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GROWTH ANALYSIS, NITROGEN ASSIMILATION AND YIELD OF MUNGBEAN GENOTYPES

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ABSTRACT

Akter SE, Islam MT, Rahman MS, Khatoon M (2022) Growth analysis, nitrogen assimilation and yield of mungbean genotypes. *Int. J. Sustain. Crop Prod.* 17(2), 20-23.

Mutants are the sources of variation and new varieties. The experiments were carried out with four mungbean genotypes *viz*. Binamoog-11, Binamoog-8, MI-12 and MM-8 BINA sub-stations Ishwardi and Magura from March to May, 2022 to find out genotype with high yield and other desirable traits. The experiments were laid out following a randomized block design with three replications. Nitrate reductase activity of all the mungbean genotypes was higher at 50 DAS than 35 days. Binamoog-11 and MI-12 showed higher nitrate reductase activity whereas Binamoog-11 and Binamoog-8 had higher chlorophyll content, absolute growth rate and net assimilation rate. MM-8 and Binamoog-8 showed higher relative growth rate. The highest leaf area plant^{-1} was produced in MM-8 and the highest total dry matter plant^{-1} in Binamoog-11. Crop duration was lower in Binamoog-11 (64.12 days) and higher in MM-8 (71.94 days). The highest seed yield was produced by Binamoog-11 (2.01 tha^{-1}) followed by MM-8 (1.92 tha^{-1}).

Key words: *mungbean, CGR, RGR, NAR, chlorophyll, NR, yield*

INTRODUCTION

Mungbean (*Vigna radiata* L. Wilczek) is one of the most important crops of global economic importance. The raw and mature seeds are rich in nutrients including carbohydrates, protein, fibers, minerals, antioxidants like flavonoids (Quercetin-3-Oglucoside), and phenolics (Guo *et al*. 2012). lt contains 59.9% carbohydrate, 24.5% protein and 1.2% fat (Kaul 1982). In addition to being the prime source of human food and animal feed, it plays an important role in maintaining the soil fertility by enhancing the soil physical properties and fixing atmospheric nitrogen (Naik *et al*. 2020). Despite being an economically important crop, overall production of mungbean is low (838 kg ha^{-1}) (BBS 2021) due to abiotic and biotic stresses (Islam 2022; Bangar *et al*. 2018 and Islam *et al*. 2006). Mungbean yield is predetermined by the potential of a given variety and the environment especially drought and temperature stress. Drought is a multidimensional complex stress, simultaneously disturbing the physiological, morphological, biochemical, and molecular states which control the growth and quality of the crop and ultimately crop productivity (Basu *et al*. 2016). This situation has been aggravated worldwide as drought-stressed areas are expanding rapidly due to uneven rainfall, limited water sources, and other rapid and drastic changes in global environmental conditions (Fahad *et al*. 2017). Pulse crops are generally cultivated during the dry season, when water deficit or unavailability of soil moisture is a common occurrence (Islam and Razzaque, 2007 and Islam *et al*. 2005). Soil moisture is an essential requirement which regulates physiological growth processes and yield of plants. In Bangladesh, summer mungbean is generally cultivated in March-May and high temperature (34-38^{o}C) often affects its growth and yield. Optimum temperature for potential yield of mungbean lies between 28-30^{o}C (Poehlman l99l). High temperature (36^{o}C) at pre-flowering and flowering stages decreases photosynthetic rate, biomass and yield in mungbean (Islam 2018 and Islam 2015). Increases in temperature resulted in changes in the fluorescence parameters on photochemical quenching (qN) and photochemical quenching (qP) in two varieties of beans, but to a different extent (Pastenes and Horton, 1996). However, mungbean varieties respond variably to drought stress depending on stress duration, growth stage, and variety of the crop. Mungbean has raceme type of inflorescence with asynchronous flowering. The number of fruits with developing seeds increases after fruit setting stage and reaches to maximum seed growth stage but during this period the plant is still growing vegetative. Therefore, developing reproductive sinks are competing for assimilates with vegetative sinks. Number of fruits and seeds is related with photosynthetic rate that determines through leaf area and dry matter production (Islam and Razzaque, 2010). Per cent solar radiation interception and rate of dry matter production increased with leaf area development (Hamid *et al*. 1990). Amelioration of drought and temperature stress environments through management practices like irrigation, mulching etc. are costly involvement and sometimes quite impossible for the poor economic conditions of the farmers. The best alternative is thus screening of cultivars in different locations for desirable traits. So, the present experiment was undertaken to evaluate some mungbean genotypes with a view to find out location specific high yielding genotype having desirable traits.

