17 was 34,783 tons from an area of 1, 02,311 ha (BBS, 2018).

Fertilizers (N and P) may increase significantly mungbean yield (Patel and Parmer, 1986) by increasing root growth, nodulation, leaf area, and total dry matter. Foliar applied N to mungbean at flowering stage was found to increase seed yields (Abdo, 2001). The foliar application of nitrogen alone was more effective than NPK combinedly in producing higher number of seeds per pod (Hamayun *et al.*, 2011). In this situation foliar spray of urea at

flowering could be an option to check the abortion rate in pulses. But optimum fertilizer requirement depends on soil fertility levels and methods of application. In this context the foliar application of nitrogen at flowering stage may fulfill the nitrogen requirement of plant at its flowering stage received very minimum N (20 kg ha^{-1}) as basal dose.

Sink in mungbean is determined by the number of pods per plant (Mackenzie *et al.,* 1975), number of seeds per pod and weight of' an individual seed (AVRDC, 1976). Removal of apical shoot above node 5 or removal of inflorescence or axillary bud at nodes 1-4 together with the apical shoot greatly increased pod number and seed weight of mungbean (Clifford, 1979). Thus, the study was undertaken to maximize the seed yield of mungbean by manipulating its source-sink through removal of selective leaves and additional foliar spray of urea during onset of flowers.

Materials and Methods

The present research work was conducted at Sher-e- Bangla Agricultural University Farm, Dhaka-1207 during the period from March to May, 2018 which belongs to 23°77′N latitude and 90°33′E longitude and the Agro-ecological zone of The Modhupur Tract, AEZ-28 (Anonymous, 1988). The experiment was carried out in Split-plot Design with three replications. Foliar spray treatments were assigned in the main plots and leaf clipping treatments were in the sub-plots. The experiment consists 4 levels of foliar spray of urea viz. i) F_0: Recommended Fertilizer (RF) + No Foliar Spray (FS), ii) F_1: RF + 1% Urea FS at Flower Initiation (FI), iii) F_2: RF + 2% Urea FS at FI and iv) F_3: RF + 3% Urea FS at FI and 4 levels of leaf clipping viz. i) C_0: No leaf clipping, ii) C_1: Clipping 1 basal leaf, iii) C_2: Clipping 2 basal leaves and iv) C_3: Clipping total apical leaves having no inflorescence. The seed of the test crop i.e., BARI Mung-5 was collected from Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur.

Seeds were sown in line in main plot after good tilth of land. The experimental area was fertilized with 20, 40, 20, 20 and 01 kg ha^{-1} of N, P_2O_5, K_2O, S and B. The entire amount of TSP, MoP, Gypsum and Boric Acid were applied during the final preparation of land. In addition that 0, 1, 2 and 3 % urea solution were prepared with water. Those solutions were applied in the field using a knapsack sprayer on the mungbean leaves thoroughly during flower initiation. After establishment of seedlings, various intercultural operations were accomplished for better growth and development of the mungbean. The height of plant was recorded in centimeter (cm) at harvest. Data were recorded from randomly selected 5 plants each plants and then average the parameters viz, plant height from the ground level to the tip of the plant, above ground dry matter and number of pods $plant^{-1}$. The number of nodules $plant^{-1}$ was observed and counted from each plot and average number of nodules $plant^{-1}$ at 60 DAS was recorded. Pod length and the number of seeds $pods^{-1}$ was taken from randomly selected 20 pods of each treatment combination at the time of harvest. One thousand cleaned, dried seeds were counted randomly from each harvest sample and expressed in gram. The seeds and the stover collected from 1 square meter of each plot were sun dried properly. The weight of seeds was taken and converted the yield in t ha^{-1}. Biological yield was calculated by Biological yield = Seed yield + Stover yield. Harvest index was calculated from the ratio of grain yield to biological yield and expressed in percentage.

The collected data were compiled and analyzed statistically using the analysis of variance (ANOVA) technique using MSTAT-C computer package and the mean differences were adjusted by Least Significance Difference (LSD) test at 5% level of probability.

