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Growth and yield of Mungbean as influenced by potassium and sulphur

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ABSTRACT

A field experiment was conducted at the experimental farm of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka-1207, Bangladesh during the period from April, 2013 to July, 2013 to study the growth and yield of Mungbean as influenced by *potassium (K) and* sulphur *(S). Four levels of K (0, 15,* 25 *and* 35 *kg ha^{-1}) and three levels of S (0,* 3 *and* 6 *kg ha^{-1}) were used in the study*.The results reveald that *grain and s*tover *yield* of mungbean increased with *increasing levels of* K *and S*.The maximum significant *grain and s*tover *yield* were obtained with the treatment combinations K_2S_2 (25 kg K *ha^{-1}* + 6 kg S *ha^{-1}*) and the same treatments combinations gave the highest p*lant height,* number of branch plant^{-1}, *yield attributes like number of pods* plant^{-1}, *number of grains pod^{-1}*, weight of *1000* seeds.

Keywords: Mungbean, potassium, sulphur, growth and yield.

INTRODUCTION

Mungbean (*Vigna radiata* L.) under the family of Leguminosae is one of the most important short duration, drought tolerant pulse crop in Bangladesh. It fixes nitrogen in symbiosis with *Rhizobium* and enriches the soil. It contains 1-3% fat, 50.4% carbohydrates, 3.5-4.5% fibers and 4.5-5.5% ash, while calcium and phosphorus are 132 and 367 mg per 100 grams of seed, respectively [1]. Hence, on the nutritional point of view, mungbean is perhaps the best of all other pulses [2, 3].

Fertilizer is one of the most important factors that affect crop production. Fertilizer recommendation for soils and crops is a dynamic process [4-6] and the management of fertilizers is one of the important factors that greatly affect the growth, development and yield of mungbean [7]. Potassium application under drought moderates the adverse effects of water shortage on plant growth [8, 5].

Potassium is the third macronutrient required for plant growth, after nitrogen and phosphorus [9] and also plays a vital role as macronutrient in plant growth and sustainable crop production [10]. Its adequate supply during growth period improves the water relations of plant and photosynthesis [11], maintains turgor pressure of cell which is necessary for cell expansion, helps in osmotic-regulation of plant cell, assists in opening and closing of stomata [12], activates more than 60 enzymes [13], synthesizes the protein, creates resistance against the pest attack and diseases [14] and enhances the mungbean yield [15]. Sulphur is best known for its role in the formation of amino acids methionine (21% S) and cysteine (27% S); synthesis of proteins and chlorophyll; oil content of the seeds and nutritive quality of forages [16-18]. The application of sulfur increases the concentration as well as total uptake of N, P, K, Ca, S, Zn and B at different stages of crop growth [19]. Lack of S causes retardation of terminal growth and root development. S deficiency induced chlorosis in young leaves and decrease seed yield by 45% [20]. The farmers of Bangladesh generally grow mungbean with almost no fertilizer. So, there is an ample scope of increasing the yield of mungbean unit^{-1} area by using balanced including potassium fertilizer. Considering the above facts the present study is aimed to determine the effects of potassium and sulfur on the growth and yield of mungbean.

