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COMPARATIVE ADAPTABLE AGRONOMIC TRAITS OF BLACKGRAM AND MUNGBEAN FOR SALINE LANDS

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Abstract

Blackgram, variety BARI Mash-1 and mungbean variety BARI Mung-5 were tested under five salinity levels (0, 30, 60, 90 and 120 mM NaCl) in a shade house at Agronomy research field of Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur, Bangladesh during 2014 to investigate the comparative agronomic traits of black gram and mungbean as influenced by salt stress. In both crops, salinity stress remarkably reduced the morphological characteristics *viz* plant height, number of branches per plant and yield attributed traits such as total pods per plant, pod length, grains per pod, 100-grain weight as well as grain yield and stover yield per plant. Under all salinity levels, black gram produced the lower reduction of number of grains per pod than mungbean. Althrough, mungbean produced the higher 100-grain weight than in black gram in control treatment but the reduction was finally more in mungbean than black gram due to salt stresses. Black gram and mungbean showed 36.71% and 49.45% reduction of 100-grain weight, respectively under 90 mM NaCl salt stress. The grain yield per plant highly hampered in mungbean (97.62% to control) while black gram showed about 86.75% reduction under high salt stress (120 mM NaCl). Blackgram may be considered more salt tolerant than mungbean byenvising all of the above parameters.

Key words : Morphological characteristics, blackgram, mungbean, salinity.

Introduction

Pulses play an important role to meet up the demand of protein for human and livestock. The cheapest source of protein are the pulses that can be considered as the peasant's meat. The minimum intake of pulse by a human should be 50 g per day whereas, it is only 14.30 g in Bangladesh (BBS, 2013).

In Bangladesh, blackgram (*Vigna mungo* L.) is an important grain legumes among pulses. It is widely cultivated in the worldwide for its' high protein in seeds. It contributes in the reinforcement and prevention of soil erosion through enhancing soil N fixation capacity. Mungbean (*Vigna radiata* L. Wilczek) is an important leguminous crop mainly cultivated in tropical, subtropical and temperate zones of Asia including Bangladesh, India, Pakistan, Myanmar, Indonesia, Philippines, Sri Lanka, Nepal, China, Korea and Japan (Rahim *et al*., 2010). It contains minerals, proteins and also serves as a food filler, resistant starch and dietary fiber. The total mungbean cultivated area of Bangladesh is 205700 ha that produced 225500 tons mungbean in 2015-16 (AIS, 2017).

The reduction of arable lands productivity due to salinity is one of the major constraints that limit the cultivated extent. The most devastating effect of salt stress can be seen mostly in in the coastal belts or regions. The physiology and performance of the crop plants which ultimately influenced by salt stress that lead to growth arrest and metabolic damage (Hasanuzzaman and Fujita, 2012). Salinity is expected to have devastating global effects resulting up to 50% land loss by 2050 as the arable land is continuously transforming into saline (1-3% per year) either due to natural salinity or induced by human

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in Bangladesh (Mahajan and Tuteja, 2005; Hasanuzzaman *et al*., 2013).

The salt affected area in the coastal zone of the country was about 0.83 million ha in 1975-76, which expanded to 3.1 million ha over the last three decades (Haque, 2006). The total land area under pulse crops are 885700 hectares of land and the total production of pulses in our country is 1005100 metric tons that is less than the country's requirement (AIS, 2017). The cultivation of legume is elbowing to the problematic soils including saline soils as the demand of cereals is higher than pulses in Bangladesh (Islam, 2001). The production practice in problematic soil (saline soil) is very difficult and cause extra expenditure to the farmer. The total production of pulses can be increased by cultivating blackgram and mungbean in these marginal saline soils. Therefore, the present study was undertaken to investigate the effect of salt stress on comparative agronomic traits of blackgram and mungbean.

Materials and Methods

A pot trial was carried out in shade house of Agronomy department, Hajee Mohammad Danesh Science and Technology University (HSTU), Bangladesh during April to July, 2014 with mungbean (cv. BARI Mung-5) and blackgram (cv. BARI Mash-1) under five levels of salinity (0, 30, 60, 90 and 120 mM NaCl). The trial was designed in completely randomized design (CRD) with five replications to know the impact of salt stress on the agronomic parameters of blackgram and mungbean. . The top soil was properly mixed in 50 plastic pots (17 cm length × 19.5 cm diameter) with decomposed cow-dung, inorganic fertilizers and fertilizers. There were, all of the necessary production practices and protection were undertaken as per necessary. In each pot, there were twelve seeds of mungbean and black gram were sown separately. Proper irrigation, thinning, weeding and pest and disease managements were properly ensured in each pot for keeping eight uniform and healthy plants. Mild salt concentration of 7.5 mM NaCl solution were imposed in salt-treated pots up to four days and 15 mM for next four days, 30 mM for next four days in all pots for hardening of seedlings before applying actual treatments. For control treatment tap water was imposed. During flowering stage and until maturity, the adequate amount of salt solutions as per the each treatment was applied in pots. Plant height, number of branches per plant, yield and yield components were recorded at the time of harvesting. The recorded data were analyzed by computer through 'R' Command.