MATERIALS AND METHODS

Two experiments were conducted at BINA sub-stations Ishwardi and Magura from March-May, 2022. Two mutants (MM-8 and MI-12) and two varieties (Binamoog-8 and Binamoog-11) were used as planting material. The mungbean mutants were developed in the project “Developing plant ideotype of lentil, mungbean, sesame and tomato for high yield, quality and stress tolerance under changing climate” of Crop Physiology Division, BINA, Mymensingh.

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The experiments were laid out in a Randomized Complete Block Design with three replications. The unit plot size was 3m × 4m. Recommended dose of fertilizers was applied and other cultural practices were followed as and when required. Five plants were selected randomly at 35 and 50 days after sowing (DAS) and data on SPAD value, nitrate reductase activity and total dry matter plant^{-1} were recorded. Nitrate reductase (NRase) was estimated according to the method of Smarrelli and Campbell (1983). AGR (Absolute growth rate), RGR (Relative growth rate) and NAR (Relative growth rate) were calculated using the following formulae of Radford (1967).

$$AGR = \frac{(W_2 - W_1)}{(t_2 - t_1)}$$

Where, W_1 and W_2 are whole plant dry weight at time $t_1 - t_2$ respectively

Relative Growth Rate (RGR) was calculated by the following formula was coined by (Radford 1967).

$$RGR = \frac{\log_e W_2 - \log_e W_1}{t_2 - t_1}$$

Where, W_1 and W_2 are whole plant dry weight at t_1 and t_2 respectively

t_1 and t_2 are time interval in days

$$NAR = \frac{(W_2 - W_1)(\log_e LA_2 - \log_e LA_1)}{(t_2 - t_1)(LA_2 - LA_1)}$$

Where, W_1 = dry weight per unit area at t_1, W_2 = dry weight per unit area at t_2, LA_1 = leaf area at t_1, LA_2 = leaf area at t_2, t_1= first sampling, t_2 =second sampling, Unit: g m^{-2} week^{-1} or g m^{-2} day^{-1}.

Leaf area growth determines the light interception capacity of a crop. It was measured by portable leaf area meter. At maturity five plants were selected randomly from each plot and yield contributing characters were recorded. The data were statistically analyzed following MSTAT-C package and the mean differences were compared by Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Nitrate reductase activity and SPAD (Chlorophyll) data at 35 and 50 DAS are shown in Table 1. In Ishwardi, nitrate reductase activity of all the mungbean genotypes was higher at 50 DAS than 35 days. This means plants convert more NO_3 to NO_2 at maturity stage. The highest nitrate reductase activity was found in Binamoog-11 at 35 and 50 DAS at Ishwardi. At Magura MI-12 and Binamoog-8 showed the highest nitrate reductase activity at 35 and 50 DAS respectively. The lentil genotypes significantly varied in chorophyll content at 35 and 50 DAS. Binamoog-11 showed the highest chlorophyll content at 35 and 50 DAS. Here Binamoog-11, MI-12 showed higher nitrate reductase activity at Ishwardi and at Magura was MI-12 and Binamoog-8. MM-8 and Binamoog-11 showed higher chlorophyll content (SPAD) in leaves. The results agree with Rahman and Islam *et al*. 2004.

