J. Bangladesh Agril. Univ. 5(2): 189–196, 2007 ISSN 1810-3030

Response of mungbean genotypes to different levels of sodium chloride salinity

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Abstract

A pot experiment was carried out at the Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh during the period from 28 February to 3 May 2005 to evaluate the effect of different levels of salinity (control, 2 dSm^{-1}, 4 dSm^{-1} and 6 dSm^{-1}) on mineral ion content, morpho-physiological and yield contributing characters of four mungbean genotypes (Barimoog-6, Barimoog-3 and two advance line, MB-46 and MB-300). The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. All the morpho-physiological characters such as plant height, number of branches $plant^{-1}$, number of leaves $plant^{-1}$, total dry matter (TDM) and yield contributing characters such as number of pods $plant^{-1}$, number of seeds $plant^{-1}$, 1000-seed weight, seed yield $plant^{-1}$ and harvest index were gradually decreased with the increase of salinity levels compared to the control. Na^+ content in leaves increased and K^+, Ca^{++}, Mg^{++} contents decreased with increasing salinity levels. The advanced line MB-46 contained less amount of Na^+ and higher amount of K^+, Ca^{++}, Mg^{++} compared to the other genotypes. Plant height, number of branches $plant^{-1}$, number of leaves $plant^{-1}$, TDM, number of pods $plant^{-1}$, number of seeds $plant^{-1}$, 1000-seed weight, seed yield $plant^{-1}$ and harvest index were the highest in MB-46 compared to those in other genotypes. Interaction effect between the genotypes and salinity levels appeared significant for most of the characters studied. Considering the performance of the mungbean genotypes the MB-46 performed better than an other genotypes at above salinity levels. This genotype may be utilized for further breeding and crop improvement program for salt affected regions.

Keywords: Mungbean, NaCl, Growth, Ion content, Yield contributing characters

Introduction

Salinity is one of the major wide spread environmental stresses affecting plant growth and development and results in severe agricultural losses (Ashraf and Wahed, 1993). In general, salinity affects plant growth, and their adverse effects are mostly attributed to non-availability of water (Singh *et al*., 2001), disturbance in nutrient uptake causing deficiency and ion toxicity to plants (Varshney *et al*., 1998). Salinity shows reduction in dry matter accumulation and grain yield which is invariably attributed with pronounced change in ionic composition. In Bangladesh, over 30% of cultivated areas are in the coastal belt. Out of 2.85 million hectares of the coastal offshore areas about 0.833 million hectares of the arable lands, constitute nearly 52.8% net cultivable saline area dispersed in 64 upazillas of 13 districts are affected by different degrees of salinity (Hossain, 2002).

Mungbean is an important grain legume rich in carbohydrate (51%), protein (26%), moisture (10%), mineral (4%) and vitamins (3%) (Kaul, 1982). It is cultivated both in summer and winter seasons in many pulse growing countries of the world. In Bangladesh mungbean is usually grown in winter season. However, there is possibility of growing mungbean in summer season and some success has already been achieved. Recently Bangladesh Agricultural Research Institute (BARI) and Bangladesh Institute of Nuclear Agriculture (BINA) have developed some genotypes of summer mungbean. In Bangladesh total production of mungbean was 30,000 metric tons from an area of 108,000 acres (BBS, 2005). It contributed 6.5% percent of the total pulse production of the country. It ranks third both in acreage and production among the pulses (BBS, 2004). The yield of mungbean is quite lower than other grain legumes. For increasing pulse production it is urgently needed to extent cultivation of pulse crops rapidly to all possible areas of Bangladesh. One of the possibilities is to cultivate in the coastal saline areas where cropping intensity is still low. But the cultivation of pulse crop in that area is not easy because of the lack of salinity tolerant varieties of this crop.

It is needed to develop stress tolerant high yielding varieties of mungbean by combining together the tolerant character that may have been distributed sporadically in different related genotypes. To develop salinity tolerant varieties of mungbean, different genotypes and mutants have to be assessed. After proper physiological and biochemical examination, the genotypes which show salinity tolerance should be identified for their adaptation to saline agriculture or future breeding application. With this consideration the present study was conducted to assess the growth and yield attributes of mungbean genotypes under imposed salt stresses and to identify the relative salt tolerant genotypes of mungbean if any.

