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VARIATION IN MORPHO-PHYSIOLOGICAL CHARACTERS AND YIELD COMPONENTS OF SUMMER MUNGBEAN (V*IGNA RADIATA* (L.) WILCZEK) VARIETIES

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Abstract

Twelve modern summer mungbean cultivars were evaluated to assess morpho-physiological characters, yield attributes and seed yield. Results revealed that high yielding cultivars, in general, showed superiority in morpho-physiological characters and seed yield/plant than the low yielding cultivars. However, in case of unit area basis, result revealed that seed yield/ha was greater in low yielding cultivars than the high yielding ones, yet they produced lower seed yield/plant compared to high yielding ones due to increase number of plants per unit area and these low yielding cultivars also matured 10 - 15 days earlier than high yielders. Among the cultivars, BINAmung-5 produced the highest seed yield/ha (1711 kg/ha) with lower HI (20.0%) and took longer days to maturity (69 days). On the other hand, BARImung-6 showed second highest seed yield (1697 kg/ha) with highest HI (32.6%) and matured earliest, took 60 days after sowing that might be fit the existing cropping pattern in Bangladesh.

The principal constraint of mungbean [V*igna radiata* (L.) Wilczek] production is its low yield potential. Most of the flowers (70 - 95%) of mungbean do not develop into mature pods (Fakir *et al.* 2011) indicating that potential fruit or seed number is usually much larger than the number actually produced by the plant community. The number of fruits increases after growth stage R1 (Fruit setting stage) and reaches a maximum after growth stage R5 (Seed growth stages) (Mondal *et al.* 2011a) but during this period the plant is still growing vegetatively. Therefore, developing reproductive sinks are competing for assimilates with vegetative sinks.

Important physiological attributes such as leaf area index (LAI), crop growth rate (CGR), net assimilation rate (NAR) and specific leaf weight (SLW) can address various constraints of a variety for increasing its productivity (Pandey *et al.* 1978). A plant with optimum LAI and NAR may produce higher biological yield. The capability of efficient partitioning between the vegetative and reproductive parts may produce high economic yield (Mondal *et al.* 2011b). The dry matter accumulation may be the highest if the LAI attains its maximum value within the shortest possible time (Mondal *et al.* 2011c).

In Bangladesh, Bangladesh Agricultural Research Institute (BARI) and Bangladesh Institute of Nuclear Agriculture (BINA), and Bangabundhu Sheikh Mazibur Rahman Agricultural University (BSMRAU) have developed a couple of varieties of summer mungbean, which are high yielding compared to local landrace. These varieties need to be assessed for their physiological growth and morphological maneuvering to select better one. Hence, the present research work has been designed to study morpho-physiological parameters, reproductive characters and other yield attributes responsible for higher seed yield in 12 summer mungbean varieties to select best one for countrywide cultivation.

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Six field experiments were performed at different agro-ecological zones of Bangladesh such as Mymensingh, Magura, Chuadanga, Pabna, Natore and Rangpur districts in Kharif-I (February-May) season of 2009. Released twelve mungbean varieties were used as planting material. The name of the varieties is presented in Table 1. Seeds were sown between 05 and 17 March, 2009. A randomized complete block design with three replicates was followed. A unit plot size of 3 m × 3 m with plant spacing of 30 cm × 10 cm or 25 cm × 10 cm (depending on variety) was used at all the locations. Recommended intercultural practices such as fertilization, weeding, thinning and application of pesticides were followed for proper growth and development of the plants.