Table 1. Nitrate reductase activity and total chlorophyll content in leaves of four mungbean genotypes grown at BINA sub-stations Ishwardi and Magura during 2021-22

Genotypes	NRA (μmolNO_2 g^{-1} fwh^{-1})		SPAD reading (Chlorophyll)	
	BINA sub-station Ishwardi			
	35 DAS	50 DAS	35 DAS	50 DAS
Binamoog-11	0.0733a	0.1177a	47.14a	50.15a
Binamoog-8	0.0473c	0.0880c	43.65b	46.43b
MI-12	0.0757a	0.0977b	38.93c	41.42c
MM-8	0.0647b	0.0950b	47.59a	50.62a
CV (%)	2.09	1.49	1.31	1.31
	BINA sub-station Magura			
	35 DAS	50 DAS	35 DAS	50 DAS
Binamoog-11	0.0580d	0.0931c	47.13c	51.34a
Binamoog-8	0.0623c	0.1159a	52.81b	48.42b
MI-12	0.0823a	0.1063b	48.99c	47.07b
MM-8	0.0650b	0.0955c	56.93a	47.55b
CV (%)	1.85	2.72	2.38	2.26

Values having common letter(s) in a column do not differ significantly at 5% level as per DMRT.

AGR, RGR, NAR, leaf area and total dry matter plant^{-1} are shown in Table 2. AGR was higher in Binamoog-11 followed by MI-12 and MM-8 at Ishwardi and Binamoog-11 and Binamoog-8 at Magura. AGR is the simplest index of plant growth; a rate of change in size, an increment in size per unit time. Most commonly applied to total dry weight or total leaf area per plant (g day^{-1}). At later stage due to mutual shading, aging and falling leaves, absolute growth rate is drastically reduced. RGR was higher in MM-8 at Ishwardi and Binamoog-8 at

Magura. RGR, the growth rate in terms of the size increase per unit time is expressed. Decreasing the RGR of plants during the growing season due to increased structure tissue is metabolically active tissue of the structure. Also shading leaves and lower leaves age also affects the size of the loss. NAR was higher in Binamoog-11 at Ishwardi and Binamoog-8 at Magura. NAR is the net gain of assimilate per unit of leaf area and time. The highest leaf area plant^{-1} was observed in MM-8 at both locations. At 50 DAS Binamoog-11 showed the highest total dry matter plant^{-1} in both the locations.

Table 2. Absolute growth rate (AGR), Relative growth rate (RGR), Net assimilation rate, leaf area and total dry matter of four mungbean genotypes at BINA sub-stations Ishwardi and Magura

Genotypes	AGR (35-50 DAS) (g day^{-1})	RGR (35-50 DAS) (g g^{-1} day^{-1})	NAR (35-50 DAS) (mg cm^{-2} day^{-1})	Leaf area plant^{-1} (cm^2)		Total dry matter plant^{-1} (g)	
				35 DAS	35 DAS	35 DAS	50 DAS
			BINA sub-station Ishwardi				
Binamoog-11	0.3712a	0.0575b	1.16a	104.67d	179.43d	0.89a	6.45a
Binamoog-8	0.3084c	0.0567b	0.81d	124.29b	213.06b	0.76c	5.39d
MI-12	0.3324b	0.0564b	0.95b	114.70c	196.63c	0.83b	5.81b
MM-8	0.3310b	0.0620a	0.84c	129.54a	222.07a	0.66d	5.63c
CV (%)	1.18	1.67	1.20	0.09	0.09	2.92	0.72
			BINA sub-station Magura				
Binamoog-11	0.4615a	0.0488b	0.44b	375.12b	535.88b	1.58b	8.50a
Binamoog-8	0.4869a	0.0550a	0.50a	348.95c	498.50c	1.29d	8.59a
MI-12	0.3692b	0.0376d	0.46b	292.55d	417.92d	2.07a	7.61b
MM-8	0.3826b	0.0457c	0.30c	459.25a	656.07a	1.49c	7.23b
CV (%)	3.20	2.16	3.83	0.15	0.15	1.84	2.47

Values having common letter(s) in a column do not differ significantly at 5% level as per DMRT.