MATERIALS AND METHODS

The experiment was conducted in the experimental farm of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka-1207, Bangladesh during the period from April, 2013 to July, 2013. The location of the experimental site was at 23.75′ N latitude and $90^0$34′ E longitude with an elevation of 8.45 meter from sea level. The experimental soil was silty clay loam in texture having p^H 6.14 and organic carbon content is 0.68%. The area represents the Agro-Ecological Zone of Madhupur tract (AEZ-28) with P^H 5.8-6.5, ECE-25.28 [21]. The high yielding variety of mungbean (BARI mung-6) was used for this experiment and it was released by Bangladesh Agricultural Research Institute, Joydebpur, Gazipur in 2003. It is photo insensitive, semi synchronous maturity, short lifespan (60 to 65 days) and bold seeded crop. Its yield potentiality is about 2 t ha^{-1}. This variety is resistant to yellow mosaic virus diseases, insects and pest attack. The experiment consisted of two factors: Factor A: four levels of Potassium (K), K_0 = No potassium, K_1 = 15 kg K ha^{-1}, K_2 = 25 kg K ha^{-1}, K_3 = 35 kg K ha^{-1} and Factor B: three levels of Sulfur (S), S_0 = No sulphur, S_1 = 3 kg K ha^{-1}, S_2 = 6 kg K ha^{-1}. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Recommended blanket doses of N, and P (20 kg ha^{-1} N from urea, 80 kg ha^{-1} P from TSP, respectively) and cow dung as manure were applied. The whole amounts of TSP and half of Urea fertilizer were applied as basal dose during final land preparation. The rest of half urea was applied 25 days after sowing (DAS). The required amounts of K (from MOP) and S (from Gypsum) were applied at a time as per treatment combination after field layout of the experiment and were mixed properly through hand spading. Mungbean seeds were sown on 18th April 2013 in lines following the recommended line to line distance of 30 cm and plant to plant distance of 10 cm. Various intercultural operations such as thinning of plants, weeding and spraying of insecticides were accomplished whenever required to keep the plants healthy and the field weed free. The crop was harvested at maturity on 18th June 2013. The collected data were analyzed with the help of MSTAT-C program and mean values of all the parameters were adjusted by Duncan's Multiple Range Test (DMRT) at 5% level of probability [22].

RESULTS AND DISCUSSION

Effect of potassium on growth and yield of mungbean

Different doses of K showed significant variation in respect of plant height, number of branches plant^{-l}, number of pods plant^{-1}, pod length, number of seeds pod^{-1}, weight of 1000 seed, grain yield and stover yield (Table 1). Table 1 showed that, plant height, number of branches plant^{-l}, number of pods plant^{-1}, pod length, number of seeds pod^{-1}, 1000-seed weight and grain yield were increased with increasing K levels upto 25 kg ha^{-1} then declined. The highest plant height (52.00 cm), highest number of branches plant^{-l} (2.66) were obtained from 25 kg K ha^{-1} whereas, the lowest plant height (41.68 cm), number of branches plant^{-l} (1.67) were observed from control treatment. It may be due to K application increased the availability of nitrogen and phosphorus [23] which resulted in better plant growth and more number of branches per plant. The highest number of pods plant^{-1} (19.52) was recorded from 25 kg K ha^{-1} whereas, the lowest number of pods plant^{-1} (14.70) was found from control treatment. Similar findings were recorded by Ali *et al.* [24] who studied the effect of different K levels and reported that the number of pod per plant was influenced significantly by K application. The minimum number of pods where no potash was applied might have been due to less availability of N and P and stunted growth. The results are almost same as reported by Samiullah and Khan [25]. The highest number of seeds pod^{-1} (11.93) was obtained from 25 kg K ha^{-1} whereas, the lowest number of seeds pod^{-1} (9.17) was recorded from control treatment. Significant increase in number of seeds per pod due to application of potash was also reported by Asgar *et al.* [26]. The highest pod length (9.51 cm), 1000-seed weight (43.87 g) and grain yield (1.597 t ha^{-1}) were obtained from 25 kg K ha^{-1} whereas, the lowest pod length (6.60 cm), 1000-seed weight (39.89 g) and grain yield (1.113 t ha^{-1}) were observed from control treatment. These findings are similar with Jahan *et al.* [2009]. Different doses of K caused significant variation on the stover yield of mungbean (Table 1). The highest stover yield of mungbean (2.475 t ha^{-1}) was recorded from K_3 (35 kg K ha^{-1}) which was statistically similar from K_3 treatment. The lowest stover yield (2.067 t ha^{-1}) was recorded from control treatment. The present result are agreement with findings of Jahan *et al.* [27].