The morpho-physiological parameters, yield components and seed yield/plant were recorded at Mymensingh and seed yield/plot data were recorded at all locations and converted into tons/ha. To study ontogenetic growth characteristics, a total of five harvests were made. The first crop sampling was done at 25 days after sowing (DAS) and continued at an interval of ten days up to 65 DAS i.e. till attaining physiological maturity of some varieties. From each sampling, five plants were randomly selected from second and third rows of each plot and uprooted for collecting necessary parameters. The plants were separated into roots, stems, leaves and pods, and the corresponding dry weight were recorded after oven drying at 80 ± 2^0C for 72 hrs. The leaf area of each sample was measured by automatic leaf area meter (Model: LICOR 3000, USA). The growth analysis like absolute growth rate was carried out following the formulae of Hunt (1978). The yield contributing characters were recorded at harvest from ten competitive plants of each plot. The seed yield was recorded from five rows of each plot (1.50 m × 3.0 m) and converted into seed yield/hectare and seed weight/plant was determined by dividing the plant number. Harvest index was calculated from the collected data using formula: (economic yield/plot ÷ biological yield/plot) × 100. The collected data were analyzed statistically by using computer package programme, MSTAT-C.

Table 1. Leaf area development at different growth stages in 12 summer mungbean varieties.

Varieties	Leaf area/plant (cm^2)				
	25 DAS	35 DAS	45 DAS	55 DAS	65 DAS
BARImung-2	64.1 c	479 bc	748 d	1212 c	1388 d
BARImung-3	42.0 f	546 a	619 e	841 d	895 e
BARImung-4	72.3 b	473 c	937 b	1753 a	2128 a
BARImung-5	49.2 e	372 d	538 fg	628 f	572 f
BARImung-6	49.0 e	277 e	494 g	623 f	580 f
BINAmung-2	95.0 a	498 bc	999 ab	1243 c	2063 a
BINAmung-5	92.4 a	521 ab	850 c	1216 c	1028 e
BINAmung-6	67.4 bc	379 d	586 ef	683 ef	580 f
BINAmung-7	56.6 d	346 d	1013 a	1472 b	1570 c
BUmung-1	51.9 de	266 e	689 d	1397 b	1840 b
BUmung-2	53.2 de	282 e	592 ef	780 de	662 f
BUmung-4	68.8 bc	345 d	493 g	608 f	613 f
F-test	**	**	**	**	**
CV (%)	4.79	6.38	5.51	6.72	8.82

In a column, means followed by same letter(s) do not differ significantly at 5% level by DMRT.
**Significant at 1% level of probability.

The leaf area (LA), total dry matter (TDM) production and absolute growth rate (AGR) of summer mungbean cultivars were differed significantly at all growth stages (Tables 1, 2). The LA increased with age till 55 DAS followed by a decline at physiological maturity (65 DAS) in six varieties (BARImung-5, BARImung-6, BINAmung-5, BINAmung-6, BUmung-2 and BUmung-4) out of twelve due to leaf shedding (Table 1). The other six cultivars, BARImung-2, BARImung-3, BARImung-4, BARImung-6, BINAmung-2, BINAmung-7 and BUmung-1 showed increasing trend in LA till 65 DAS because of they were then at flowering and pod development stages. It is noted that BARImung-2, BARImung-4, BINAmung-2, BINAmung-5, BINAmung-7 and BUmung-1 matured nearly 72-75 DAS where as other six cultivars (BARImung-3, BARImung-5, BARImung-6, BINAmung-6, BUmung-2 and BUmung-4) matured at 60-65 DAS (Table 4). The cultivars BARImung-4, BINAmung-2, BINAmung-7 and BUmung-1 showed superiority in LA at later growth stages compared to other eight cultivars. In contrast, BARImung-5, BARImung-6, BINAmung-6, BUmung-2 and BUmung-4 showed inferiority in case of LA over its growth period and also matured 10-15 days earlier than the remainder.

Table 2. Total dry mass production and absolute growth rate at different growth stages in 12 summer mungbean varieties

