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# Responses of selected mungbean (*Vigna radiata* L.) varieties to boron fertilization

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ABSTRACT

This experiment was carried out during the period of March–June 2016 to evaluate the influence of variety and boron (B) levels on the growth and yield performance of four summer mungbean (*Vigna radiata* L.) varieties. The experimental treatments consisted of four mungbean varieties viz. BARI Mung–2, BARI Mung–6, Binamoog–5 and Binamoog–7 and four doses of boron *viz*. 0, 0.5, 1.0 and 1.5 kg ha$^{-1}$. The experiment was arranged by randomized complete block design and replicated thrice. Variety BARI Mung–6 showed superiority to other varieties regarding pods plant$^{-1}$, pod length, and 1000-grains weight which resulted in the highest seed yield (1.86 t ha$^{-1}$). The lowest pods plant$^{-1}$ in Binamoog–7, pods length and 1000-grain weight in BARI Mung–2, number of grains pod$^{-1}$, and seed yield (1.25 t ha$^{-1}$) stover yield and harvest index were found in Binamoog–5. Results revealed that the 1.0 kg ha$^{-1}$ was superior to other doses of boron in respect of pods plant$^{-1}$, pod length, number of grains pod$^{-1}$, 1000-grain weight, seed yield, and stover yield as well as harvest index. The lowest seed yield (0.87 t ha$^{-1}$) was found from control treatment. Variety BARI Mung–6 was grown with 1.0 kg ha$^{-1}$ boron showed best performance to other interactions of variety and boron doses regarding pod length, number of pods plant$^{-1}$, number of grains pod$^{-1}$, number of grains plant$^{-1}$, 1000-grain weight and seed yield (1.66 t ha$^{-1}$).

**Keywords:** Mungbean, variety, boron, yield

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## 1 Introduction

Mungbean (*Vigna radiata* L.), an important quality pulse crop of Bangladesh, it is not only the food crops but also the soil building one as they belong to the family Fabaceae. Cultivation of mungbean can improve the physico-chemical and biological attributes of soil and the same time it is capable of fixing atmospheric nitrogen through biological N-fixation process in presence of *Rhizobium*. Mungbean has good digestibility and flavor. Mungbean contains carbohydrate, protein, moisture, minerals and vitamins by 51%, 26%, 10%, 4%, 3%, respectively (Kaul, 1982). Hence, on nutritional point of view, mungbean is considered as the best of all other pulse. It is like other pulses widely used as 'Dal' in the country. Mungbean is an important component in the intensive crop production system for its short life cycle and is one of the leading pulse crops of Bangladesh.

The agro-ecological condition of Bangladesh is favorable for growing this crop. It is a drought tolerant crop and can be grown with a minimum supply of nutrients (Uddin et al., 2010). To produce higher yield, improved variety plays a remarkable role in mungbean production. But at present, pulses are beyond the reach of the poor people because of its high price and acute shortage. In Bangladesh, daily per capita consumption of pulses is only 14.72 g (BBS, 2012), while the World Health Organization (WHO) of the United Nations (UN) recommended 45 g $d^{-1}$ $capita^{-1}$ for a balance diet (BARI, 1998). So the consumption of pulses by our people in their daily diet is far below the recommendation. To maintain the supply of this level, the Government of Bangladesh has to spend a huge amount of foreign currency every year. The total production of pulses in Bangladesh in 2016–2017 was 1026300 m tons from an area of 997600 ha (DAE, 2018). So to meet the suggested requirement of pulses of 45 g per capita per day, the production is to be increased near about three folds.

Moreover, farmers are losing interest to produce mungbean due to low income per unit of resource invested. Therefore, attention should be given to increase yield through selection of suitable varieties and adoption of improved cultural practices for establishing mungbean as a profitable crop. The high yielding varieties are less prone to disease incidence and mature in a shorter period of time are preferred to the growers (Uddin et al., 2017). Mungbean is the only pulse crop which can be grown throughout the year in three cropping seasons. As mungbean is a tropical and subtropical crop it requires warm temperatures for its growth. It can be grown under rainfed and irrigated conditions. The average yield of mungbean in this country is lower than that of other country. The average yield is about 0.85 m t $ha^{-1}$ (BBS, 2010). The probable reason for low yield of seed legumes is mostly due to low yielding potentiality of local varieties.