Results and Discussion

Plant height

Plant height greatly varied due to salt stress in both black gram and mungbean (table 1). Among all of the salt stress, black gram always produced higher plant height than that in mungbean. Blackgram and mungbean were provided 27.52 and 33.02% reduction of plant height, respectively as compare to control treatment, under 90 mM salt stress. Black gram produced the maximum plant height (27.07cm) that was 38.50% reduction from control while mungbean showed only 20.48 cm height at harvesting stage and the reduction was 52.10%, under higher salt stress (120 mM NaCl). Therefore, in case of plant height black gram exhibited higher salt tolerant potentiality than mungbean. Results revealed that plant height progressively influenced by different levels of salinity. It is reported that observed that the plant height of mungbean decreased more than that in black gram under saline condition (Raptan, 2000; Islam, 2001). Similar trends were also reported by Hossain *et al.* (2008), Qados (2011) and Velmani *et al.* (2012) in *Vigna* spp. Salinity stress resulting a considerable decrease in fresh and dry weights of leaves, stems and roots through a clear stunting of plant growth. Significant reductions was observed in plant height and root length with Increasing salt stress in different crops (Parida and Das, 2005; Hajier *et al*., 2006; Islam *et al*., 2011; Abd El-Wahed *et al*., 2015; EL Sabagh *et al*., 2015a).

Number of branches plant^{-1}

Both mungbean and blackgram significantly affected the number of branches plant^{-1} during harvesting stage by salt stress given in table 1. The reduction of number of branches per plant was higher in mungbean (22.40%) while blackgram reduced 17.27% under 60 mM NaCl salt stress. Black gram produced 29.57 and 43.86% reduction of number of branches while mungbean showed 41.21% and 57.50% under 90 and 120 mM NaCl, respectively. The number of branches plant^{-1} was higher in control condition that is decreased with imposing salt stress reported by Mohamed and Kramany (2005). These results are in line with those of Raptan *et al.* (2001).

Total pods per plant

Salt stress significantly affected the number of pods per plant in both black gram and mungbean. Among all of the salt stress, black gram produced more pods per plant than mungbean (table 1). Total pods per plant of black gram and mungbean were 27.25 and 45.44%, at 90 mM NaCl that are reduced in to 42.72 and 71.74%, respectively under 120 mM NaCl (table 1). The pod

Table 1 : Effect of salt stress on the plant height (PH), number of branches per plant (NB), total pods per plant (TPP) and pod length (PL) of black gram (BG) and mungbean (MB).

Salt stress (mM)	Different traits of black gram (BG) and mungbean (MB)							
	PH (cm)		NB		TPP		PL (cm)	
	BG	MB	BG	MB	BG	MB	BG	MB
0	44.01a	42.76a	5.00a	3.40d	11.00a	7.00e	3.39d	5.91a
30	42.15ab(4.24)	40.41bc(5.49)	4.50b(9.96)	3.00e(11.82)	10.00b(9.09)	6.00f(14.33)	3.30d(2.77)	5.68ab(3.79)
60	38.33c(12.91)	35.73d(16.44)	4.14c(17.17)	2.64f(22.40)	9.00c(18.18)	5.00g(28.61)	3.26d(3.78)	5.65ab(4.33)
90	31.90e(27.52)	28.64f(33.02)	3.52d(29.57)	2.00g(41.21)	8.00d(27.25)	4.01h(42.72)	3.16e(6.90)	5.47b(7.35)
120	27.07f(38.50)	20.48g(52.10)	2.81f(43.86)	1.45h(57.50)	6.00f(45.44)	2.00i(71.74)	2.94e(13.22)	4.51c(23.70)
LSD	2.27**		0.18*		0.41*		0.27**	
CV (%)	5.09		4.42		4.67		4.90	

Values in parenthesis indicate percent values to the control.
Black gram (BG) = BARI Mash-1 and Mungbean (MB) = BARI Mung-5.

Table 2: Effect of salt stress on the grains per pod (GP), hundred grain weight (HGW), grain yield per plant (GY) and stover yield per plant (SY) black gram (BG) and mungbean (MB).

Salt stress (mM)	Different traits of black gram (BG) and mungbean (MB)							
	GP		HGW (g)		GY (g plant^{-1})		SY (g plant^{-1})	
	BG	MB	BG	MB	BG	MB	BG	MB
0	5.50bc	6.30a	3.81ab	4.00a	2.31a	1.76c	0.37a	0.27c
30	5.38bc(2.18)	5.76b(8.61)	3.62b(5.19)	3.71b(7.26)	1.94b(15.84)	1.28d(27.24)	0.32b(13.37)	0.21d(22.96)
60	4.82d(12.33)	5.05cd(19.85)	2.95c(22.65)	2.56d(35.89)	1.28d(44.49)	0.65e(63.34)	0.26c(31.55)	0.12f(55.56)
90	3.85e(29.93)	3.72e(40.93)	2.41d(36.71)	2.02e(49.45)	0.74e(67.88)	0.30f(82.97)	0.17e(54.01)	0.07g(73.33)
120	2.75f(49.96)	1.72g(72.72)	1.85e(51.49)	1.20f(69.97)	0.31f(86.75)	0.04g(97.62)	0.11f(71.87)	0.04h(85.93)
LSD	0.57**		0.23**		0.12*		0.02**	
CV (%)	8.97		6.35		9.42		7.47	