At BINA Sub-station Ishwardi, plant height had no significant difference among the genotypes. Binamoog-8 produced the highest branches plant^{-1} (1.08) among the genotypes. Binamoog-8 produced the highest pods plant^{-1} (16.35) followed by Binamoog-11 (12.85). Binamoog-11 (7.50) produced the longest pod followed MI-12 (7.33). The seeds plant^{-1} had no significant difference among the genotypes. The highest 1000-seed weight was found in Binamoog-11 (32.74 g) and lowest in Binamoog-8 (31.37 g). Crop duration was lower in Binamoog-11 (64.27 days) and higher in MM-8 (71.63 days). The highest seed yield was produced by MM-8 (2.00 tha^{-1}) followed by Binamoog-11 (1.92 tha^{-1}). At BINA Sub-station Magura, Binamoog-8 produced the longest plant. MM-8 produced the highest number of branches plant^{-1} (2.27). Binamoog-8 produced the highest number of pods plant^{-1} (21.20) followed by Binamoog-11 (16.40). MI-12 (8.31) produced the longest pod followed Binamoog-11 (8.06). Number of seeds plant^{-1} and 1000-seed weight had no significant difference among the genotypes. Crop duration was lower in Binamoog-11 (64.12 days) and higher in MM-8 (71.94 days). The highest seed yield was produced by Binamoog-11 (2.01 tha^{-1}) followed by MM-8 (1.92 tha^{-1}). The results agree with Islam and Rahman 2022.

Table 3. Morphological attributes and yield of four mungbean genotypes at BINA sub-station Ishwardi

Genotypes	Plant height (cm)	Branches plant^{-1} (no.)	Pods plant^{-1} (no.)	Pod length (cm)	Seeds pod^{-1} (no.)	1000-seed wt. (g)	Days to maturity	Seed yield (tha^{-1})
Binamoog-11	37.33a	0.70b	12.85b	7.50a	10.13a	32.74a	64.27d	1.92b
Binamoog-8	40.70a	1.08a	16.35a	6.59b	10.69a	31.37b	65.28c	1.87c
MI-12	39.27a	0.76b	12.08bc	7.33a	10.07a	32.13ab	66.45b	1.54d
MM-8	38.40a	0.74b	11.23c	6.07c	9.67a	32.59ab	71.63a	2.00a
CV (%)	7.00	12.91	4.77	2.63	5.69	1.94	0.53	0.49

Values having common letter(s) in a column do not differ significantly at 5% level as per DMRT.

Table 4. Morphological attributes and yield of four mungbean genotypes at BINA sub-station Magura

Genotypes	Plant height (cm)	Branches plant^{-1} (no.)	Pods plant^{-1} (no.)	Pod length (cm)	Seeds pod^{-1} (no.)	1000-seed wt. (g)	Days to maturity	Seed yield (tha^{-1})
Binamoog-11	39.13b	1.40b	16.40b	8.06a	12.20a	32.53a	64.12c	2.01a
Binamoog-8	42.07a	2.33a	21.20a	6.35b	11.73a	32.20a	64.96c	1.81b
MI-12	39.60b	0.93c	13.93c	8.31a	11.27a	32.97a	66.74b	1.85ab
MM-8	41.88a	2.27a	15.73bc	6.44b	12.07a	32.60a	71.94a	1.92ab
CV (%)	1.88	9.22	5.85	4.18	5.07	2.36	0.76	4.49

Values having common letter(s) in a column do not differ significantly at 5% level as per DMRT.

CONCLUSION

Nitrate reductase activity of all the mungbean genotypes was higher at 50 DAS than 35 days. Binamoog-11 and MI-12 showed higher nitrate reductase activity whereas Binamoog-11 and Binamoog-8 had higher chlorophyll content, absolute growth rate and net assimilation rate. MM-8 and Binamoog-8 showed higher relative growth rate. The highest leaf area plant^{-1} was produced in MM-8 and the highest total dry matter plant^{-1} in Binamoog-11. Crop duration was lower in Binamoog-11 (64.12 days) and higher in MM-8 (71.94 days). The highest seed yield was produced by Binamoog-11 (2.01 tha^{-1}) followed by MM-8 (1.92 tha^{-1}).

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