Effect of variety and sowing date on the growth and yield of summer mungbean (*Vigna radiata* L. Wilczek)

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Abstract: A field experiment was carried out at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh during the period from January to May 2010 to study the effect of sowing date on the performance of mungbean varieties. Four mungbean [*Vigna radiata* (L.) Wilczek] varieties viz. BINA moog2, BINA moog5, BINA moog6 and BINA moog7 were sown at 15-day intervals starting from 31 January to 2 March 2010 to identify the suitable variety and optimum sowing date for getting maximum yield. Among the varieties BINA moog7 was ranked first in terms of seed yield (1.85 t ha^{-1}) which was statistically similar to BINA moog6 (1.84 t ha^{-1}) followed by BINA moog5 (1.51 t ha^{-1}). BINA moog6 matured earlier than the other three varieties. The highest seed yield (1.77 t ha^{-1}) was obtained from 2 March sowing followed by 15 February (1.67 kg ha^{-1}) and 31 January sowing produced the lowest seed yield (1.44 kg ha^{-1}). BINA moog7 yielded the highest (1.95 kg ha^{-1}) when sown on 2 March which was statistically identical with BINA moog6 with 2 March (1.92 t ha^{-1}) and BINA moog7 sown in 15 February (1.92 t ha^{-1}). Therefore, summer mungbean varieties BINA moog7 or BINA moog6 may be sown during the period from 15 February to 2 March for obtaining higher seed yield.
Key words: Variety, sowing date, summer mungbean, growth and yield.

Introduction

Mungbean [*Vigna radiata* (L.) Wilczek)] is one of the important pulse crops, which contains high quality vegetable protein and satisfactory amounts of minerals and vitamins. Due to easy digestibility, better palatability and high market price, mungbean is the first choice to the farmers. The agro-ecological condition of Bangladesh is favorable for growing mungbean in the winter season although it is cultivated in both summer and winter seasons in many countries of the world (Bose, 1982). Recently, farmers are not much interested in growing pulse crops in winter season. Besides these, increasing area under wheat and irrigated *boro* rice cultivation has further reduced the area under pulses. Therefore, it has become imperative to shift the cultivation of some of the low yielding pulses from winter to summer seasons. The possibility of growing mungbean in the summer season in Bangladesh has been tried with some success (FAO, 1984). A good number of high yielding mungbean varieties are available now in Bangladesh but, farmers generally grow the local varieties using almost no fertilizer and they rarely maintain the proper sowing time. Moreover, farmers are loosing interest in producing mungbean due to low income per unit of resources invested. Therefore, attention should be given to increasing yield through selection of suitable varieties and adoption of improved cultural practices for establishing mungbean as a profitable crop.

For any yield improvement programme selection of superior parents is a prerequisite i.e., possessing better heritability and genetic advance for various traits (Ahmad *et al*., 2008). Sowing time, a non-monetary input, is the single most important factor to obtain optimum yield from mungbean (Samanta *et al*., 1999). So determination of optimum time of sowing for mungbean is inevitable. Optimum time of sowing of mungbean may vary from variety to variety and season to season due to variation in agroecological conditions. Therefore, there must be a specific sowing date, especially in the summer season for different varieties to obtain maximum yield. Delayed sowing after March and early sowing before February reduce yield of summer mungbean (Chovatia *et al*., 1993). February may be considered as the optimum time for summer mungbean and late planting after March may subject to rain damage during maturity period (Dharmalingam and Basu, 1993). The present investigation was, therefore, undertaken to identify the suitable variety (s) and sowing time of summer mungbean in Bangladesh context.