Results and Discussion

Plant height

Plant height of mungbean at harvest showed statistically significant in combine effect of foliar spray and leaf clipping treatment, but insignificant in fertilizer management in respect of foliar spray of urea and leaf clipping treatment (Table 1). The maximum plant height at harvest was 51.96 cm respectively, which were recorded from F_0 which was statistically similar with F_1 and F_2. The minimum plant height 49.23 cm, at harvest was observed from F_2. These are an agreement with those of Palta *et al.* (2005) and Zeidan (2003). In leaf clipping, the maximum plant height was recorded in C_1 (51.46 cm) which was closely followed by C_0 and C_2 at harvest. On the other hand, the minimum plant height was obtained in C_3 (48.74 cm). The finding is close conformity of findings with Tripathi *et al.* (2012), Kumar *et al.* (2009) and Raj and Tripathi (2005). The maximum plant height (61.20 cm) was obtained in the treatment combination of F_0C_1 which was statistically similar with F_1C_0 while the minimum plant height (45.10 cm) was recorded in the treatment combination of F_1C_1 which was statistically similar with F_0C_0, F_0C_3, F_1C_3, F_2C_0, F_2C_1, F_2C_3, F_3C_0, F_3C_1 and F_3C_2.

Above ground dry matter plant^{-1}

Statistically significant variation was found due to different foliar spray of urea, leaf clipping and treatment combination of above ground dry matter plant^{-1} at harvest (Table 1). In case of foliar spray, the highest above ground dry matter plant^{-1} (11.89 g) was found from F_0 which was statistically similar to F_1, whereas the lowest dry matter plant^{-1} (10.57 g) was recorded in F_3 which was statistically similar to F_2. Similar result was found by Salisbury and Ross (1985). In case of leaf clipping, the highest above ground dry matter plant^{-1} was recorded in C_1 (11.85 g) which was closely followed by C_2 and C_0. On the other hand, the lowest dry matter plant^{-1} was obtained in C_3 (10.27 g). The high source-sink ratio caused by defoliation increased the photosynthetic rates in the remaining leaves in okra, mungbean, soybean and groundnut (Bhatt and Rao, 2003; Pandey and Singh, 1984; Chen and Lia, 1991; Ghosh and Sengupta, 1986). The highest above ground dry matter plant^{-1} (14.76 g) was obtained in the treatment combination of F_0C_1 which was statistically similar with F_3C_3 while the lowest dry matter plant^{-1} (8.41 g) was recorded in the treatment combination of F_0C_0 which was statistically similar with F_0C_2, F_0C_3, F_2C_0, F_2C_3 and F_3C_1.

Number of nodules plant^{-1}

Statistically significant variation was found due to different foliar spray of urea, leaf clipping and its combination in terms of nodules plant^{-1} at 60 DAS (Table 1). The highest nodules plant^{-1} (3.00) was found from F_0 which was statistically similar to F_3 and followed by F_1, whereas the lowest nodules plant^{-1} (2.38) was recorded in F_2 from foliar spray treatment. Tripathi *et al.* (2012) and Muhammad *et al.* (2006) found that production of nodules plant^{-1} differed significantly due to different fertilizer application in many legumes. In case of leaf clipping, the highest nodules plant^{-1} (3.01) was found in C_1 which was statistically similar to C_0, while the lowest nodules plant^{-1} was recorded in C_3 (2.53) which was statistically similar to C_2. The highest nodules plant^{-1} (3.40) was found in the treatment combination of F_0C_1 which was statistically similar to F_0C_0, F_0C_3, F_1C_2, F_1C_3, F_3C_0, F_3C_1 and F_3C_3. The lowest nodules plant^{-1} (1.87) was observed in the treatment combination of F_2C_0 which was statistically similar to F_0C_2, F_1C_0, F_2C_0, F_2C_1 and F_3C_2.