Values in parenthesis indicate percent values to the control
Black gram (BG) = BARI Mash-1 and Mungbean (MB) = BARI Mung-5.

production was more in black gram than mungbean under salt stress reported Raptan (2000). Hossain *et al*. (2008) and Elangaimannan (2011) reported that with imposing the higher doses of salt stress, number of pods per plant was subsequently reduced in mungbean.

Pod length

Increasing salinity stress in both crops significantly reduced the pod length (table 1) of mungbean provided 4.33 and 23.70% reduction of pod length under 60 and 120 mM NaCl, respectively. On the contrary, black gram showed 3.78 and 13.22% reduction at 60 and 120 mM NaCl salt stress, respectively. The higher amount of reduction was observed in mungbean as compared with black gram. Ahmed (2009) found that pod length in mungbean exponentially reduced by salt stress.

Grains per pod

Under different salinity levels, the amount of reduction in black gram was lower than mungbean (table 2). The number of grains per pods in black gram showed 29.93 and 49.96% reduction of while 40.93 and 72.72% reduction was recorded in mungbean under 90 and 120 mM NaCl salt stress, respectively. The more disturbance was observed by salinity in mungbean than blackgram for the production of grains per pod as reported by Raptan (2000) and Islam (2001). The food material transportations hampers more in mungbean than black gram due to salt stress resulting the reduction of number of grains per pod substantially decreased more in mungbean than black gram (Nahar and Alam, 2010; Elangaimannan, 2011; Sehrawat *et al.*, 2013). These results were supported with the findings of Fauzia *et al*. (1988).

Hundred-grain weight

The 100-grain weight ranges from 1.20-1.85 g due to salt stress. The higher 100-grain weight was observed in mungbean (4.00 g) than blackgram (3.81 g) under control treatment (table 2). But the reduction percentage is always lower in black gram than mungbean in all salinity levels. Salt stress in black gram and mungbean reduced the 100-grain weight about 36.71 and 49.45% at 90 mM NaCl, respectively. Under high salt stress (120 mM) mungbean showed the severe reduction (69.97%) while black gram recorded only 51.49% reduction. The yield and yield components of black gram and mungbean (number of seed per plant, 100-seed weight and seed yield per plant) reduced due the imposition of salt stress reconfirms by Ahmed (2009), Hossain *et al*. (2008).

Grain yield per plant

The grain yield per plant was statistically varied between black gram and mungbean due to salt stress. Any change or alteration in the yield characters significantly influenced the grain yield. Yield reduction was minimum in both species under 30 mM but it trends is increasing exponentially up to high salt stress (120 Mm NaCl). The grain yield of black gram and mungbean were (2.31 and 1.76 g plant^{-1}) in normal treatment while it decreased 44.49 and 67.88%, respectively at 90 mM salt stress (table 2). The most severe grain yield reduction was recorded in mungbean (97.67%) while only 71.87% was in black gram under same treatment (120 mM NaCl). At high salt stress inflicts in pod setting per plant subsequently reducing 100-grain weight as well as the grain yield. Raptan (2000) reported that black gram can tolerate the higher salt stress than mungbean. This result are in agreement with the findings of Islam (2001) in blackgram and mungbean. Islam *et al*. (2006) reported that grain yield plant^{-1} gradually decreased with the increasing of salinity levels. Blackgram and mungbean produced the lower grain yield per plant under salt stress as compared to control was reported by Hossain *et al*. (2008), Ahmed (2009) and Golezani *et al*. (2012). These findings are in agreement with the reports of Salim and Pitman (1988) and EL Sabagh *et al*. (2015b,c,d,e), who reported that salinity stress conditions resulted in a decrease in growth and seed yield (g plant^{-1}).

Stover yield per plant

Stover yield was significantly affected by salinity over control in black gram and mungbean (table 2). Mungbean produced the 73.33 and 85.93% reduction of stover yield per plant at salt stresses of 90 and 120 mM NaCl, respectively. The stover yield per plant reduced 54.01 and 71.87% in blackgram under high salt of 90 and 120 mM NaCl, respectively. Kafi *et al*. (2013) reported different salinity levels significantly reduced the stover yield of sorghum.

Conclusion

Yield and yield traits of mungbean were more affected than black gram and it reflected more salt tolerant of black gram than in mungbean. Therefore, blackgram (BARI Mash-1) was relatively salt tolerant than mungbean (BARI Mung-5) based on morphological and yield parameters.

Conflict of interest

Authors would hereby like to declare that there is no conflict of interests that could possibly arise.

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