Materials and Methods

The experiment was carried out at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh, Bangladesh during January to May 2010 with four high yielding summer mungbean varieties viz. BINA moog2, BINA moog5, BINA moog6 and BINA moog7 sown at three different dates viz. 31 January, 15 February and 2 March. The experiment was laid out in a randomized complete block design with three replications. Each unit plot measured 2.5m × 2.0 m. The experimental site was located at 24º75′ north latitude and 90º50′ east longitude at an elevation of 18 m above the mean sea level. The soil of the experimental land belongs to the Sonatola seires of non-calcareous dark grey floodplain under Old Brahmaputra Floodplain "AEZ-9" (UNDP and FAO, 1988). The experimental plots were fertilized with urea, triple super phosphate (TSP) and muriate of potash (MoP) at the rate of 30, 80 and 55 kg ha^{-1} N, P_2O_5 and K_2O at the time of final land preparation at each sowing date. Seeds of all varieties were sown at the rate of 25 kg ha^{-1} in the line sowing method. A distance of 25 cm was maintained between rows and finally a plant to plant distance of 25 cm within a row was maintained by thinning the excess plants at 15 and 25 days after sowing. Weeding was done twice at 20 and 35 days after sowing followed by thinning, where necessary. The crops were grown under rainfed condition, therefore, no irrigation was applied. Malathion 57 EC was sprayed at the rate of 0.02% during the pre-flowering, pod setting and pod maturity stages to protect the crop against aphid (*Aphis* spp.) and pod borer (*Heliothis* spp.). Data on growth and yield components were taken from five randomly selected plants of each plot and grain and stover yields were taken from the whole plot. The recorded data were analyzed

statistically following the computer package MSTAT-C and means differences were adjudged by Duncan's Multiple Range Test (Gomez and Gomez, 1984).

Results and Discussion

Effect of variety on growth characters: Variety exerted significant effect on plant height and plant dry weight of mungbean at all sampling dates (Table 1). The tallest plant of 13.86 cm, 35.03 cm, 47.99 cm and 60.95 cm was obtained at 30, 40, 50 and 60 DAS, respectively from the variety Binamoog7 followed by Binamoog6. The smallest plant of 11.39, 30.07, 40.70 and 51.32 cm were found from Binamoog2. The highest plant weight of 0.85, 7.45, 13.05 and 18.64 g was recorded at 30, 40, 50 and 60 DAS, respectively from the variety Binamoog7 followed by Binamoog6. The minimum plant dry weight was of 0.22, 5.62, 11.04 and 16.45 g was obtained at 30, 40, 50 and 60 DAS, respectively from the variety Binamoog2. Plant height is a genetic character of a specific variety, therefore, it was differed among the varieties.

Table 1. Effect of variety and sowing date on growth characters of mungbean

Treatment	Plant height (cm)				Plant dry weight (g)			
	30 DAS	40 DAS	50 DAS	60 DAS	30 DAS	40 DAS	50 DAS	60 DAS
Variety								
BINA moog2	11.39c*	30.07c	40.70c	51.32b	0.22b	5.62d	11.04d	16.45d
BINA moog5	12.58b	31.15b	45.59b	60.03a	0.33b	6.15c	11.77c	17.39c
BINA moog6	12.86b	31.85b	46.22b	60.58a	0.75a	6.66b	12.38b	18.09b
BINA moog7	13.86a	35.03a	47.99a	60.95a	0.85a	7.45a	13.05a	18.64a
$S_{\bar{x}}$	0.12	0.24	0.35	0.69	0.04	0.08	0.08	0.13
Level of significance	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Sowing date								
31 January	12.24b	31.08c	43.93c	56.77b	0.32b	6.07c	11.73c	17.38b
15 February	12.43b	32.16b	45.11b	58.05b	0.40b	6.38b	12.08b	17.77a
2 March	13.35a	32.83a	46.34a	59.85a	0.90a	6.96a	12.37a	17.78a
$S_{\bar{x}}$	0.20	0.21	0.43	0.85	0.03	0.07	0.08	0.18
Level of significance	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

*In a column figures having common letter(s) do not differ significantly as per DMRT, NS= Not significant

Effect of date of sowing on growth characters: Plant height and plant dry weight were significantly affected by date of sowing (Table 1). The tallest plant of 13.35, 32.83, 46.34 and 59.85 cm was produced at 30, 40, 50 and 60 days after sowing (DAS), respectively from 2 March sowing. The smallest plant of 12.24, 31.08, 43.93 and 56.77 cm was produced at 30, 40, 50 and 60 DAS, respectively from 31 January sowing. The highest plant dry weight of 0.90, 6.96, 12.37 and 17.78 g was obtained from 2 March sowing and the lowest plant dry weight was observed from 31 January from all the sampling dates.

Effect of interaction of variety and date of sowing: Interaction effect between variety and sowing dates had significant effect on plant height at all sampling dates except 60 DAS (Table 2). The tallest plant of 15.24, 37.46, 50.60 and 63.74 cm was found at 30, 40, 50 and 60 DAS, respectively from the treatment combination of Binamoog7 × 2 March sowing. Plant dry weight was not significantly affected at all the sampling dates except 30 DAS. At 30 DAS, Binamoog7 × 2 March sowing treatment combination produced the highest plant dry weight (1.50 g). However, numerically the highest plant dry weight was observed in the treatment combination of Binamoog7 × 2 March sowing date at all sampling dates.