Pod length

Statistically non-significant variation was recorded for pod length due to fertilizer management in respect of foliar spray of urea, leaf clipping and combination treatment (Table 1). The highest pod length (7.70 cm) was recorded from F_0 followed by F_1 where the lowest pod length (7.33

cm) was observed from F_3 which was statistically identical with F_2. Azadi *et al.*, (2013) showed that stem diameter, number of node and seed yield showed significant difference among various amounts of nitrogen fertilizer where pod length varied non-significantly. Numerically highest pod length (7.57 cm) was observed from C_1 which was similar to C_2 and C_0 and the lowest pod length (7.41 cm) was observed from C_3. From combination treatment, the numerically longest pod length (7.82 cm) was recorded from the treatment combination of F_0C_1. Numerically the shortest pod length (7.14 cm) was found from F_3C_0.

Number of pods plant^{-1}

Statistically significant variation was recorded for number of pods plant^{-1} due to fertilizer management in respect of foliar spray of urea and combination treatment but insignificant in leaf clipping treatment (Table 1). In case of foliar spray, the highest number of pods plant^{-1} (7.96) was recorded from F_0 followed by F_1 where the lowest number of pods plant^{-1} (6.51) was observed from F_3 which was statistically similar to F_2. Patel and Patel (1994) reported the similar results. In case of leaf clipping, numerically highest number of pods plant^{-1} (7.49) was observed from C_1 which was statistically similar to C_2 and C_0 and the lowest number of pods plant^{-1} (6.87) was observed from C_3. These results are in conformity with Bernacchi *et al.* (2007) who observed that transpiration was proportional to leaf conductance in soybean under constant environmental conditions. The highest number of pods plant^{-1} (9.81) was recorded from the treatment combination of F_0C_1 which was statistically similar to F_0C_3, F_3C_0, and F_3C_3. The lowest number of pods plant^{-1} (5.66) was found from F_1C_3 which was statistically similar to F_0C_0, F_0C_2, F_1C_1, F_1C_3, F_2C_0, F_2C_1, F_2C_2, F_2C_3, F_3C_1, and F_3C_2. Patel and Patel (1994) found similar results.

Table 1. Interaction effect of foliar spray and leaf clipping on plant height, above ground dry matter plant^{-1}, nodules plant^{-1}, pod length and pods plant^{-1} of mungbean

Treatments	Plant height (cm)	Above ground dry matter plant^{-1} (g)	Nodules plant^{-1} (no.)	Pod length (cm)	Pods plant^{-1} (no.)
Foliar spray					
F_0	51.96	11.89	3.00	7.70	7.96
F_1	49.99	11.40	2.67	7.62	7.70
F_2	49.23	10.77	2.38	7.42	7.14
F_3	49.49	10.57	2.88	7.33	6.51
$LSD_{(0.05)}$	NS	0.42	0.88	NS	0.08
Leaf clipping					
C_0	50.61	11.17	2.82	7.54	7.46
C_1	51.46	11.85	3.01	7.57	7.49
C_2	49.86	11.35	2.55	7.55	7.55
C_3	48.74	10.27	2.53	7.41	6.87
$LSD_{(0.05)}$	NS	NS	NS	NS	NS
Interactions					
F_0C_0	48.71	8.41	2.80	7.59	5.81
F_0C_1	61.20	14.76	3.40	7.82	9.81
F_0C_2	51.03	9.71	2.40	7.61	6.04
F_0C_3	46.89	10.19	3.40	7.78	9.14
F_1C_0	55.82	10.91	2.27	7.72	8.19
F_1C_1	45.10	10.50	2.60	7.23	6.80
F_1C_2	50.77	12.41	3.00	7.35	7.91
F_1C_3	46.27	11.78	2.80	7.36	5.66
F_2C_0	50.63	10.04	1.87	7.21	6.49
F_2C_1	50.33	11.09	2.40	7.77	6.85
F_2C_2	51.47	12.62	2.67	7.76	6.90
F_2C_3	47.53	8.53	2.53	7.75	5.80

