



Full Length Article

Optimizing Seed Rate for Summer Mungbean Varieties

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ABSTRACT

An experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh from March to June, 2007 to investigate the effect of cultivar and seed rate on morphological characters, yield attributes and yield of summer mungbean. The experiment comprised four varieties viz., BINA moog2, BINA moog5, BINA moog6 and BINA moog7 and four seed rates viz. 30, 40, 50 and 60 kg ha⁻¹. The experiment was laid out in a randomized complete block design with four replications. Results revealed that variety and seed rate had significant effect on the studied crop characters and yield. The variety BINA moog7 showed superiority in relation to plant height, number of branches and effective pods per plant, number of seeds pod⁻¹ compared to other varieties, which resulted in the highest seed yield both per plant and per hectare. The plant height, stover yield and number of non-effective pods per plant increased with the increase in seed rate, while branch number, number of effective pods per plant, seeds per pod, 100-seed weight, as well as seed weight per plant decreased with increasing seed rate. The higher number of branches and effective pods per plant, number of seeds pod, 100-seed weight and seed yield per plant were recorded at the rate of 30 and 40 kg seeds ha⁻¹ and the lowest values for the above parameters were observed at the rate of 60 kg seeds ha⁻¹. But per unit area basis, the highest seed yield was recorded in 40 kg seeds ha⁻¹ followed by 50 kg seeds ha⁻¹ due to accommodation of higher number of plants. BINA moog7 interacted favorably with the seed rate of 30 kg ha⁻¹ to produce the highest seed yield.

Key Words: Variety; Seed rate; Bio-fertilizer; Mungbean

INTRODUCTION

Mungbean [*Vigna radiata* (L.) Wilczek] is one of the most important pulse crops grown in Bangladesh. Its edible grain is characterized by good digestibility, flavour, high protein content and absence of any flatulence effects (Ahmed, 2001). In Bangladesh, total production of pulses is only 0.65 million ton against 2.7 million tons requirement. This means the shortage is almost 80% of the total requirement (Rahman & Ali, 2007). This is mostly due to low yield (MoA, 2005). The reasons for low yield are manifold: some are varietals and some are agronomic management. Due to the shortage of land, the scope of its extensive cultivation is very limited. Therefore, attempts must be made to increase the yield per unit area by applying improved technology and management practices. For any yield improvement program selection of superior parents is an essential prerequisite i.e., possessing better heritability and genetic advance for various traits (Khan *et al.*, 2005; Ahmad *et al.*, 2008). Among the cultural technologies seed rate is one of the important components, manipulation of which is an essence for optimizing yield. There are large differences in yield among the mungbean varieties (Ahmad *et al.*, 2003; Bina, 2007) and the maximum potentiality can

be achieved from the optimum spacing. Various experiments and work on spacing of mungbean have been carried out in Bangladesh, as well as in other countries to find out the suitable plant population to get maximum yield (Mondal, 2007). Improper spacing reduced the yield of mungbean up to 20-40% (AVRDC, 1974) due to competition for light, space, water and nutrition. The optimum spacing favors the plants to grow in their both aerial and underground parts through efficient utilization of solar radiation and nutrients and thus increase grain yield (Miah *et al.*, 1990). Plant spacing directly affects the physiological activities through intra-specific competition. Narrowing of plant spacing by increasing seed rate generally means a more uniform distribution of plants over a given area, thus matching the plant canopy effective in intercepting radiant energy and shading weeds. Though wider space allows individual plants to produce more branches and pods, but it provides smaller number of pods per unit area due to fewer plants per unit area. Thus, the branch production may compensate partially the number of plants in wider spacing and it would end up with low yield by misusing land space (Singh *et al.*, 2003). So, optimum seed rate should be ensured for the plant to grow properly in order to give higher yield (Miah *et al.*, 1990). The

experimental evidences of the effect of seed rate on the yield and yield components of Bangladesh's mungbean cultivars are limited. Therefore, present study was undertaken to determine the optimum seed rate for getting higher seed yield of four summer mungbean varieties in Bangladesh.

