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Yield and yield contributing characters of mungbean as affected by variety and level of phosphorus

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Abstract: An experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during the period from October to January 2011 to study the performance of mungbean as affected by variety and level of phosphorus. The experiment comprised four varieties viz. BARI Mung-6, Binamoog-4, Binamoog-6 and Binamoog-8 and four levels of phosphorus viz. 0, 20, 40 and 60 kg P_2O_5 ha^{-1}, and laid out in a Randomized Complete Block Design with three replications. Results revealed that the longest plant, highest number of branches $plant^{-1}$, number of total pods $plant^{-1}$, seeds $plant^{-1}$ and seed weight $plant^{-1}$ were obtained from BARI Mung-6. The longest plant, highest number of branches $plant^{-1}$, number of total pods $plant^{-1}$, number of mature pods $plant^{-1}$, length of pod, seed weight $plant^{-1}$, 1000-seed weight, seed yield, stover yield and harvest index were obtained when 60 kg P_2O_5 was applied. Binamoog-6 produced the highest seed yield which was as good as Binamoog-8. The second highest and the lowest seed yield were recorded from Binamoog-4 and BARI Mung-6, respectively. The highest stover yield was obtained from Binamoog-8 followed by Binamoog-4. The lowest stover yield was recorded from BARI Mung-6. The highest seed yield was recorded when phosphorus was applied at the rate of 60 kg P_2O_5 ha^{-1} which was statistically identical to 40 kg P_2O_5 ha^{-1}. The intermediate and the lowest seed yield was obtained when phosphorus was applied at the rate of 20 kg P_2O_5 $ha^{-1}$and control treatment, respectively. The highest stover yield was obtained when 60 kg P_2O_5 ha^{-1} was applied but the lowest stover yield was recorded in control treatment (0 kg P_2O_5 ha^{-1}). The highest plant height, number of branches $plant^{1}$, number of total pods $plant^{-1}$ and seeds pod^{-1} were obtained from BARI Mung-6 in combination with 60 kg P_2O_5 ha^{-1}. The highest seed yield was obtained from Binamoog-6 when 60 kg P_2O_5 $ha^{-1}$was applied which was as good as Binamoog-8 in combination with 60 kg P_2O_5 ha^{-1} and the highest stover yield was recorded from Binamoog-8 with 60 kg P_2O_5 ha^{-1}. It can be concluded that mungbean variety Binamoog-6 or Binamoog-8 can be grown with higher dose of phosphorus (60 kg P_2O_5 ha^{-1}) for higher seed yield.

Key words: Mungbean, variety, phosphorus and seed yield

Introduction

Mungbean (*Vigna radiata,* L. Wilczek) is one of the most important pulse crops of Bangladesh. Mungbean is highly adapted to the agro-climatic conditions of Bangladesh. It is grown both in the '*Rabi*' (winter) and '*Kharif* (summer) season in many countries of the world (Bose, 1982 and BARI, 1998). About 57462 acres of land is under its cultivation and its production is 20177 metric tons (BBS, 2009). Cultivation of pulses can improve the physical, chemical and biological properties of soil as well as increase soil fertility status through biological nitrogen fixation from the atmosphere. Besides fixing atmospheric nitrogen in soils mungbean also play an impotant role in agriculture. Its stem and leaves are used in preparing a concentrate feed called "Bhushi" which is rich in protein. The husks of the seeds are also used as feed for milch cow. Its roots break the plough pan of puddled rice field and go deep in search of water and nutrients. Mungbean, and other pulse like cowpea and black gram are used as green manuring crop.