F_3C_0	50.69	11.71	3.27	7.14	9.49
F_3C_1	45.81	9.03	2.87	7.32	6.36
F_3C_2	46.16	12.65	2.07	7.55	6.61
F_3C_3	54.27	14.18	3.3	7.32	9.36
$LSD_{(0.05)}$	5.602	1.98	0.60	NS	1.37
CV (%)	6.63	10.52	13.10	9.58	11.07

F_0 = Recommended fertilizer + No foliar spray, F_1 = Recommended fertilizer + 1% urea foliar spray at flower initiation, F_2 = Recommended fertilizer + 2% urea foliar spray at flower initiation, F_3 = Recommended fertilizer + 3% urea foliar spray at flower initiation. C_0 = No leaf clipping, C_1 = Clipping 1 basal leaf, C_2 = Clipping 2 basal leaves, C_3 = Clipping total apical leaves having no inflorescence

Number of seeds pod^{-1}

Statistically significant variation was recorded for number of seeds pod^{-1} due to fertilizer management in respect of foliar spray of urea and interaction effect of foliar spray and leaf clipping but insignificant leaf clipping treatment (Table 2). In case of foliar spray, the highest number of seeds pod^{-1} (10.92) was recorded from F_0 followed by F_1 where the lowest number seeds pod^{-1} (9.92) was observed from F_3 which was statistically similar to F_2. This result was close to Mahajan *et al.* (2016). In case of leaf clipping, numerically highest number seeds pod^{-1} (10.54) was observed from C_1 which was statistically similar to C_0 and C_2. The lowest number of seeds pod^{-1} (10.17) was observed from C_3. This observation agreed with those of Pandey (1983) who worked in cowpea and Hintz and Fehr (1990) who worked in soybean. The highest number of seeds pod^{-1} (12.08) was found from the treatment combination of F_0C_1 which was statistically similar to F_1C_2, F_2C_0, F_2C_1, F_2C_2, F_2C_3, F_3C_0, and F_3C_3. The lowest number of seeds pod^{-1} (9.20) was found from F_0C_3 which was statistically similar to F_0C_0, F_0C_2, F_1C_0, F_1C_1, F_1C_2, F_1C_3, F_2C_1, F_2C_3, F_3C_0, F_3C_1, F_3C_2, and F_3C_3. Combined foliar spray and leaf clipping may support the plant to stop floral dropping, hence empty or partially filled pod production reduced.

Thousand seeds weight

Statistically non-significant variation was recorded for thousand seeds weight in all cases of treatments (Table 2). In case of foliar spray, the highest thousand seeds weight (46.33 g) was recorded from F_0 followed by F_1, where the lowest thousand seeds weight (45.60 g) was observed from F_3 which was statistically identical with F_2. Rajender *et al.* (2002) showed 1000-seed weight increased with increasing N rates. The highest thousand seeds weight (46.49 g) was observed from C_1 which was statistically similar to C_2 and C_0 and the lowest thousand seed weight (44.54 g) was observed from C_3. Similarly Clifford (1979) found increased grain weight after the removal of axillary buds. The highest thousand seeds weight (48.07 g) was recorded from the treatment combination of F_0C_1. The lowest thousand seeds weight (43.32 g) was found from F_1C_0.

Seed yield

Statistically non-significant variation was recorded for seed yield due to fertilizer management in respect of foliar spray of urea but significant in leaf clipping and combination effect (Table 2). In case of foliar spray, numerically the highest seed yield (0.90 t ha^{-1}) was recorded from F_0 followed by F_1 where the lowest seed yield (0.83 t ha^{-1}) was observed from F_2 and F_3. Similar observations were reported by Rahman *et al.* (2014) who observed that foliar spray of N, P and K significantly increased pods/plant, seeds / pod, biomass and grain yield in common bean. Significantly highest seed yield (0.98 t ha^{-1}) was observed from C_1 which was statistically similar to C_0 and C_2 and the lowest seed yield (0.8 t ha^{-1}) was observed from C_3. Clifford (1979) reported an increased seed weight by removing axillary buds in mungbean. The highest seed yield (1.26 t ha^{-1}) was recorded from the treatment combination of F_0C_1 which was statistically

similar to F_3C_3. The lowest seed yield (0.60 t ha^{-1}) was found from F_0C_0 which was statistically similar to F_0C_2, F_0C_3, F_1C_1, F_1C_3, F_2C_0, and F_3C_2.