Effect of variety on yield and yield components: Variety had significant influence on the yield and yield contributing characters of mungbean (Table 3). The variety BINA moog7 ranked first in terms of seed yield (1.85 t ha^{-1}) which was statistically identical with that of BINA moog6. The highest plant dry weight at all the sampling dates, highest seeds $plant^{-1}$ and heaviest 1000-seed weight mostly contributed to the highest seed yield. The lowest seed yield was obtained with BINA moog2, which was the consequence of lowest number of mature pods $plant^{-1}$, lowest number of seeds $plant^{-1}$ and lowest seed weight $plant^{-1}$. BINA moog6 produced the second highest seed yield (1.67 t ha^{-1}) which was the outcome of length of pod, number of seeds pod^{-1} and 1000-seed weight. The differences in seed yield among the mungbean varieties might be due their genetic make up. This finding resembles to those obtained by Patil (2003), Mondal (2004), BINA (2006), BINA (2007) and Siddique *et al*. (2006).

Although the highest harvest index was recorded with the variety BINAmoog6, the highest stover yield and the highest biological yield were obtained from the variety BINA moog7. Variation in stover yield, biological yield and harvest index among mungbean varieties have been also reported by many researchers ((Tomar and Tiwari, 1996; Sarkar *et al*., 2004; BINA, 2007).

Effect of date of sowing on yield and yield components: Seed yield of mungbean was significantly affected by date of sowing. Crops planted on 2 March produced the highest seed yield (1.77 t ha^{-1}) followed by 15 February sowing (1.67 t ha^{-1}) (Table 3). The highest seed yield was obtained in 2 March might be due to higher performance of plant dry weight, number of pods $plant^{-1}$, number of seeds pod^{-1}, highest seed weight $plant^{-1}$ and heaviest 1000-seed weight. Sowing before 2 March decreased the seed yield (1.67 t ha^{-1}) and 31 January sowing produced the lowest grain yield ((1.44 t ha^{-1}). Similar research finding was also reported by Miah *et al*. (2009) who reported that early sowing before 2 March summer mungbean caused a substantial decrease in growth and yield of mungbean. The highest seed yield obtained from 2 March sowing might be due to suitable temperature prevailing accompanied by

higher soil moisture content due to sufficient rainfall in April, which enhanced the vegetative as well as reproductive growth of the crop. This findings closely resembles to those reported by Sinha *et al*. (1989), Poehlman (1991) and Miah *et al.* (2009) who opined that mungbean being a warm season plant produced higher yield at the optimum mean temperature range of 25-30°C. The lowest seed yield of 1.44 t ha^{-1} was recoded from 31 January sowing. Stover yield (2.70 t ha^{-1}) was the highest in 2 March sowing and the lowest stover yield (1.91 t ha^{-1}) was obtained in 31 January sowing. The highest biological yield (4.47 t ha^{-1}) was recorded in 2 March sowing and the lowest (3.36 t ha^{-1}) in 31 January although the highest harvest index (42.72%) was recorded in 31 January and 15 February sowing followed by 2 March sowing.

Table 2. Interaction effect variety and date of sowing on the growth character of mungbean

Date of sowing × Variety	Plant height (cm)				Plant dry weight (g)			
	30 DAS	40 DAS	50 DAS	60 DAS	30 DAS	40 DAS	50 DAS	60 DAS
Binamoog 2 × 31 January	10.80e*	29.27g	38.74e	48.21	0.19ef	5.27	10.86	16.45
Binamoog 5 × 31 January	12.33cd	30.84def	44.82c	58.79	0.18f	5.91	11.50	17.08
Binamoog 6 × 31 January	12.62bcd	31.67cde	46.19bc	60.71	0.40cde	6.33	12.12	17.91
Binamoog 7 × 31 January	13.21b	32.55c	45.96bc	59.36	0.50cd	6.78	12.43	18.08
Binamoog 2 × 15 February	11.37e	30.15fg	40.83d	51.50	0.18f	5.38	11.00	16.61
Binamoog 5 × 15 February	12.47cd	31.22c-f	45.58bc	59.94	0.30def	5.87	11.67	17.46
Binamoog 6 × 15 February	12.73bc	32.19cd	46.61bc	61.02	0.56c	6.67	12.55	18.43
Binamoog 7 × 15 February	13.13b	35.08b	47.42b	59.76	0.55c	7.60	13.09	18.58
Binamoog 2 × 2 March	12.00d	30.78ef	42.52d	54.26	0.28ef	6.20	11.25	16.30
Binamoog 5 × 2 March	12.93bc	31.40c-f	46.39bc	61.37	0.50cd	6.67	12.15	17.64
Binamoog 6 × 2 March	13.23b	31.70cde	45.86bc	60.02	1.30b	7.00	12.47	17.94
Binamoog 7 × 2 March	15.24a	37.46a	50.60a	63.74	1.50a	7.97	13.61	19.26
$S_{\bar{x}}$	0.21	0.42	0.60	1.20	0.07	0.14	0.15	0.23
Level of significance	0.01	0.01	0.01	NS	0.01	NS	NS	NS