Varieties	Total dry mass/plant (g)					Absolute growth rate (mg/plant/day)			
	25 DAS	35 DAS	45 DAS	55 DAS	65 DAS	25-35 DAS	35-45 DAS	45-55 DAS	55-65 DAS
BARImung-2	0.57d	3.78 bc	10.9a	22.72a	27.29 c	321b	683a	711de	857 d
BARImung-3	0.41h	4.34a	8.77cde	14.62de	23.82 d	376a	393f	685e	1020 c
BARImung-4	0.62cd	4.14 ab	9.34c	18.65b	32.63 a	413a	420def	1031a	1398a
BARImung-5	0.51e	3.24 de	7.05g	10.99gh	11.20 g	273bc	281g	294i	221 g
BARImung-6	0.46e-h	2.92ef	5.64i	10.80 h	15.78 f	206d	312g	416h	598 e
BINAmung-2	0.77a	3.61cd	8.44def	16.97bc	30.63ab	284 bc	483c	853b	1366a
BINAmung-5	0.71 b	3.30 de	7.92 f	17.84 b	20.40e	259c	462cd	592 f	656 e
BINAmung-6	0.64 c	3.23 de	10.1 b	13.37de	15.52f	259c	388f	426 h	415 f
BINAmung-7	0.50 ef	2.58 fg	7.98 ef	15.63cd	28.42bc	208d	540b	765 c	1279 b
BUmung-1	0.44 gh	2.41 g	6.11 hi	13.52def	27.98bc	167d	400ef	741cd	1445 a
BUmung-2	0.48efg	2.43 g	6.53gh	12.31fgh	16.97 f	195d	378f	410 h	666 e
BUmung-4	0.45fgh	3.57 cd	8.99 cd	13.13efg	14.52 f	312 b	442cde	514 g	239 g
F-test	**	**	**	**	**	**	**	**	**
CV (%)	5.64	6.56	5.54	8.20	7.95	9.71	5.75	4.38	6.94

In a column, means followed by same letter (s) do not differ significantly at 5% level by DMRT.
*Significant at 1% level of probability; DAS = Days after sowing

TDM was slowly increased up to 35 DAS in all the varieties and thereafter increased rapidly up to maturity (Table 2). Result revealed that high LA bearing cultivars produced higher TDM than low LA bearing cultivars. These results indicate that TDM depend on LA in mungbean. The result is consistent with Mondal *et al.* (2011c) who reported that high TDM accumulation was the result of increase LA in mungbean. The AGR increased with age till 55 DAS in three cultivars, BARImung-5, BINAmung-6 and BUmung-4 followed by a decline where as other nine cultivars, the AGR increased with age till 65 DAS (Table 2). However, high TDM producing cultivars showed high AGR than low TDM producing ones.

Pod number, the most important yield attribute, showed significant differences among the varieties (Table 3). Results revealed that bold seeded cultivars produced fewer numbers of pods/plant as well as seed yield/plant. BARImung-2, BARImung-3, BINAmung-2, BINAmung-7 and BUmung-1 are the small seeded cultivars, produced higher number of pods/plant (range 25.0-33.2) and also showed higher seed yield/plant (range 6.02-6.94 g) except BARImung-4. This result is consistent with Singh *et al.* (2008) who reported that seed yield had negatively correlated with seed size in mungbean. Harvest index was greater in low yielding cultivars than high yielding ones indicating assimilates partition to economic yield is better in low yielding ones than high yielders.

Table 3. Some yield contributing characters and yield in twelve mungbean varieties.

Varieties	Pods/ plant (no.)	Pod length (cm)	Seeds/ pod (no.)	Single pod weight (mg)	1000-seed weight (g)	Seed yield/ plant (g)	Harvest index (%)
BARImung-2	26.6 b	6.92 ef	10.37abc	403 g	31.9 e	6.94 a	18.8 cd
BARImung-3	28.6 b	6.74 fg	10.12 bc	464 f	37.5 d	6.00 bc	31.8 a
BARImung-4	25.4 b	7.04 e	10.19 abc	445 f	33.9 e	5.33 de	14.3 e
BARImung-5	16.1 cd	8.40cd	10.40 abc	665 d	50.4 b	5.10 ef	28.4 b
BARImung-6	13.7 d	8.98 a	10.50 abc	843 a	55.4 a	4.68 cd	32.6 a
BINAmung-2	33.2 a	6.27 h	10.22 abc	323 h	27.0 f	6.02 ef	16.2 de
BINAmung-5	18.3 c	8.23 d	10.21 abc	563 e	43.8 c	6.23 b	20.0 c
BINAmung-6	16.4 cd	8.72 b	10.60 a	788 b	52.8ab	5.25 de	26.9 b
BINAmung-7	32.4 a	6.59 g	10.10 bc	381 g	33.3 e	6.50 ab	21.3 c
BUmung-1	25.0 b	7.12 e	10.57 ab	400 g	34.2 e	5.17def	16.0 de
BUmung-2	14.8cd	8.47bcd	10.50 abc	650 d	50.0 b	4.68 f	32.4 a
BUmung-4	13.8 d	8.65 bc	10.09 c	703 c	50.6 b	5.00 ef	27.0 b
F test	**	**	**	**	**	**	**
CV (%)	9.98	2.00	2.35	2.85	3.85	5.11	7.16