The farmers of Bangladesh generally grow mungbean by one ploughing and hardly use phosphorus due to their poor socio-economic condition and lack of proper knowledge. As a result, yield becomes low. There is an ample scope for increasing the yield of mungbean with improved management practices and by using proper dose of fertilizer. Mungbean is highly responsive to phosphorus fertilizers. To fix nitrogen in soil, an adequate phosphorus supply must be satisfied for the legumes, other factors being adequate. As mungbean is a legume crop, it responds well to added phosphorus (Sarkar and Banik, 1991). Phosphorus plays a key role in plant physiological processes. It is needed for energy storage and release in the living cells. Phosphorus deficiency causes yield reduction by limiting the plant growth (Poehlman, 1991). Mungbean responds favourably to phosphorus fertilization (Chovati *et al.,* 1993). In Bangladesh some studies have been conducted to find out the effect of phosphorus and variety separately. Research work on the combined effect of phosphorus and vatiety on mungbean is limited. Considering the above facts the present study was undertaken to find out the suitable variety and optimum dose of phosphorus on seed yield of mungbean.

Materials and Methods

An experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University (BAU), Mymensingh during the period from October to January 2011. The land topography was medium high and the soil was silty loam having P^H 6.7. The experiment comprised four varieties of mungbean viz. BARI Mung-6, Binamoog-4, Binamoog-6 and Binamoog-8, and four level of Phosphorus viz. 0, 20, 40 and 60 kg P_2O_5 ha^{-1}. The experiment was laid out in a Randomized Complete Block Design with three replications. The size of each unit plots was 10 m^2 (4.0 m × 2.5m). The experimental land was prepared with ploughing and laddering. Fertilizers were applied at final land preparation and laying out of the land where urea, muriate of potash, gypsum, zinc sulphate and molybdenum were applied at 30, 40, 50, 4 and 1 $kgha^{-1}$,respectively in all plots and the specific rate of P_2O_5 were applied at specific plots. Seeds were sown in furrow on 22 October 2011 and furrows were then covered with soil. The seed rate was maintained 25-30 kg ha^{-1}. Line to line and plant to plant distances were 30 cm and 10 cm, respectively. The sowing depth was maintained at about 3 cm from the soil surface. Crop management practices such as weeding, thinning and plant protection measures were done as per requirement. Data on yield attributes were taken from 5 randomly selected plants $plot^{-1}$. Whole plot was harvested by hand picking of plods at different dates as per maturity of different varieties. The seeds were

dried (at 12% moisture level), cleaned and weighed plot-wise and the weights were converted to t ha^{-1}. The collected data were compiled and analyzed statistically using the analysis of variance (ANOVA) technique with the help of computer package program MSTAT-C and the mean differences were adjudged by "Duncan's Multiple Range Test" (Gomez and Gomez, 1984).

Results and Discussion

Effect of variety: Variety showed significant influence on plant height, number of branches $plant^{-1}$, number of pods $plant^{-1}$, length of pod, number of seeds pod^{-1}, seed weight plant-1, 1000-seed weight, seed yeald, stover yield and harvest index. The tallest plant (52.49 cm) was produced by BARI Mung-6 variety followed by Binamoog-6 and the shortest plant (40.54 cm) was produced by Binamoog-8. Probably the genetic make-up of the variety was responsible for the variation in plant height. Similar results were reported elsewhere (Saharia 1988 ; Thakuria and Saharia 1990). The highest number of branches $plant^{-1}$(2.97) was produced by BARI Mung-6 variety followed by Binamoog-6 while the lowest one was (2.36) recorded from Binamoog-4. BARI Mung-6 produced the highest number of total pods $plant^{-1}$ followed by Binamoog-6 whereas, the lowest number of total pods $plant^{-1}$ was produced by Binamoog-4. BARI Mung-6 (17.98) produced the highest number of mature pods $plant^{-1}$ followed by Binamoog-6 whereas the lowest on (12.20) was Binamoog-4. The highest length of pod (10.43 cm) was found from Binamoog-6 followed by Binamoog-8 (10.39) and the lowest length of pod (6.80cm) was found in BARI Mung6 (Table 1). BARI Mung-6 produced the highest seed weight $plant^{-1}$ (29.88 g) followed by Binamoog-6 which was identical to Binamoog-8 whereas the lowest one (14.74 g) was produced by Binamoog-4 (Table 1). The highest number of seeds pod^{-1} (18.42) was BARI Mung-6 followed by Binamoog-8 (17.16) whereas the lowest number seeds pod^{-1} (15.47) was Binamoog-4 (Table 1). The highest weight of 1000-seed (39.57g) was produced by Binamoog-8 followed by Binamoog-6 which was as good as Binamoog-4 whereas, the lowest weight of 1000 seeds (27.36g) was produced by BARI Mung-6 (Table 1). The highest seed yield (1.94 t ha^{-1}) was produced by Binamoog-6 which was statistically identical to Binamoog-8 (1.88 t ha^{-1}), and the lowest seed yield (1.01 t ha^{-1}) was produced by BARI Mung-6 (Table 1). The highest stover yield (4.15 t ha^{-1}) was produced by Binamoog-8 whereas the lowest stover yield (3.65 t ha^{-1}) was produced by BARI Mung-6 (Table 1). The highest harvest index (34.52%) was recorded in Binamoog-6 variety whereas the lowest harvest index (21.57%) was recorded in BARI Mung-6 (Table 1). Varietal potentiality of mungbean might be influences various plant characters, yield contributing characters and yield of mungbean. The supported results were reported elsewhere (BINA, 1998; Mohanty *et al*., 1995 and Mitra *et al*., 1999).