*In a column figures having common letter(s) do not differ significantly as per DMRT, NS= Not significant

Table 3. Yield and yield contributing characters of summer mungbean as affected by variety and sowing date

Treatment	Mature pods plant^{-1}	Immature pods plant^{-1}	Length of pod (cm)	Seeds /pod	Seed weight plant^{-1}(g)	1000-seed weight (g)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
Variety										
BINA moog2	15.76	7.04	6.21a*	15.15b	24.57c	44.69b	1.31c	1.79d	3.10d	42.00a
BINA moog5	16.08	6.61	5.62c	16.13a	32.92b	46.38b	1.51b	2.13c	3.64c	41.89a
BINA moog6	16.41	5.83	6.04ab	15.78a	31.88b	48.37a	1.84a	2.48b	4.32b	42.86a
BINA moog7	17.41	5.65	5.82bc	15.74	36.2a	49.60a	1.85a	2.90a	4.75a	39.47b
$S_{\bar{x}}$	0.25	0.05	0.08	0.19	0.75	0.63	0.03	0.05	0.07	0.62
Level of sig.	NS	NS	**	**	**	**	**	**	**	**
Sowing date										
31 January	14.47	6.73	6.45a	14.09c	20.13c	42.85c	1.44c	1.91c	3.36c	42.72a
15 February	16.92	6.32	5.6b	15.85b	32.38b	48.21b	1.67b	2.36b	4.02b	41.96a
2 March	17.85	5.80	5.66b	17.17a	41.67a	50.73a	1.77a	2.70a	4.47a	39.39b
$S_{\bar{x}}$	0.21	0.05	0.07	0.17	0.65	0.55	0.03	0.04	0.06	0.53
Level of sign.	NS	NS	NS	0.01	0.01	0.01	0.01	0.01	0.01	0.01

*In a column figures having common letter(s) do not differ significantly as per DMRT, NS= Not significant

Interaction effect of variety and date of sowing on the yield and yield component of mungbean: Interaction effect of variety × sowing date exerted significant effect on all the yield and yield components except number of pods palnt^{-1}, mature pods palnt^{-1} and harvest index. In case of interaction the highest pod length (6.75 cm) was obtained from Binamoog7 × 31 January sowing date which was statistically similar with Binamoog6 × 31 January, BINA moog5 × 2 March sowing and BINA moog5 × 31 January. The highest number (18.47) of seeds pod^{-1} was recorded in BINA moog5 × 2 March sowing followed by BINA moog7 × 2 March sowing (17.13) and lowest one was observed in BINA moog5 × 31 January sowing. The highest seed weight plant^{-1} (48.43 g) was obtained from BINA moog5 × 2 March sowing which was statistically at par with BINA moog7 × 2 March sowing (44.84 g). The highest 1000-seed weight (51.65 g) was recorded in BINA moog7 × 2 March sowing which was statistically at par with BINA moog5 × 2 March sowing (51.37 g), BINA moog6 × 2 March sowing (50.02 g), BINA moog2 × 2 March sowing (49.87 g), BINA moog7 × 15 February sowing (48.68 g), BINA moog7 × 31 January sowing (48.46 g), BINA moog5 × 15 February sowing (48.40 g) and BINA moog2 × 15 February sowing (48.06 g). The lowest 1000-seed weight (36.13 g) was recorded from BINA moog2 × 31 January sowing (Table 4). The highest seed yield (1.95 t ha^{-1}) was recorded from BINA moog7 × 2 March sowing which was statistically identical with that of BINA moog6 × 2 March sowing (1.92 t ha^{-1}), BINA moog7 × 15 February sowing (1.92 t ha^{-1}) and BINA moog5 × 15 February sowing (1.88 t ha). Similar research finding was also reported by Maih et al. (2009). The lowest seed yield (1.07 t ha^{-1}) was obtained from BINA moog2 × 31 January sowing. The lowest seed yield