MATERIALS AND METHODS

The experiment was carried out at the Field Laboratory, Department of Agronomy, Bangladesh Agricultural University, Mymensingh, during the period from March to June, 2007. The experiment included four mungbean cultivars viz. BINA moog2, BINA moog5, BINA moog6 and BINA moog7, which were sown at the seed rate of 30, 40, 50 and 60 kg ha⁻¹. The experiment was quadruplicated in a Randomized Complete Block Design. The size of the unit plot was 2.5 m×2.0 m. Distances between blocks and between plots were 1.0 and 0.5 meter, respectively. The experimental field was medium high belonging to the Sonatola Soil Series of Grey Floodplain soil under the agro-ecological zone of Old Bahmaputra Flood plain (AEZ-9). The soil was silty loam in texture, low fertility level and very slightly acidic in nature (pH 6.4). Soil organic carbon (%), organic matter (%) and total nitrogen were recorded 1.30, 1.28 and 0.11%, respectively. The average temperatures recorded in different months during the experimental period were 18.97°C (February), 24.73°C (March), 25.37°C (April), 27.64°C (May), 24.73°C (June), while the total month wise rainfall were recorded as 0.00, 0.00, 0.00, 39.0 and 350 mm, respectively. The average relative humidity was 80.57 to 82.51 during the experimental period. The experimental plot was fertilized with TSP, MP and gypsum @ 120, 80 and 40 kg ha⁻¹, respectively. Total amount of those fertilizers were applied during final land preparation. Biofertilizer was used instead of urea at the rate of 100 g kg⁻¹. Before sowing the seeds, the seeds were mixed with molasses for adhering to the biofertilizer. Then the biofertilizer was mixed thoroughly with the seeds and the seeds were placed in a cool dry place to avoid sticking together. Treated seeds were hand sown in lines at about 3-4 cm depth from the soil surface on March 05, 2007. Different intercultural operations such as weeding and water management were done as and when necessary. Harvesting was done at different dates due to variation in maturity. Five random selected plants from each plot were cut at the ground level with sickle and bundled and tagged carefully for recording necessary data. Thereafter, the pods were harvested manually from the each plot, when 80-90% pods became mature. Pods were then sun dried and threshed by stick. Harvests were completed by June 20, 2007. Finally, grain weights were taken on individual plot basis at moisture content of about 12% and converted into kg ha⁻¹. The data obtained were analyzed statistically following the analysis of variance (ANOVA) technique by MSTAT C and the mean differences were adjudged by Duncan's Multiple Range Test (DMRT).

RESULTS

Effect of variety. Variety had significant influence on all of the observed morphological characters, yield attributes and yield of summer mungbean (Table I). Results showed that BINA moog7 produced maximum plants followed by BINA moog2, BINA moog5 and BINA moog6. The tallest plants were observed in BINA moog2 and BINA moog7 and the shortest ones were recorded in BINA moog6. The highest number of branches plant⁻¹ was recorded in BINA moog7 and BINA moog6 produced the lowest one. In case of stover yield, BINA moog2 produced the highest stover yield followed by BINA moog7 and BINA moog5. On the other hand, BINA moog6 produced the lowest stover yield due to production of fewer branches plant⁻¹ (Table I). The number of effective and non-effective pods plant⁻¹ was significantly the highest in BINA moog7 followed by BINA moog2, BINA moog5 and the lowest number of effective pods plant⁻¹ was recorded in BINA moog6. In case of number of seeds pod⁻¹, the highest number of seeds pod⁻¹ was recorded in BINA moog7 followed by BINA moog2 with same statistical rank, whereas the lowest seeds pod⁻¹ was observed in variety BINA moog6. The highest 100-seed weight was recorded in BINA moog6. The highest seed yield per plant and per unit area was recorded in BINA moog7 followed by BINA moog2 (Table I) and the lowest one was recorded in BINA moog6. This yield variation occurred due to the contribution of different yield traits.

Effect of seed rate. Seed rate had significant influence on all of the observed morphological characters, yield attributes and yield of summer mungbean (Table I). The different seed rates that were used in the present experiment to maintain variation in plant population were found very effective and ranged from 31 to 57 plants m⁻². Result indicated that number of plants m⁻² gradually increased with increasing seed rate. Plant height increased with increasing seed rate producing the tallest plant at the rate of 60 kg seeds ha⁻¹ followed by 50 kg seeds ha⁻¹ with same statistical rank. In contrast, seed rate of 30 kg ha⁻¹ had the shortest plant, which was statistically similar to that of 40 kg seeds ha⁻¹. Result revealed that branch number plant⁻¹ decreased with increased seed rates. The highest branches plant⁻¹ was observed at the rate of 30 kg seeds ha⁻¹, which was identical to 40 kg seeds ha⁻¹ and the lowest one was recorded at the rate of 60 kg seeds ha⁻¹. In case of yield attributes, the number of effective pods plant⁻¹ decreased with increasing seed rates in mungbean. This trend was opposite in non-effective seeds pod⁻¹. The higher number of seeds pod⁻¹ was observed in 30 and 40 kg seeds ha⁻¹ followed by a decline seeds pod⁻¹ with increased seed rate. Result revealed that 100-seed weight decreased with increasing seed rate, but the decrement was identical up to 40 kg seeds ha⁻¹. Seed rate had significant effect on seed yield per plant and per unit area (Table I). Result revealed that seed yield plant⁻¹ increased with decreasing seed rate producing the highest yield per plant at 30 kg seed ha⁻¹, which was statistically