Table 1. Effect of variety on the yield contributing characters and yield of mungbean

Variety	Plant height (cm)	No. of branches $plant^{-1}$	No. of total pods $plant^{-1}$	Mature pods $plant^{-1}$	Length of pod (cm)	Number of seeds pod^{-1}	Seed weight $plant^{-1}$ (g)	1000-seed weight (g)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})	Harvest Index (%)
V_1	52.49a	2.97a	23.62a	17.98a	6.80c	18.42a	29.88a	27.36c	1.01c	3.65b	21.57d
V_2	40.97bc	2.36d	19.62c	12.20c	9.95b	15.47d	14.74c	37.56b	1.78b	3.71b	32.41b
V_3	43.05b	2.65b	20.68b	13.79b	10.43a	16.31c	19.51b	37.96b	1.94a	3.67b	34.52a
V_4	40.54c	2.45c	20.39b	13.39b	10.39a	17.16b	19.18b	39.57a	1.88a	4.15a	31.20c
CV (%)	5.77	3.58	4.47	7.07	2.82	2.30	15.68	3.12	2.82	4.13	3.53
Level of sig.	**	**	**	**	**	**	**	**	**	**	**

Mean values in a column having the same letter do not differ significantly whereas mean unless with dissimilar letter differ significantly as per DMRT, **

Effect of phosphorus: Plant height, number of branches $plant^{-1}$, number of pods $plant^{-1}$, length of pod, number of seeds pod^{-1}, seed weight plant-1, 1000-seed weight, seed yeald, stover yield and harvest index were significantly influence by application of level of phosphorus. The tallest plant (46.62 cm) was recorded when phosphorus was applied at the rate of 60 kg P_2O_5 ha^{-1} followed by 40 kg P_2O_5 ha^{-1} at treated plots and the shortest plant (42.42 cm) was recorded from control plots (Table 2). This result is in agreement with the findings of Shukla and Dixit (1996) and Sharma and Singh (1997). They reported that application of phosphorus enhance the plant height significantly.

The highest number of branches $plant^{-1}$ (2.98) was obtained while phosphorus was applied at the rate of 60 kg P_2O_5 ha^{-1} followed by 40 kg P_2O_5 ha^{-1} and the lowest number of branches $plant^{-1}$ (2.18) was recorded from control treatment. Shukla and Dixit (1996) reported that increased levels of P_2O_5 increased the primary branches of mungbean. The highest number of total pods $plant^{-1}$ was recorded when phosphorus was applied at the rate of 60 kg P_2O_5 ha^{-1} treatment and the lowest one was recorded in control treatment. The highest number of mature pods $plant^{-1}$ (16.17) was recorded when 60 kg P_2O_5 ha^{-1} applied followed by 40 kg P_2O_5 ha^{-1} and the lowest mature pods $plant^{-1}$ (13.54) was recorded from application of 20 kg P_2O_5 ha^{-1}. These results are in agreement with the result of Reddy *et al*. (1990). They reported that phosphorus fertilization on mungbean increased number of pods $plant^{-1}$. Tank *et al*. (1992) found that mungbean fertilized with P_2O_5 could be assigned to significantly higher number of pods $plant^{-1}$ over the unfertilized control. The highest length of pod (10.14cm) which was recorded when phosphorus was applied at the rate of 60 kg P_2O_5 ha^{-1} followed by applied 40 kg P_2O_5 ha^{-1} and the lowest length of pod (8.50cm) was recorded from control treatment (Table 2). Similar results were reported by Khatun *et al*. (2008) and Tank *et al*. (1992). They observed that pod length in mungbean increased due to application of higher level of phosphorus. The highest weight of seeds $plant^{-1}$