Use of high yielding variety could overcome the low yield to some extent. There are about ten HYV's of mungbean which are released by the Bangladesh Agricultural Research Institute (BARI) and the Bangladesh Institute of Nuclear Agriculture (BINA). All these varieties are extensively cultivated by the farmers of Bangladesh and at the same time they are cultivating some other local varieties with low yield potential. Therefore, research is essential to find out suitable varieties for establishing mungbean as a profitable crop in different regions of Bangladesh. Boron is necessary for growth and yield of crops. The necessity of boron in a number of crops was confirmed. It is relatively mobile in plants and absorbed as $BO_3^-$.The availability of boron is lower in dry summer than in other seasons (Al-Ahmadi, 2014). Boron deficiency caused seed yield reduction through impaired development of anthers and pollen seeds and seed set failure. Boron is essential for translocation of sugars, development of meristematic tissues and synthesis of protein, RNA and auxin; and formation of ribosome (Gupta and Singh, 1972; Mengel and Kirkby, 1987).

Considering the above fact, the present study was conducted to investigate the varietal response of mungbean to boron fertilization and to optimize boron requirement for mungbean.

## 2 Materials and Methods

### 2.1 Experimental site

This experiment was conducted at the Agronomy Field Laboratory (AFL) of Bangladesh Agricultural University during the period from March to June, 2016. The site is located at 24°43′8.3″N, 90°25′41.2″E, in the South- West part of Old Brahmaputra river at an altitude of 18 m. The site belongs to non-calcareous dark grey floodplain soil under Old Brahmaputra Floodplain 'AEZ-9' (UNDP and FAO, 1988). The climate of the area is sub-tropical, which is characterized by low temperature and scanty rainfall during Rabi season (October to March) and high temperature with heavy rainfall during Kharif season (April to September). The experimental field was a medium high land with well drained clay loam textured soil having a pH value 6.8. During the experimental period the maximum, minimum and average temperature ranges between 29.96 °C and 32.06 °C, 19.73 °C and 25.86 °C and 24.85 °C and 28.96 °C, respectively. While the average relative humidity, total sunshine and total rainfall ranged from 73.74–85.50%, 116.7–233.0 h $month^{-1}$ and 32.6–413.7 mm, respectively.

### 2.2 Experimental treatments

The experiment was consisted four mungbean varieties *viz.* a) BARI Mung–2, b) BARI Mung–6, c) Binamoog–5, d) Binamoog–7 and four doses of boron *viz.* a) 0.0 (kg $ha^{-1}$) (control) b) 0.5 (kg $ha^{-1}$), c) 1.0 (kg $ha^{-1}$), and d) 1.5 (kg $ha^{-1}$). The experiment was conducted in a randomized complete block design with three replications. The unit plot size was 3 m × 2 m.

### 2.3 Land preparation

The land was opened with a power tiller on 17 March 2016. Later on, ploughing and cross ploughing were done with country plough followed by laddering. Weeds, stubble and crop residues were removed. The corners of the field were spaded and large clods were broken. Land preparation was completed on 19 March, 2016. Urea and muriate of potash were applied at the rate of 50 and 35 kg $ha^{-1}$, respectively, during final land preparation at each planting date as a basal dose. Boron was applied in the form of slobber Boron $BO_3^-$ following the treatment specification of the experiment as basal dose.

## 2.4 Crop husbandry

Seeds were sowed on 25 March 2016 @ 40 kg ha$^{-1}$ for all varieties. The distance of row to row and plant to plant was maintained at 30 cm and 10 cm, respectively. Two times weeding and thinning were done simultaneously at 20 and 30 days after sowing. No irrigation was applied during the experimental periods as there was no symptom of moisture stress. The crop was attacked by pod borer which was controlled successfully by applying 'Gain' @ 1.7 L ha$^{-1}$. When 80% of the pods turned brown in color, the crop was assessed to attain maturity for harvesting. Central 5.0 m$^2$ area of each plot was harvested. Plants were uprooted and bundled separately plot-wise. Bundles were tagged and brought to the threshing floor. All of the harvested pods were kept separately in properly tagged gunny bags. The crop bundles were sun-dried for four days on the threshing floor. Seeds were separated from the plants by beating them with bamboo sticks. The seeds thus collected were sun dried for reducing the moisture in the seeds. The grain yield and straw yield were recorded and converted to ton ha$^{-1}$. From each plot five plants were collected at random by uprooting prior to harvesting to collect the data on crop and yield components.