Stover yield

Statistically significant variation was recorded for stover yield due to fertilizer management in respect of foliar spray of urea, leaf clipping and combination of treatment (Table 2). The significantly highest stover yield (2.49 t ha^{-1}) was recorded from F_1 followed by F_0 where the lowest stover yield (2.11 t ha^{-1}) was observed from F_3 which was statistically identical to F_2. Mahajan *et al.* (1994) found that soil application of 1% urea foliar spray at flower initiation increased stover yield significantly of groundnut. The highest stover yield (2.42 t ha^{-1}) was observed from C_1 which was statistically similar to C_2 and C_0 and the lowest stover yield (2.20 t ha^{-1}) was observed from C_3. Higher rate of photosynthesis in remaining leaves of partially clipped plants compared to the leaves in intact plants may contribute the compensation to source loss by clipping in soybean (Rao and Ghildiyal, 1985). The highest stover yield (2.62 t ha^{-1}) was recorded from the treatment combination of F_0C_1 which was statistically similar to F_0C_2, F_0C_3, F_1C_0, F_1C_1, F_1C_2, F_1C_3, F_2C_1, F_2C_2 and F_3C_3. The lowest stover yield (1.76 t ha^{-1}) was found from F_2C_3 which was statistically similar to F_0C_0, F_3C_0, F_3C_1 and F_3C_2.

Biological yield

Statistically significant variation was recorded for stover yield due to fertilizer management in respect of foliar spray of urea, leaf clipping and its treatment combination (Table 2). The highest biological yield (3.32 t ha^{-1}) was recorded from F_0 followed by F_1 where the lowest biological yield (3.07 t ha^{-1}) was observed from F_2 which was statistically identical to F_3. The highest biological yield (3.40 t ha^{-1}) was observed from C_1. The lowest biological yield (3.00 t ha^{-1}) was observed from C_3, which was statistically similar to C_2 and C_0. The high source - sink ratio caused by defoliation increased the photosynthetic rates in the remaining leaves in okra, mungbean, soybean and groundnut (Bhatt and Rao, 2003; Pandey and Singh, 1984; Chen and Lia, 1991; Ghosh and Sengupta, 1986). The highest biological yield (3.88 t ha^{-1}) was recorded from the treatment combination of F_0C_1 which was statistically similar to F_1C_0, F_2C_1 and F_3C_3. The lowest biological yield (2.53 t ha^{-1}) was found from F_3C_2 which was statistically similar to F_0C_0, F_2C_0, F_2C_3, F_3C_0, F_3C_1 and F_3C_2.

Table 2. Effect of foliar spray and leaf clipping on seeds pod-1, weight of 1000 seeds, seed yield, straw yield, biological yield and harvest index of mungbean

Treatments	Seeds pod^{-1} (no.)	Weight of 1000 seeds (g)	Seed yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
Foliar spray						
F_0	10.92	46.33	0.90	2.45	3.32	25.79
F_1	10.34	46.18	0.88	2.49	3.18	24.90
F_2	10.22	45.77	0.83	2.18	3.01	28.73
F_3	9.92	45.60	0.83	2.11	3.00	29.70
$LSD_{(0.05)}$	0.88	NS	NS	0.09	0.11	2.73
CV (%)	11.32	9.88	11.74	8.99	11.56	12.03
Leaf clipping						
C_0	10.40	45.82	0.84	2.23	3.07	26.52
C_1	10.54	46.49	0.98	2.42	3.41	26.58
C_2	10.28	46.02	0.82	2.27	3.09	28.64
C_3	10.17	44.54	0.80	2.20	3.00	27.42
$LSD_{(0.05)}$	NS	NS	0.08	0.22	0.26	NS