(25.79 g) was recorded from 60 kgha^{-1} phosphorus treated followed by 40 kg and 20 kg P_2O_5 ha^{-1} and the lowest one (15.55 g) was recorded from control treatment (Table 2). The highest number of seeds pod^{-1} (17.63) was recorded when applied 60 kg P_2O_5 ha^{-1} which was statistically identical to application of 40 kg P_2O_5 ha^{-1} and 20 kg P_2O_5 ha^{-1} and the lowest one (14.89) was recorded from control treatment (Table 2). Similar result was reported by Gopala Rao *et al*. (1993). Their study supported that number of seeds pod^{-1} significantly increased with the increased phosphorus level from 0 to 50 kg P_2O_5 ha^{-1}**.** The highest weight of 1000-seed (39.99) was recorded from 60 kg P_2O_5 ha^{-1} which was identical to (37.09) 40 kg P_2O_5 ha^{-1} and the lowest one (32.67) was recorded from control treatment (Table 2). Bali *et al*. (1991) reported that 1000-seed weight increased up to 60 kg P_2O_5 ha^{-1}**.**

Table 2. Effect of level of phosphorus on the yield contriburting characters and yield of mungbean

Phosphors level (kg P_2O_5 ha^{-1})	Plant height (cm)	No. of branches plant^{-1}	No. of total pods plant^{-1}	Mature pods plant^{-1}	Length of pod (cm)	No. of seeds pod^{-1}	Seed wt. plant^{-1} (g)	1000 seed wt. (g)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})	Harvest Index (%)
P_0	42.42b	2.18d	19.96c	12.62d	8.50d	14.89b	15.55d	32.67c	1.34c	3.25d	28.80b
P_1	42.74b	2.53c	20.62b	13.54c	9.22c	17.41a	19.66c	34.70b	1.59b	3.66c	29.82ab
P_2	45.26a	2.75b	21.11b	15.04b	9.71b	17.43a	22.30b	37.09a	1.82a	4.00b	30.89a
P_3	46.62a	2.98a	22.61a	16.17a	10.14a	17.63a	25.79a	37.99a	1.87a	4.28a	30.18a
CV (%)	5.77	3.58	4.47	7.07	2.82	2.3	15.68	3.12	2.82	4.13	3.53
Level of sig.	**	**	**	**	**	**	**	**	**	**	**

Mean values in a column having the same letter do not differ significantly whereas mean unless with dissimilar letter differ significantly as per DMRT, ** indicates significant at 1% level of probability.

The highest seed yield (1.87 t ha^{-1}) was produced by application of 60 kg P_2O_5 ha^{-1} which is as good as to 40 kg P_2O_5 ha^{-1} (1.82 t ha^{-1}) and the lowest one (1.34 tha^{-1}) was produced when phosphorus was not applied (Table 2). The result revealed that application of phosphorus increased the seed yield over control. Ahmed *et al*. (1986) reported that application up to 60 kg P_2O_5 ha^{-1} progressively and significantly enhanced the seed yield of mungbean. The highest stover yield (4.28 t ha^{-1}) was also recorded from application of 60 kg P_2O_5 ha^{-1} followed by 40 kg P_2O_5 ha^{-1} and the lowest stover yield (3.25 t ha^{-1}) was recorded from control treatment (Table 2). Similar result was reported by Sharma *et al*. (1993) and Sharma and Singh (1997). The highest harvest index (30.89%) was recorded in phosphorus was applied at the rate of 40 kg P_2O_5 ha^{-1} and the lowest harvest index (28.80%) was found phosphorus was not applied in plots (Table 2). Tomar *et al*. (1996) reported that harvest index of summer mungbean were the highest with 60 kg P_2O_5 ha^{-1}.