## 2.5 Statistical analyses

The collected raw data were first checked for normality distribution. Then the mean comparisons were checked by ANOVA using Statistical software MSTAT–C and Duncan's Multiple Range Test (Gomez and Gomez, 1984) was used for mean comparison.

# 3 Results and Discussion

## 3.1 Varietal performance

Variety had significant influence on pods plant$^{-1}$, pod length, number of grains pod$^{-1}$, 1000-grain weight, seed and stover yield. From Table 1 and Fig. 1a, it is revealed that BARI Mung–6 gave the highest number of pods plant$^{-1}$ (15.92), pod length (8.07 cm), number of grains pod$^{-1}$ (9.54), 1000-grain weight (50.91 g), seed yield (1.38 t ha$^{-1}$), stover yield (2.52 t ha$^{-1}$). These results are in conformity with that of Uddin et al. (2010). The lowest number of pods plant$^{-1}$ (15.14) from Binamoog–7, pod length (7.10 cm), 1000-grain weight plant$^{-1}$ (30.45 g) from BARI Mung–2, number of grains pod$^{-1}$ (8.41), seed yield (1.25 t ha$^{-1}$), stover yield (2.23 t ha$^{-1}$) from Binamoog–5 was obtained (Table 1 and Fig. 1a). These findings are in agreement with those reported by Uddin et al. (2010). The results exposed that seed yield was increased due to high pods plant$^{-1}$, pod length, number of grains pod$^{-1}$ and 1000-grain weight of mungbean which accelerated by genotypic variations among varieties also observed by Mondal et al. (2004) and BARI Mung–6 showed highest performance. Parvez et al. (2013) and Hossain et al. (2016) also reported that the probable reason of pod length differences due to genetic make of the varieties that is contributing to yield variation among the studied varieties of mungbean.

## 3.2 Effect of boron fertilization

Boron had a significant effect on pods plant$^{-1}$, pod length, number of grains pod$^{-1}$, 1000-grain weight, seed yield and stover yield (Table 1 and Fig. 1b). The highest number of pods plant$^{-1}$ (18.92), pod length (7.86 cm), number of grains pod$^{-1}$ (10.11), 1000-grain weight (43.90 g), seed yield (1.50 t ha$^{-1}$, $p$<0.05) and stover yield (2.61 t ha$^{-1}$, $p$<0.05) were produced from the application of 1.0 kg ha$^{-1}$ of boron. While the lowest number pods plant$^{-1}$, pod length, number of grains pod$^{-1}$, 1000-grain weight, seed yield and stover yield (1.42 t ha$^{-1}$) were observed in control treatment (Table 1). Other researchers also reported that the boron application has positive effect on mungbean yield (Verma and Mishra, 1999; Ashraf, 2007; Quddus et al., 2011).

In legume crops, sufficient boron is also required for effective nodulation and nitrogen fixation which ultimately promotes plant growth by increasing number of flower plant$^{-1}$, reducing immature abortion, elongating pollen tube, increasing emergence rate and seed development. Boron application increased the maximum production of yield contributing crop characters (Table 1) and influenced the mungbean varieties to have good production of yield contributing characters and eventually maximum production was obtained from 1.0 kg ha$^{-1}$ boron application. Boron increases nodulation activity (Yakubu et al., 2010) even in boron deficient soil which may have increased the nitrogen content and nutrient uptake and dry matter production (Debnath and Ghosh, 2011; Debnath et al., 2011). Influence of boron on various metabolic processes like photosynthesis, respiration, enzyme activity (Ganie et al., 2013) augments metabolites production and their translocation to different plant parts to increase the concentration of nutrients in seed and stover.

## 3.3 Variety and boron fertilization interaction

Interaction of variety and level of boron had significant influence on pods plant$^{-1}$, pod length, number of grains pod$^{-1}$, 1000-grain weight, seed yield and stover yield (Table 2). The highest number of pods plant$^{-1}$ (21.03), pod length (9.19 cm), number of grains pod$^{-1}$ (12.43), 1000-grain weight (56.28 g), seed yield (1.66 t ha$^{-1}$) and stover yield (3.02