Effect of sulphur on growth and yield of mungbean

Different doses of sulphur showed significant variation in respect of plant height, number of branches plant^{-l}, number of pods plant^{-1}, pod length, number of seeds pod^{-1}, 1000-seed weight, grain yield and stover yield (Table 2). The highest plant height (48.84 cm) was obtained from 6 kg S ha^{-1} whereas, the lowest plant height (46.16 cm) was observed from control treatment. Almost similar results were obtained by Kaisher *et al.* [28]. The result might be due to sulphur is involved in chlorophyll formation which enhance vegetative growth resulting increase in plant height. The highest number of branches plant^{-1} (2.43), number of pods plant^{-1} (18.40), pod length (8.85 cm) and number of seeds pod^{-1} (11.26) were obtained with 6 kg S ha^{-1} whereas, the lowest number of branches plant^{-1} (2.05), number of pods plant^{-1} (16.12), pod length (7.41 cm) and number of seeds pod^{-1} (9.80) were observed from control treatment. The process of tissue differentiation from somatic to reproductive meristematic activity and development of floral primordial might have increased with increasing sulphur levels resulting in more flowers and pods, longer pods and higher grain yield. Increase in growth and straw yield can be ascribed to cell division, enlargement and elongation resulting in overall improvement in plant organs associated with faster and uniform vegetative growth of the crop under the effect of sulphur application. Similar findings were also reported by [29-31]. The highest 1000-seed weight (43.65 g) was obtained from 6 kg S ha^{-1} whereas, the lowest (40.83 g) was observed from control treatment. The increase in 1000-seed weight may be due to sulphur, which increases the seed weight and size. Singh and Yadav [29] stated sulphur significantly increased the 1000-seed weight in mungbean. The highest grain yield (1.511 t ha^{-1}) was obtained from 6 kg S ha^{-1} whereas, the lowest (1.266 t ha^{-1}) was observed from control treatment. Sulphur significantly increased the grain yield Mondal *et al.* [32]. Different doses of S had significant effect on stover yield of mungbean (Table 2). Application of 6 kg S ha^{-1} produced the highest stover yield (2.427 t ha^{-1}) and the lowest (2.208 t ha^{-1}) was recorded from control treatment. The results are agreement with the findings of Singh and Yadav [29] and they found significant increases in stover yield of mungbean due to application of S.

Table 1. Effect of potassium on growth and yield contributing characters

Treatments	Plant height **(cm)**	No. of branches plant^{-1}	No. of pods plant^{-1}	Pod length **(cm)**	No. of seeds pod^{-1}	1000-seed wt. **(g)**	Grain yield (t **ha**$^{-1}$)	Stover yield (t **ha**$^{-1}$)
K_0	41.68 d	1.67 d	14.70 c	6.60 d	9.17 c	39.89 c	1.113 c	2.067 c
K_1	46.39 c	2.22 c	16.91b	7.64 c	10.50 b	42.00 b	1.273 b	2.230 b
K_2	52.00 a	2.66 a	19.52 a	9.51 a	11.93 a	43.87 a	1.597 a	2.451 a
K_3	49.89 b	2.45 b	17.64 b	8.89 b	10.84 b	43.30 a	1.552 a	2.475 a
LSD $_{(0.05)}$	0.9830	0.119	1.123	0.579	0.571	0.8330	0.0535	0.07573
CV (%)	1.22	2.98	3.86	4.18	3.18	1.16	2.49	1.97

In a column figures having similar letter(s) do not differ significantly whereas figures with dissimilar letter(s) differ significantly.