Materials and Methods

A pot experiment was conducted at the pot yard of Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh during 28 February to 3 May 2005 to investigate the effect of salinity stress on four mungbean genotypes (Barimoog-6, Barimoog-3, advanced line MB-46 and advanced line MB-300). Four levels of salinity like control (no salt was added), 2 dSm^{-1}, 4 dSm^{-1} and 6 dSm^{-1} were used in this study. The diameter of each pot was 21 cm and the depth of each pot was 26 cm. Each pot contained 9 kg of soil receiving 0.269 g, 0.628 g, 0.314 g of urea, TSP and MP @ of 30, 70 and 35 kg ha^{-1}, respectively. The experiment was laid out in a Randomized Block Design (RBD) with three replications. Each replication represented one pot. As there were 4 genotypes, the total number of pots of each genotype was 12 and each pot contained three plants. Data on morphological parameters namely plant height, number of branches $plant^{-1}$ and number of leaves $plant^{-1}$ were recorded from three individual plants pot^{-1}. Total dry matter and yield contributing data were recorded after final harvest. Total Na^+ and K^+ content of the leaf extract were determined by flame emission spectrophotometer (Jackson, 1973). Calcium (Ca^{++}) and magnesium (Mg^{++}) content was determined as described by Pase *et al.* (1982). The recorded data were analyzed using MSTAT-C package where mean differences were compared by Duncan's Multiple Range Test (DMRT).

Results and Discussion

Genotypes exerted significant effect on plant height (Table 1). The tallest plant (29.56 cm) was found in advance line MB-46 while the shortest (25.07 cm) was in Barimoog-3. The effect of salinity on plant height was statistically significant. The highest plant height (27.92 cm) was obtained from the control and the lowest (26.01 cm) was in T_3 and it was identically followed by T_2. The interaction effect on plant height between genotypes and salinity levels was not found significant. The results of the present study showed gradual decrease of plant height with increasing salinity level. The decrease of plant height might be due to inhibition of cell division or cell enlargement under salinity stress.

The effect of variety on number of branches plant^{-1} was found statistically significant (Table 1). The maximum number of branch plant^{-1} (0.89) was observed in MB-46 and the minimum (0.46) in advanced line MB-300 which was statistically similar to that of Barimoog-6. Salinity levels significantly decreased the number of branches plant^{-1}. The highest number of branch plant^{-1} (0.82) was recorded with the control and the lowest (0.42) was noticed in 6 dSm^{-1} level of salinity. The interaction effect on number of branches plant^{-1} between genotypes and salinity levels was statistically significant. The maximum number of branch plant^{-1} (1.09) was found in Barimoog-3 with the control (V_2T_0) and it was identically followed by V_1T_0, V_2T_1, V_2T_2 and V_3T_0 and the minimum (0.20) in advanced line MB-300 at 6 dSm^{-1} (V_4T_3) and Barimoog-6 at 6 dSm^{-1} salinity level (V_1T_3). From the present study it was indicated that number of branches plant^{-1} was significantly decreased with increasing NaCl salinity level. Hossain (2004) and Islam (2004) also reported similar results.

Table 1. Effect of genotypes, salinity levels and their interactions on growth, yield and yield attributes of mungbean genotypes

Characters	Plant height (cm)	No. of branches plant^{-1}	No. of leaves plant^{-1}	TDM plant^{-1} (g)	No. of pods plant^{-1}	No. of seeds plant^{-1}	1000-seed weight (g)	Seed yield plant^{-1} (g)	Harvest index (%)
Genotypes									
Barimoog-6 (V_1)	26.83 b	0.54 c	5.63 b	4.93 b	5.16 c	34.59 b	58.03 a	1.97 b	39.96
Barimoog-3 (V_2)	25.07 c	0.72 b	6.19 a	5.03 b	8.00 ab	58.87 a	37.02 b	2.15 b	42.74
MB-46 (V_3)	29.56 a	0.89 a	6.46 a	7.05 a	8.82 a	60.53 a	58.73 a	3.05 a	43.26
MB-300 (V_4)	26.57 b	0.46 c	5.71 b	4.37 b	6.79 b	44.13 b	49.79 a	1.64 b	37.52
Salinity (dSm^{-1})									
Control (T_0)	27.92 a	0.82 a	6.53 a	7.86 a	8.90 a	68.81 a	56.65 a	3.28 a	41.73 a
2 (T_1)	27.44 ab	0.75 ab	5.91 b	6.56 a	8.16 a	56.33 b	61.57 a	2.83 a	43.14 a
4 (T_2)	26.65 bc	0.62 b	5.96 b	4.43 b	6.33 b	39.02 c	54.39 a	1.75 b	39.50 a
6 (T_3)	26.01 c	0.42 c	5.59 c	3.02 b	5.08 c	33.95 c	31.97 b	0.96 c	31.78 b
Interaction									
V_1T_0	27.40	0.80 abc	6.08 cde	7.37 b	7.00 bc	51.20 b	80.86 a	3.06 ab	41.51 ab
V_1T_1	27.87	0.64 bcd	5.77 def	6.90 bc	6.00 c	42.50 c	65.96 ab	2.93 b	42.46 a
V_1T_2	27.09	0.53 cde	5.34 f	4.25 c	5.16 d	34.67 c	60.30 b	1.80c	42.35 ab
V_1T_3	24.95	0.20 e	5.32 f	1.12 e	2.50 e	10.00 e	25.00 d	0.10 f	8.92d
V_2T_0	25.89	1.09 a	6.75 ab	6.90 bc	9.06 ab	78.03 a	41.02 c	3.19ab	46.23 a
V_2T_1	25.09	0.93 ab	6.14 bcd	6.46 bc	9.00 ab	76.67 a	43.69 c	3.12 ab	48.29 a
V_2T_2	24.87	0.99 ab	6.58 abc	4.21 cd	8.30 b	41.67 bc	43.89 c	1.71 c	40.61 ab
V_2T_3	24.42	0.56 cd	5.28 f	2.54cde	5.66 d	39.10 bc	19.53 d	0.60 de	23.62 cd
V_3T_0	30.55	0.96 ab	7.06 a	10.11 a	10.87 a	82.00 a	60.73 b	4.11 a	40.65 ab
V_3T_1	30.63	0.73 bcd	6.12 bcd	8.45 ab	10.50 a	59.97b	70.65 ab	3.50 a	41.42 ab
V_3T_2	28.23	0.73 bcd	6.46 abc	5.96 bc	7.30 bc	54.83 b	59.56 b	2.33 bc	39.09 ab
V_3T_3	28.80	0.46 cde	6.19 bcd	5.66 bc	6.63 c	45.30 bc	43.97 c	2.14 bc	37.92 ab
V_4T_0	27.82	0.72 bcd	6.22 bcd	7.07 b	8.70 b	64.00 ab	60.55 b	2.78 b	39.32 ab
V_4T_1	26.17	0.53 cde	5.60 def	4.44 c	7.16 bc	51.33 b	51.08 bc	1.76 c	39.63 ab
V_4T_2	26.42	0.40 de	5.56 def	3.29 cd	5.76 cd	37.00 c	48.19 c	1.15 bc	34.95 abc
V_4T_3	25.88	0.20 e	5.48 ef	2.68cde	5.53 d	24.17 d	39.37 cd	0.86 d	32.08 bc