Table 3. Interaction effect between variety and level of phosphorus on the yield contributiing characters and yield of mungbean

Variety × Phosphorus level	Plant height (cm)	No. of branches plant^{-1}	No. of total pods plant^{-1}	Mature pods plant^{-1}	Length of pod (cm)	No. of seeds pod^{-1}	Seed wt. plant^{-1} (g)	1000 seed wt. (g)	Seed yield (t ha^{-1})	Stover yield (t ha-1)	Harvest Index (%)
$V_1 \times P_0$	41.14cd	2.09g	22.43bcd	15.13cd	5.11i	16.12ef	23.83c	24.41g	0.81i	3.11g	20.75f
$V_1 \times P_1$	52.93b	2.84c	22.60bc	15.97c	6.31i	20.07a	30.25b	25.79g	0.92i	3.57f	20.47f
$V_1 \times P_2$	56.83ab	3.33b	23.16b	19.67b	7.53h	18.70b	31.53b	29.18f	1.09h	3.85cde	22.12ef
$V_1 \times P_3$	59.06a	3.63a	26.28a	21.16a	8.26g	18.78b	33.91a	30.06f	1.21h	4.08c	22.92e
$V_2 \times P_0$	42.71c	1.91h	19.31g	11.34h	9.45f	14.29h	10.01h	32.96e	1.52g	3.16g	32.50c
$V_2 \times P_1$	37.09de	2.31f	19.60fg	11.93gh	9.83e	15.69efg	13.09g	35.57d	1.73f	3.72ef	31.79cd
$V_2 \times P_2$	41.29cd	2.52e	19.67fg	12.55g	10.10d	16.37de	17.52f	40.84a	1.97bcd	4.01c	32.92bc
$V_2 \times P_3$	42.78c	2.70cd	19.90fg	12.99fg	10.41c	15.52fg	18.33ef	40.86a	1.92de	3.98cd	32.44c
$V_3 \times P_0$	43.74c	2.52e	18.21h	11.91gh	9.60f	14.12h	14.89g	37.00cd	1.57g	3.50f	31.01cd
$V_3 \times P_1$	45.22c	2.65de	20.47ef	13.72ef	10.35c	16.17def	17.79ef	36.63cd	1.93cde	3.60f	34.88ab
$V_3 \times P_2$	42.46c	2.60de	21.39de	14.25de	10.72b	16.87d	19.69de	38.27bc	2.08abc	3.59f	36.68a
$V_3 \times P_3$	40.78cd	2.85c	22.64bc	15.28cd	11.05a	18.07bc	25.66c	39.95ab	2.19a	3.98cd	35.50a
$V_4 \times P_0$	42.08c	2.19fg	19.89fg	12.09gh	9.83e	15.02g	13.47g	36.32cd	1.45g	3.24g	30.94cd
$V_4 \times P_1$	35.73e	2.34f	19.81fg	12.54g	10.38c	17.70c	17.52f	40.80a	1.77ef	3.75def	32.14cd
$V_4 \times P_2$	40.47cd	2.54e	20.22fg	13.69ef	10.50c	17.79c	20.47d	40.08ab	2.12ab	4.55b	31.85cd
$V_4 \times P_3$	43.87c	2.72cd	21.64cd	15.26cd	10.83b	18.13bc	25.26c	41.08a	2.16a	5.08a	29.87d
CV (%)	5.77	3.58	4.47	7.07	2.82	2.30	15.68	3.12	2.82	4.13	3.53
Level of sig.	**	**	**	**	**	**	**	**	**	**	**