Table 1. Varietal difference and effect of boron on yield contributing characterstics of mungbean

| | Pods plant$^{-1}$ | Pod length (cm) | Grain pod$^{-1}$ | 1000-grain wt. (g) | Harvest index (%) |
|---|---|---|---|---|---|
| Variety | | | | | |
| BARI Mung-2 | 15.185bc | 7.100b | 9.088a | 30.452d | 35.34b |
| BARI Mung-6 | 15.923a | 8.068a | 9.538a | 50.913a | 36.61a |
| Binamoog-5 | 15.248ab | 7.312b | 8.405b | 49.253b | 36.08a |
| Binamoog-7 | 15.140c | 7.485ab | 8.785ab | 40.505c | 36.17 |
| Level of sig. | * | * | * | ** | ** |
| Sd | 0.1345 | 0.2518 | 0.2268 | 0.5018 | 0.1518 |
| Boron (kg ha$^{-1}$) | | | | | |
| 0 | 11.283d | 6.990b | 6.800c | 38.990b | 26.46d |
| 0.5 | 13.350c | 7.850a | 8.840b | 43.600a | 27.03c |
| 1 | 18.925a | 7.860a | 10.110a | 43.900a | 40.21a |
| 1.5 | 16.542b | 6.930b | 9.400b | 42.293ab | 38.48 |
| Level of sig. | ** | ** | ** | ** | * |
| Sd | 0.1345 | 0.2518 | 0.2268 | 0.5018 | 0.1647 |

Sd = Standard deviation

Table 2. Interaction of variety and boron on yield and yield contributing characterstics of mungbean

| Interaction (Variety × Boron) | Pods plant$^{-1}$ | Pod length (cm) | Grain pod$^{-1}$ | 1000-grain wt. (g) | Seed yield (t ha$^{-1}$) | Stover yield (t ha$^{-1}$) | Harvest index (%) |
|---|---|---|---|---|---|---|---|
| V1 × B0 | 11.360g | 6.710d | 6.660c | 27.710g | 0.816c | 1.400c | 25.37g |
| V1 × B1 | 12.860e | 7.300c | 8.730b | 31.690f | 1.297b | 2.680a | 32.61e |
| V1 × B2 | 18.860a | 7.880bc | 11.200a | 31.990f | 1.470ab | 2.780a | 34.59d |
| V1 × B3 | 17.660b | 6.510d | 9.760b | 30.420g | 1.530ab | 2.590a | 37.14b |
| V2 × B0 | 10.700h | 7.160c | 6.760c | 45.670c | 1.018c | 1.730bc | 37.04b |
| V2 × B1 | 14.030gh | 8.200b | 9.130b | 51.450b | 1.337b | 2.750a | 32.71e |
| V2 × B2 | 21.030a | 9.190a | 12.430b | 56.280a | 1.860a | 3.020a | 38.11a |
| V2 × B3 | 17.930bc | 7.720bc | 9.830b | 50.250bc | 1.320b | 2.580a | 34.92d |
| V3 × B0 | 12.200ef | 6.800d | 6.930c | 46.290c | 0.875c | 1.160c | 28.83fg |
| V3 × B1 | 15.060d | 7.910bc | 9.100b | 50.110bc | 1.310b | 2.390ab | 35.41c |
| V3 × B2 | 18.830a | 7.740bc | 8.830b | 51.620b | 1.430ab | 2.780a | 33.97de |
| V3 × B3 | 16.560c | 6.800d | 8.760b | 48.990c | 1.410ab | 2.580a | 35.34c |
| V4 × B0 | 11.500fg | 7.610bc | 7.160c | 36.290e | 0.986c | 1.410c | 31.85f |
| V4 × B1 | 14.760d | 8.010b | 8.730b | 42.320d | 1.267b | 2.650a | 32.35e |
| V4 × B2 | 19.300a | 7.980bc | 9.980b | 41.900d | 1.440ab | 2.430ab | 37.21b |
| V4 × B3 | 15.000d | 7.350c | 9.270b | 41.510d | 1.440ab | 2.580a | 35.82c |
| Level of sig. | ** | * | ** | * | ** | ** | ** |
| Sd | 0.2689 | 0.2518 | 0.4535 | 0.5018 | 0.0966 | 0.2352 | 0.4815 |