Table 2. Effect of sulphur on growth and yield contributing parameters

Treatments	Plant height **(cm)**	No. of branches plant^{-1}	No. of pods plant^{-1}	Pod length **(cm)**	No. of seeds pod^{-1}	1000-seed wt. **(g)**	Grain yield (t **ha**$^{-1}$)	Stover yield (t **ha**$^{-1}$)
S_0	46.16 c	2.05 c	16.12 b	7.41 c	9.80 b	40.83 c	1.266 c	2.208 b
S_1	47.46 b	2.27 b	17.06 b	8.22 b	10.77 a	42.31 b	1.325 b	2.282 b
S_2	48.84 a	2.43 a	18.40 a	8.85 a	11.26 a	43.65 a	1.511 a	2.427 a
LSD $_{(0.05)}$	0.9830	0.119	1.123	0.579	0.571	0.833	0.0535	0.0757
CV (%)	1.22	2.98	3.86	4.18	3.18	1.16	2.49	1.97

In a column figures having similar letter(s) do not differ significantly whereas figures with dissimilar letter(s) differ significantly.

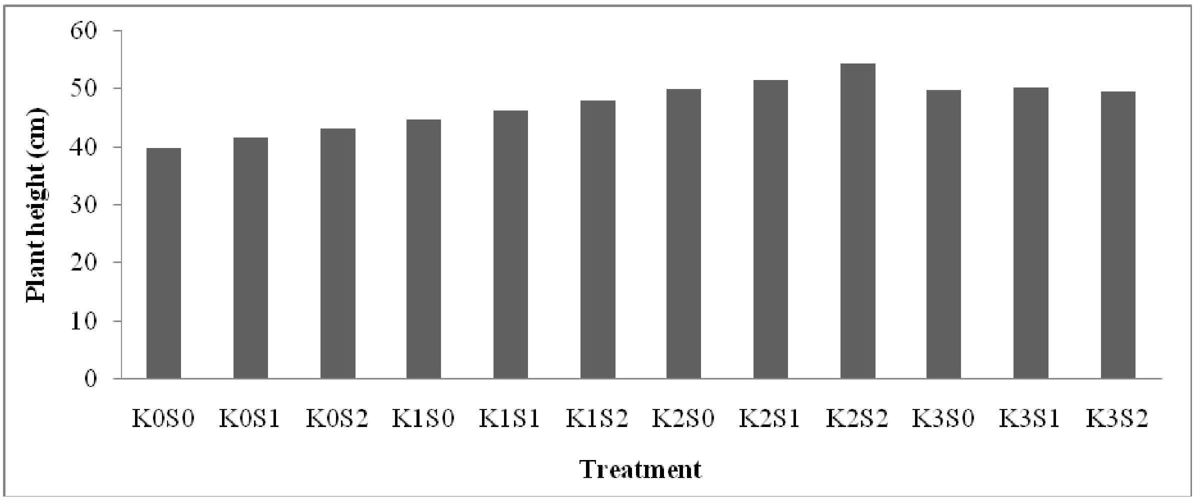

Figure 1. Interaction effect of K and S on plant height of mungbean

Interaction effect of K and S on growth and yield of mungbean

Combined application of different doses of potassium and sulphur showed significant effect on the plant height of mungbean (Figure 1). The highest plant height (54.38 cm) was recorded from K_2 S_2 (25 kg K ha^{-1} + 6 kg S ha^{-1})

which was statistically superior to other treatments.The lowest plant height (39.90 cm) was observed from the treatment combination of K_0S_0 (No potassium and No sulphur).