was attributed due to lowest number of seed weight plant^{-1} and lowest 1000-seed weight. The highest stover yield (3.43 t ha^{-1}) was obtained from the interaction of BINA moog7 × 2 March sowing and the lowest stover yield (1.58 t ha^{-1}) was recorded from BINA moog2 × 15 February sowing. The highest biological yield (5.38 t ha^{-1}) was recorded from BINA moog7 × 2 March sowing which was statistically identical (5.10 t ha^{-1}) with BINA moog7 × 15 February sowing. The lowest biological yield (2.65 t ha^{-1}) was recorded in BINA moog2× 15 February sowing.

Table 4. Interaction effect of variety and sowing date on yield and yield contributing characters of mungbean

Interaction (Variety× sowing date	Mature pods plant^{-1}	Immature pods plant^{-1}	Length of pod (cm)	Seeds/pod	Seed wt. plant^{-1} (g)	1000-seed wt. (g)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})	Bio. yield (t ha^{-1})	Harvest index (%)
Binamoog 2 × 31 January	13.93	7.41	6.11bc	14.36cd	14.69f	36.13d	1.07e	1.58f	2.65g	4041
Binamoog 5 × 31 January	13.89	7.00	6.33ab	13.82d	17.12f	3938c	1.30d	1.89de	3.19ef	40.87
Binamoog 6 × 31 January	13.97	6.38	6.62a	14.26cd	21.80e	47.42b	1.73bc	2.10d	3.83c	45.09
Binamoog 7 × 31 January	16.11	6.13	6.75a	13.92cd	26.93d	48.46ab	1.68c	2.08d	3.75cd	44.52
Binamoog 2 × 15 February	16.14	7.10	6.16bc	14.94c	25.72d	48.07ab	1.26d	1.75ef	3.01f	41.81
Binamoog 5 × 15 February	16.75	6.70	5.51de	16.10b	33.20c	48.40ab	1.60c	1.85de	3.45de	46.68
Binamoog 6 × 15 February	17.13	5.82	5.77cd	16.19b	33.70c	47.68b	1.88ab	2.65c	4.53b	41.68
Binamoog 7 × 15 February	17.65	5.67	5.19ef	16.16b	36.90bc	48.68ab	1.92a	3.18ab	5.10a	37.69
Binamoog 2 × 2 March	17.20	6.60	6.36ab	16.17b	33.30c	49.87ab	1.59c	2.05d	3.64cd	43.79
Binamoog 5 × 2 March	17.60	6.13	5.02f	18.47a	48.43a	51.37a	1.63c	2.65c	4.27b	38.13
Binamoog 6 × 2 March	18.13	5.30	5.73cd	16.91b	40.14b	50.02ab	1.92a	2.68c	4.60b	41.82
Binamoog 7 × 2 March	18.47	5.16	5.51de	17.13b	44.84a	51.65a	1.95a	3.43a	5.38a	36.20
$S_{\bar{x}}$	0.43	0.09	0.14	0.33	1.30	1.10	0.06	0.08	0.11	1.07
Level of significance	NS	NS	0.01	0.01	0.01	0.01	0.01	0.01	0.01	NS

*In a column figures having common letter(s) do not differ significantly as per DMRT, NS = Not significant

From the present study it may be concluded that summer mungbean varieties differed in their yield potential and sowing date had significant influence on the growth and yield. Among the four cultivars Binamoog7 was the best and 2 March was the optimum time of sowing to obtain higher yield. But BINA moog6 sowing in 2 March or BINA moog7 sowing in 15 February may be other options for obtaining higher yield since these combinations produced statistically identical yield with BINAmoog7 and 2 March sowing. Therefore, summer mungbean variety BINA moog7 and BINA moog6 may be sown during the period from 15 February to 2 March for obtaining higher seed yield. BINA moog6 with 2 March (1.92 t ha^{-1}) and BINA moog7 with 15 Feb. (1.92 t ha^{-1}).

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