Sd = Standard deviation

t ha$^{-1}$) were produced by BARI Mung–6 from 1.0 kg ha$^{-1}$ boron application. The lowest number of pods plant$^{-1}$ (10.70) from BARI Mung–6, number of grains pod$^{-1}$ (6.66), 1000-grain weight (27.71 g) and seed yield (0.816 t ha$^{-1}$) from BARI Mung–2, stover yield from Binamoog–5 with control treatment and the shortest pod (6.51) was produced by BARI Mung–2 with 1.5 kg B ha$^{-1}$ (Table 1). In an investigation, the interaction effect between Zn and B produced the highest seed yield (3058 and 2631.0 kg ha$^{-1}$ for the years 2008 and 2009, respectively) from the treatment of Zn and B @ 1.5 and 1.0 kg ha$^{-1}$, respectively, where boron plays a positive role (Quddus et al., 2011). Similarly, positive response of boron and sulphur interaction also found by (Islam et al., 2017). Boron increases the leaf area; improve individual seed weight, nodule formation and finally seed and biological yield. Different levels of sulphur and boron has great in-

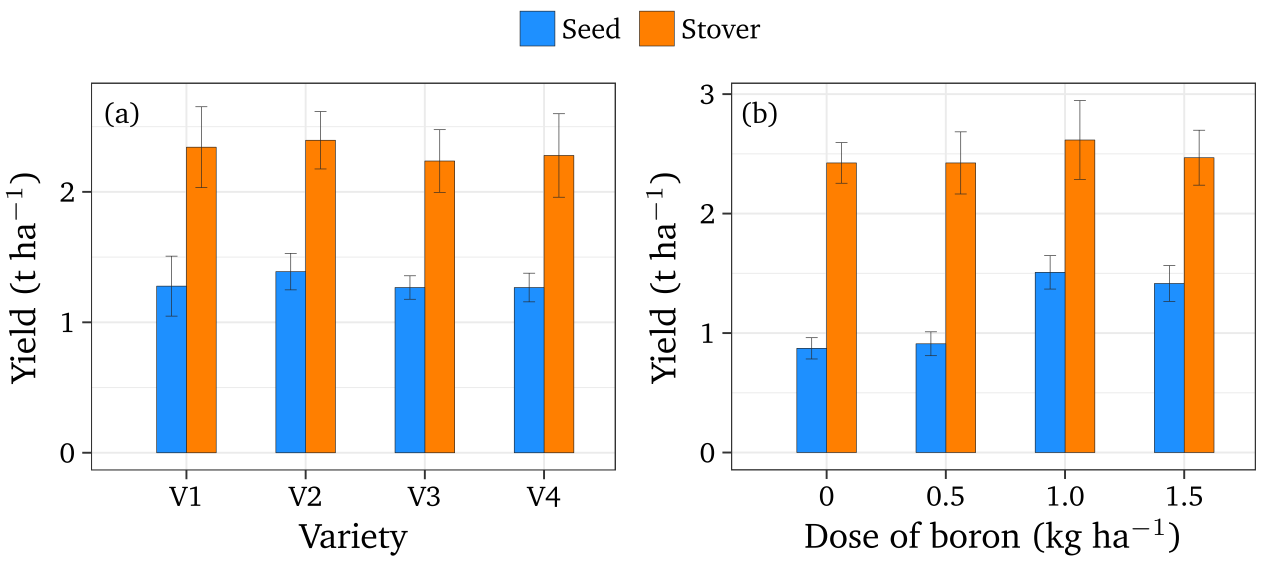


Figure 1. Seed and stover yields of mungbean for different (a) varieties and (b) boron fertilization. V1 = BARI Mung–2, V2 = BARI Mung–6, V3 = Binamoog–5, V4 = Binamoog–7

fluence on yield and yield characters of mungbean (Halwai et al., 2016) and soybean (Jamal et al., 2005) and significantly varied the plant height, total pods plant$^{-1}$, pod length, grains pod$^{-1}$, 1000-grain weight and yield.

The soil of experimental field had 0.15 mg kg$^{-1}$ available boron content (Debnath and Ghosh, 2011) and it was found that mungbean responded to 1.0 kg ha$^{-1}$ boron for obtaining the highest yield. Since, boron content was below the critical level in the soil for the mungbean plant growth, the additional boron supply in the soil therefore boosted yield in the plant.

## 4 Conclusions

From the experiment, it can be concluded that, mungbean yields are affected by variety and BARI Mung–6 performed better than BARI Mung–2, Binamoog–5 and Binamoog–7. Among the boron fertilizer doses used, 1.0 kg ha$^{-1}$ boron was the best for the highest yield of mungbean. The research findings may be helpful to cultivate mungbean with suitable varieties and boron fertilizer dose.

## Conflict of Interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

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