The interaction effect of K and S had significant role on the number of number of branches plant^{-1}, number of pods plant^{-1}, pod length, number of seeds pod^{-1}, 1000- seed weight, grain yield and stover yield of mungbean (Table 3). The highest number of branches plant^{-1} (2.90) was recorded from the treatment combination of K_2S_2 (25 kg K ha^{-1} + 6 kg S ha^{-1}) and the lowest (1.54) was found from K_0S_0 (0 kg K ha^{-1} + 0 kg S ha^{-1}) which was statistically similar (1.62) to K_0S_1. The highest number of pods plant^{-1} (21.20) was found from the treatment combination of K_2S_2 (25 kg K ha^{-1} + 6 kg S ha^{-1}) and the lowest (14.05) was found from K_0S_0 (0 kg K ha^{-1} + 0 kg S ha^{-1}) which was statistically similar (14.64) to K_0S_1. Bandopadhyay *et al.* [33] found significant increase in number of pods plant^{-1} of mungbean due to the application of increasing level of K and S. The highest pod length (10.61 cm), number of seeds pod^{-1} (13.12), weight of 1000 seed (45.78 g) and grain yield (1.783 t ha^{-1}) were found from the treatment combination of K_2S_2 (25 kg K ha^{-1} + 6 kg S ha^{-1}). The lowest pod length (6.05 cm), number of seeds pod^{-1} (8.05), 1000-seed weight (38.63 g) and grain yield (1.063 t ha^{-1}) were found from K_0S_0 (0 kg K ha^{-1} + 0 kg S ha^{-1}). The highest stover yield (2.660 t ha^{-1}) was recorded from the treatment combination of K_2S_2 (25 kg K ha^{-1}+ 6 kg S ha^{-1}) and the lowest (1.997 t ha^{-1}) was found from treatment K_0S_0 (0 kg K ha^{-1}+ 0 kg S ha^{-1}) which was statistically similar (2.070 t ha^{-1}) to K_0S_1.

Table 3. Interaction effect of K and S on growth and yield contributing characters

Treatments	No. of branches plant^{-1}	No. of pods plant^{-1}	Pod length (cm)	No. of seeds pod^{-1}	1000-seed wt. (g)	Grain yield (t ha^{-1})	Stover yield (t ha^{-1})
K_0S_0	1.54 h	14.05 h	6.05 g	8.05 g	38.63 f	1.063 i	1.997 h
K_0S_1	1.62 h	14.64 gh	6.69 f	9.29 f	39.52 e	1.120 h	2.070 gh
K_0S_2	1.86 g	15.41 g	7.07 f	10.19 de	41.51 c	1.157 gh	2.133 fg
K_1S_0	2.04 f	15.57 fg	7.21 f	9.94 e	40.67 d	1.203 g	2.143 fg
K_1S_1	2.25 e	16.62 ef	7.30 f	10.66 cd	41.88 c	1.260 f	2.173 f
K_1S_2	2.36 de	18.53 bc	8.42de	10.89 c	43.45 b	1.357 e	2.373 d
K_2S_0	2.34 de	17.84 cd	7.92 e	10.56 cd	42.00 c	1.380 de	2.273 e
K_2S_1	2.75 b	19.53 b	10.01 b	12.12 b	43.83 b	1.427 cd	2.420 cd
K_2S_2	2.90a	21.20 a	10.61 a	13.12 a	45.78 a	1.783 a	2.660 a
K_3S_0	2.29 e	17.01 de	8.47 de	10.67 cd	42.01 c	1.417 cd	2.420 cd
K_3S_1	2.45 d	17.46 c-e	8.89 cd	11.00 c	44.02 b	1.493 b	2.463 c
K_3S_2	2.61 c	18.45 bc	9.30 c	10.84 c	43.87 b	1.447 bc	2.543 b
$LSD_{(0.05)}$	0.119	1.123	0.579	0.571	0.833	0.053	0.075
CV (%)	2.98	3.86	4.18	3.18	1.16	2.49	1.97

In a column figures having similar letter(s) do not differ significantly whereas figures with dissimilar letter(s) differ significantly.

CONCLUSION

Based on the results of the present study, it may be concluded that - application of K and S @ 25 kg K ha^{-1} and 6 kg S ha^{-1}(i.e. MOP 50 kg ha^{-1} and Gypsum 33.34 kg ha^{-1}) may be the best combination for higher yield of mungbean and also to maintain soil fertility and productivity than their individual application.

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