identical to 40 kg seed ha⁻¹ and lowest was at 50 and 60 kg seed ha⁻¹. However, based on unit area, the seed yield was greater at the rate of 30 and 40 kg seeds ha⁻¹, as well as 50 kg seeds ha⁻¹ compared to 60 kg seeds ha⁻¹.

Interaction effect of variety and yield. The interaction effect of variety and seed rate was significant at $P \leq 0.05$ for number of plants m², plant height, stover yield, effective pods plant⁻¹, non-effective pods plant⁻¹ and seed yield t ha⁻¹ (Table II). The highest number of plant m² was observed in BINA moog7 with 60 kg seeds ha⁻¹ followed by BINA moog2 with the same amount of seeds ha⁻¹. The lowest number of plant m² was observed in BINA moog6 with 30 kg seeds ha⁻¹. The highest stover yield was observed at the rate of 60 kg seeds ha⁻¹ in BINA moog2, which was statistically similar to those of 60 kg seeds ha⁻¹ both in BINA moog5 and BINA moog7. The lowest stover yield was observed in BINA moog6 at 30 kg seeds ha⁻¹. Result revealed that there was no significant influence on effective pods plant⁻¹ between 30 and 40 kg ha⁻¹ seed rate within each variety. The highest effective pods plant⁻¹ was observed in BINA moog7 with the rate of 30 and 40 kg seeds ha⁻¹. In contrast, the lowest number of effective pods plant⁻¹ was observed in BINA moog6 with the higher seed rate of 60 kg seeds ha⁻¹. In general, the trend was increasing the seed rate decreasing the number of effective pods plant⁻¹ and vice-versa for non-effective pods plant⁻¹.

DISCUSSION

Differences among varieties in all the morphological characters and yield attributes as well were found. The maximum plant density observed in BINA moog7 may be due to small seed size of the variety, which accommodated more plants per unit area compared to bold seeded ones. It is possible because of bold seeds are in fewer number per unit weight than in the smaller ones. BARI (1991) found that small seeded entries had greater germination percentage than bold seeded ones and even with same seed rate, small seeded entries accommodated more plants per unit area, which contributed towards higher yield than the bold seeded entries. Variation in number of branches per plant among varieties is mostly due to the differences in their genetic makeup. BINA (2007) reported that among the released varieties by BINA, BINA moog6 produced the lowest number of branches ranged 0.60-1.00, which is supported by the present experimental result. A genotypic variation in stover weight, which is mostly favored by increased plant height and profuse branching habit was also observed by Tomar and Tiwari (1996) in mungbean. The highest seed yield per plant recorded with BINA moog7 was the consequence of highest number of effective pods per plant and seeds per pod. Sarker *et al.* (2004) observed seed yield differences between two mungbean varieties BARI mung 2 and BARI mung 5, which was due to variation in number of effective pods plant⁻¹. BINA moog6 produced the heaviest seeds, which may be due to the fact that this variety

produced lowest number of seeds per pod, which enhanced to produce bold seeds. Genotypic variation in 100-seed weight was also observed by Borah (1994) among 15 genotypes in mungbean. Similarly, Thakuria and Saharia (1990) and Siddique *et al.* (2006) reported that mungbean varieties differed significantly in yield related traits resulting in seed yield differences.