Mean values in a column having the same letter do not differ significantly whereas mean unless with dissimilar letter differ significantly as per DMRT, ** indicates significant at 1% level of probability, Note: P0= 0 kg P2O5 ha-1, P1= 20 kg P2O5 ha-1, P2=40 kg P2O5 ha-1. P3=60 kg P2O5 ha-1

Interaction effect of variety and phosphorus: The interaction effect between variety and levels of phosphorus was significant on different plant characters, yield and yield contributing characters of mungbean. The highest plant height (59.06 cm) was recorded from the interaction of BARI Mung-6 with application of phosphorus at the rate of 60 kg P_2O_5 ha^{-1}. The lowest plant height (35.73 cm) was observed in Binamoog-8 with control treatment (0 kg P_2O_5 ha^{-1}). The highest number of branches plant^{-1} (3.63) was obtained from the interaction of BARI Mung-6 with phosphorus at the rate of 60 kg P_2O_5 ha^{-1}. The lowest number of branches plant^{-1} (1.91) was found on the interaction of Binamoog-4 with control treatment (Table 3). The highest number of total pods plant^{-1} (26.28) was observed in the interaction between BARI Mung-6 with 60 kg P_2O_5 ha^{-1} and the lowest number of pods plant^{-1} (18.21) was observed in the interaction between Binamoog-6 without application of phosphorus. The highest number of mature pods plant^{-1} (21.16cm) was BARI Mung-6 with application of 60 kg P_2O_5 ha^{-1} followed by application of 40 kg P_2O_5 ha^{-1} and the lowest one (11.34) was Binamoog-4 with control treatment (Table 3). The longest pods

(11.05cm) was recorded Binamoog-6 with application 60 kg P_2O_5 ha^{-1} and the shortest pod (5.11cm) was found from BARI Mung-6 without phosphorus application (Table 3). The highest weight of seeds $plant^{-1}$ (33.9 g) was recorded from BARI Mung-6 with 60 $kgha^{-1}$ phosphorus treatment and the lowest one (10.01 g) was recorded from Binamoog-4 with under control treatment (Table 3).

The highest number of seeds pod^{-1} (20.07) was recorded in the interaction of BARI Mung-6 with 20 kg P_2O_5 ha^{-1} whereas, the lowest number of seeds pod^{-1} (14.12) was recorded from Binamoog-6 with control treatment (Table 3). The highest weight of 1000-seed (41.08) was recorded from Binamoog-8 with 60 kg P_2O_5 ha^{-1} whereas the lowest weight of 1000-seed (24.41) was recorded from BARI Mung-6 without application of phosphorus (Table 3). The highest seed yield (2.19 t ha^{-1}) was recorded from Binamoog-6 with application 60 kg P_2O_5 ha^{-1} phosphorus followed by Binamoog-6 with 40 kg P_2O_5 ha^{-1} and the lowest seed yield (0.81 t ha^{-1}) was recorded from BARI Mung-6 without application of phosphorus in plots (Table 3). The highest stover yield (5.08 t ha^{-1}) was recorded from the interaction of Binamoog-8 with 60 kg P_2O_5 ha^{-1} and the lowest stover yield (3.11 t ha^{-1}) was recorded from BARI Mung-6 with control treatment (Table 3). The highest harvest index (36.68%) was recorded from Binamoog-6 with 40 kg P_2O_5 ha^{-1} whereas the lowest harvest index (20.47%) was recorded from BARI Mung-6 with 20 kg P_2O_5 ha^{-1} (Table 3).

From this study it can be concluded that Binamoog-6 (1.94 t ha^{-1}) was the highest yielding variety, which was as good as Binamoog-8 (1.88 t ha^{-1}) and phosphorus application at the rate of 60 kg P_2O_5 ha^{-1} was the best which produced the highest seed (1.87 t ha^{-1}) yield. So to obtain better yield of mungbean variety Binamoog-6 or Binamoog-8 can be grown with higher rate of phosphorus (60 kg P_2O_5 ha^{-1}).

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