Interactions						
F_0C_0	10.05	47.35	0.60	1.94	2.53	23.66
F_0C_1	12.08	48.07	1.26	2.62	3.88	32.55
F_0C_2	10.02	43.36	0.74	2.47	3.21	22.99
F_0C_3	9.20	46.54	0.74	2.35	3.09	23.97
F_1C_0	10.08	43.32	0.96	2.61	3.58	26.86
F_1C_1	10.30	45.31	0.76	2.57	3.32	22.77
F_1C_2	10.60	44.73	0.88	2.43	3.31	26.56
F_1C_3	9.88	45.04	0.71	2.33	3.05	23.39
F_2C_0	11.12	45.48	0.71	2.19	2.90	24.43
F_2C_1	10.50	45.74	1.08	2.42	3.50	30.96
F_2C_2	11.22	44.95	0.97	2.37	3.34	29.19
F_2C_3	10.84	46.92	0.77	1.76	2.53	30.33
F_3C_0	10.37	47.14	0.93	2.07	3.01	31.14
F_3C_1	9.27	44.97	0.82	2.09	2.91	28.30
F_3C_2	9.28	45.13	0.68	1.80	2.49	27.34
F_3C_3	10.75	47.46	1.16	2.47	3.62	32.01
$LSD_{(0.05)}$	1.73	NS	0.17	0.43	0.52	4.27
CV (%)	9.94	9.25	11.58	11.23	9.93	9.28

F_0 = Recommended fertilizer + No foliar spray, F_1 = Recommended fertilizer + 1% urea foliar spray at flower initiation, F_2 = Recommended fertilizer + 2% urea foliar spray at flower initiation, F_3 = Recommended fertilizer + 3% urea foliar spray at flower initiation. C_0 = No leaf clipping, C_1 = Clipping 1 basal leaf, C_2 = Clipping 2 basal leaves, C_3 = Clipping total apical leaves having no inflorescence

Harvest index

Statistically significant variation was recorded for harvest index due to fertilizer management in respect of foliar spray of urea and treatment combination, but insignificant in leaf clipping of mungbean (Table 2). The highest harvest index (29.7%) was recorded from F_3 followed by F_2 where the lowest harvest index (24.9%) was observed from F_1 which was statistically similar to F_0. The highest harvest index (28.64%) was observed from C_2, which was statistically similar to C_3. The lowest harvest index (26.52%) was observed from C_0, which was statistically similar to C_2. From combination treatment, the highest harvest index (32.55%) was recorded from the treatment combination of F_0C_1 which was statistically similar to F_2C_1, F_2C_2, F_2C_3, F_3C_0, F_3C_1 and F_3C_3. The lowest harvest index (22.77%) was found from F_1C_1 which was statistically similar to F_0C_0, F_0C_2, F_0C_3, F_1C_0, F_1C_2, F_1C_3 and F_2C_0. Hamid (1994) demonstrated that the development of tertiary branches and much of the secondary branches in mungbean is counterproductive.

Conclusion

Considering the above results, it may be concluded that fertilizer dose and leaf clipping had significant role in the grain yield. Among the fertilizer dose and leaf clipping, recommended fertilizer dose with no foliar spray and clipping 1 basal leaf gave best yield. So, recommended fertilizer dose with clipping 1 basal leaf is very important to get optimum yield of mungbean variety. However, further experimentation will need to be executed in different agro-ecological zones with more varieties under recommended fertilizer dose with clipping basal leaf to reach a specific conclusion and recommendation.

Acknowledgement

The author acknowledged the Ministry of Science and Technology, Govt. of the Peoples Republic of Bangladesh for providing financial support to conduct the study at Sher-e-Bangla Agricultural University.

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