In a column, means followed by same letter(s) do not differ significantly at 5% level by DMRT.
**Significant at 1% level of probability

In case of unit area basis, result revealed that seed yield/ha was greater in low yielding varieties than high yielding ones (except BINAmung-7) at all locations (Table 4) might be due to increase number of plants accommodation per unit area for closer plant spacing (25 cm × 10 cm). It is possible because of low yielding varieties had lower canopy area than high yielding ones (Table 1). On the other hand, high yielding varieties had higher yield/plant but showed medium seed yield per hectare due to lower number of plants per unit area because of its bushy stature (Table 1). The highest seed yield/ha was recorded in BINAmung-5 (1758 kg/ha) followed by BARImung-6 (1707 kg/ha) with same statistical rank. In contrast, the lowest seed yield/ha was recorded in BUmung-4 (1444 kg/ha).

It may be concluded that high yielding cultivars have higher leaf area as well as TDM and AGR which resulted higher number of pods/plant than the low yielders in mungbean. Though low yielding cultivars showed lower yield/plant but produced higher seed yield per hectare and also matured 10 - 15 days earlier compared to high yielding ones.

Table 4. Days to maturity and seed yield over six locations of 12 mungbean varieties conducted during Kharif-I season, 2009.

Varieties	Days to maturity	Seed yield (kg/ha)						
		Locations						
		Mymen-singh	Magura	Chua-danga	Ishurdi	Natore	Rangpur	Mean over locations
BARImung-2	74.3 a	1562 de	1543 c	1583 a	1803 d	2067 c	1306 c	1644 b
BARImung-3	66.7 cd	1701 b	1595 ab	1567 a	1921 bc	2089 c	1139 f	1669 ab
BARImung-4	75.0 a	1199 h	1217 e	1305 d	1912 bc	2278 b	1262 cd	1529 cd
BARImung-5	61.0 e	1529de	1450 d	1461 b	1870 bc	2078 c	1367 b	1626 c
BARImung-6	59.7 e	1703 c	1450 d	1517 ab	1874 bc	2433 ab	1262 c	1707 a
BINAmung-2	74.7 a	1131 h	1207 e	1139 e	1847 c	2017 c	1322 bc	1444 d
BINAmung-5	68.7 bc	1869 a	1562 ab	1528 ab	1971 b	2267 b	1355 b	1758 a
BINAmung-6	61.0 e	1575 d	1647 a	1417 c	1744 d	2100 c	1300 c	1631 c
BINAmung-7	71.7 ab	1471 f	1573 ab	1156 e	1716 d	2594 a	1539 a	1675 ab
BUmung-1	73.3 a	1163 h	1605 ab	1461 b	2087 a	2155 c	1233 de	1617 c
BUmung-2	63.3 d	1403 g	1583 a	1417 c	1555 e	1878 d	1200 e	1506 d
BUmung-4	60.7 e	1501 ef	1390 d	1333 d	1632 e	1822 d	1089 f	1461 d
F-test	**	**	**	**	**	**	**	**
CV (%)	3.52	2.60	5.16	3.33	8.22	10.24	5.66	5.18

In a column, means followed by same letter (s) do not differ significantly at 5% level by DMRT.
**Significant at 1% level of probability.

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