All the morphological characters, yield attributes and yield of mungbean were tremendously influenced by seed rate. Plant height increased with increasing seed rate. Taller plant in higher seed rate might have resulted due to competition for sunlight than those of lower seed rate because of densely population in the higher seed rates. These results are in agreement with that of Hassan (2000), who reported that seed rate had significant effect on plant height of mungbean. Similar result was also reported by Chowdhury (1999), who opined that plant height increased with increasing seed rate. Reduction in branch number in higher seed rate might be due to increased number of plants per unit area and their inter competition. Whereas, increased stover yield with increasing seed rate might be due to increased plant number per unit area with increasing seed rate. The result is consistent with the findings of Chowdhury (1999), who reported that total dry matter in mungbean per unit area increased with increasing seed rates. The number of effective pods plant⁻¹ decreased with increasing seed rates, while in case of non-effective seeds pod⁻¹ the trend was just opposite. The differential response for seed rate might be due to the fact that lower seed rate have fewer number of plants per unit area, which allowed more nutrients for producing more number of effective pods plant⁻¹. Similar result was also reported by many workers (Singh & Singh, 1995; Chowdhury, 1999; Hassan, 2000; Singh *et al.*, 2003), who observed that pods plant⁻¹ decreased with increasing seed rate in mungbean. Similarly Mimber (1993) observed that non-effective pods plant⁻¹ decreased with lower plant densities. Reduced number of seeds pod⁻¹ under high seed rates might be due to lower production of assimilates by lesser leaf area, which was not capable to supply available assimilates to the seeds. This result is in agreement with that of Hassan (2000), who observed that seeds pod⁻¹ decreased with increasing seed rate in mungbean. Reduced 100-seed weight at higher seed rate might be due to lower amount of assimilate translocation from leaf to grain. Similar result was also reported by many workers, who observed that 100-seed weight decreased with increasing plant density in mungbean (Tomar *et al.*, 1996; Chowdhury, 1999; Hassan, 2000; Singh *et al.*, 2003). Seed yield plant⁻¹ increased with decreasing seed rate producing the highest yield per plant at 30 kg seed ha⁻¹ this might be happened due to yield contributing characters like effective pods plant⁻¹, seeds pod⁻¹ and 100-seed weight favored by the lowest seed rate due to less competition among plants, which resulted in the highest seed yield. Although plants per unit area were the highest in 60 kg seeds ha⁻¹, but lower seed yield per plant, as well as per unit area under densely populated condition was might

Table I. Effect of variety and seed rate morphology, yield attributes an yield of summer mungbean

Variety	Morphological characters					Yield attributes				
	Plants m ⁻² (no.)	Plant height (cm)	Branches plant ⁻¹ (no.)	Stover yield (t ha ⁻¹)	Effective pods plant ⁻¹ (no.)	Non-effective pods plant ⁻¹ (no.)	Seeds pod ⁻¹ (no.)	100-seed weight (g)	Seed yield plant ⁻¹ (g)	Seed yield (t ha ⁻¹)
BINA moog2	48.0 b	55.8 a	1.96 b	6.62 a	21.8 b	2.83 b	11.38 a	3.28 d	8.15 b	1.85 b
BINA moog5	40.4 c	51.8 b	1.55 c	5.31 c	17.1 c	2.94 b	11.05 b	3.63 b	6.88 c	1.79 c
BINA moog6	34.2 d	40.0 c	1.06 d	3.09 d	13.4 d	2.21 c	10.51 c	4.79 a	6.80 c	1.31 d
BINA moog7	50.9 a	55.1 a	3.24 a	6.46 b	24.8 a	3.48 a	11.53 a	3.46 c	9.95 a	1.93 a
F-test	**	**	**	**	**	**	**	**	**	**
CV (%)	6.01	4.21	9.16	3.71	6.80	7.90	3.37	2.10	3.58	4.66
Seed Rate										
30 kg ha ⁻¹	31.1 d	47.9 b	2.37 a	4.51 d	22.0 a	2.34 c	11.41 a	3.87 a	9.41 a	1.75 a
40 kg ha ⁻¹	38.2 c	48.9 b	2.23 a	5.10 c	21.6a	2.41 c	11.43 a	3.85 ab	9.20 a	1.81 a
50 kg ha ⁻¹	47.4 b	52.2 a	1.78 b	5.63 b	18.3 b	2.89 b	11.00 b	3.78 b	7.39 b	1.77 a
60 kg ha ⁻¹	56.8 a	53.6 a	1.44 c	6.23 a	15.2 c	3.48 a	10.61 c	3.67 c	5.78 c	1.56 b
F-test	**	**	**	**	**	**	**	**	**	**
CV (%)	6.01	4.21	9.16	6.80	7.90	3.37	2.10	3.58	3.71	4.66

In a column, figures with same letter (s) or without letter do not differs significantly, whereas figures with dissimilar letter (s) do not differ significantly (as per DMRT)

Table II. Interaction of variety, seed rate and yield on the performance of summer mungbean varieties

Interaction of variety and seed rate	Morphological characters					Yield attributes					
	Number of plants m ⁻²	Plant Height (cm)	Branches plant ⁻¹ (no.)	Stover Yield (t ha ⁻¹)	Effective pods plant ⁻¹ (No.)	Non-effective pods plant ⁻¹ (No.)	Seeds pod ⁻¹ (No.)	100-seed weight (g)	Seed yield plant ⁻¹ (g)	Seed Yield (t ha ⁻¹)	
BINA moog2	30 40 50 60	35.0 f 41.5 e 52.5 bc 63.0 a	54.4 55.4 56.1 57.3	2.32 2.25 1.75 1.50	6.00 e 6.50 d 6.80 bc 7.18a	25.4 b 24.9 b 20.4 c 16.4 d	2.20 hi 2.50 gh 3.10 de 3.50 bc	11.75 11.98 11.20 10.57	3.33 3.31 3.27 3.23	9.96 c 9.85 c 7.36 f 5.44 i	2.13 ab 1.87 de 1.79 ef 1.63 g
BINA moog5	30 40 50 60	29.4 g 36.2 f 44.1 de 52.0 c	47.5 48.5 54.5 56.5	2.00 1.80 1.40 1.00	3.95 h 4.52 g 5.80 ef 6.95 ab	19.5 c 18.6 c 16.2 de 14.2 ef	2.45 gh 2.45 gh 2.85 ef 4.00 a	11.18 11.30 11.07 10.63	3.72 3.70 3.60 3.52	8.11 e 7.65 f 6.46 h 5.28 i	1.51 h 2.02 c 1.93 d 1.71 fg
BINA moog6	30 40 50 60	24.0 h 30.0 g 37.0 f 46.0 d	37.5 38.6 41.2 42.6	1.45 1.35 0.95 0.50	2.50 j 2.85 i 3.10 i 3.91 h	14.3 ef 14.9 def 13.0 fg 11.7 g	2.00 i 2.00 i 2.20 hi 2.65 fg	10.75 10.68 10.42 10.17	4.91 4.88 4.79 4.57	5.28 i 7.74 ef 6.49 h 5.50 i	1.14 j 1.31 i 1.52 h 1.28 i
BINA moog7	30 40 50 60	36.1 f 45.1 de 56.0 b 66.2 a	52.2 53.2 56.9 58.1	3.70 3.50 3.00 2.75	5.57 f 6.53 cd 6.83 b 6.90 ab	28.9 a 28.0 a 23.7 b 18.6 c	2.70 fg 2.70 fg 3.40 cd 3.75 ab	11.95 11.78 11.33 11.05	3.51 3.50 3.45 3.37	12.1 a 11.5 b 9.25 d 6.90 g	2.22 a 2.04 bc 1.83 e 1.64 g
F-test	*	NS	NS	**	**	**	NS	NS	**	**	
CV (%)	6.01	4.21	9.16	3.71	6.80	7.90	3.37	2.10	3.58	4.66	

In a column, figures with same letter (s) or without letter do not differs significantly, whereas figures with dissimilar letter (s) do not differ significantly (as per DMRT)

be due to lesser amount of assimilate produced by the plants through lesser photosynthetic area plant⁻¹ and competition of nutrients uptake by the plants. Similar result was also reported by many workers (Tomar *et al.*, 1996; Chowdury, 1999; Hassan, 2000; Singh *et al.*, 2003). They observed that grain yield increased with increasing seed rate up to certain levels (25-40 kg ha⁻¹) and thereafter decreased. Wajid *et al.* (2004) showed that plant population had significant effect on yield components. The reduction of crop yield components by increasing plant population was due to greater inter-plant competition for incident light, soil nutrition and soil water in high plant density than low plant density. In case of BINA moog2 and BINA moog7, seed yield decreased gradually with each increment of seed rate up to the highest seed rate of 60 kg ha⁻¹, while in opposite, seed yield increased till 40 kg seeds ha⁻¹ and 50 kg seeds ha⁻¹ for BINA moog5 and BINA moog6, respectively and thereafter declined.

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