Mean values followed by the same or without letter(s) in a column do not differ significantly at 5% level as per DMRT.

Mungbean genotypes significantly affected the number of leaves plant^{-1} under salt stress. The highest number of leaves plant^{-1} (6.46) was recorded in advanced line MB-46 and the lowest (5.63) was in Barimoog-6. (Table 1). Salinity levels also showed significant variation in number of leaves plant^{-1}. The highest number of leaves plant^{-1} (6.53) was found in the control and the lowest (5.59) was recorded in 6 dSm^{-1} salinity. The interaction effect of genotypes and salinity in relation to number of leaf plant^{-1} was statistically significant. The highest number of leaf (7.06) was obtained from advanced line MB-46 at control condition (V_3T_0) and the lowest (5.28) in Barimoog-3 at 6 dSm^{-1} level of salinity (V_2T_3). From the present study it was observed that number of leaves plant^{-1} decreased gradually with increasing salinity compared to that of the untreated control plant. Similar result was observed by Hossain (2004).

Variation among genotypes on plant height, number of branches and number of leaves plant^{-1} indicated that different genotypes had different levels of salinity tolerance. This might be due to different genetic make up of the genotypes. Genotypes showed significant influence on TDM plant^{-1} (Table 1). The highest TDM plant^{-1} (7.54 g) was found in advanced plant MB-46 and the lowest (4.37 g) was in MB-300 which was statistically similar to that of Barimoog-6 and Barimoog-3. Total dry matter (TDM) accumulation was significantly affected by salinity stress. At final harvest the highest TDM plant^{-1} (7.86 g) was found in control which was statistically similar to that of 2 dSm^{-1} level of salinity and the lowest (3.02 g) was in 6 dSm^{-1} level of salinity. The interaction effect between genotypes and salinity levels on TDM plant^{-1} was statistically significant. The highest TDM plant^{-1} (10.11 g) was obtained from advanced plant MB-46 at control condition (V_3T_0) and the lowest (1.12 g) was in Barimoog-6 at 6 dSm^{-1} salinity (V_1T_3). The decrease in TDM accumulation in response to salinity might be the result of poorly developed roots, stems, leaves and pods. The present results are in agreement with the findings of Patil *et al.* (1996).

Genotypes showed significant variation on the production of number of pods plant^{-1} (Table 1). The highest number of pods plant^{-1} (8.82) was found in advanced line MB-46 and the lowest (5.16) was in the Barimoog-6. Effect of salinity on the number of pods plant^{-1} was statistically significant. The highest number of pods plant^{-1} (8.90) was recorded in the control, which was statistically similar to that of 2 dSm^{-1} salinity level and the lowest (5.08), was recorded in 6 dSm^{-1} level of soil salinity. The interaction effect of genotypes and salinity levels in relation to number of pods plant^{-1} was statistically significant. MB-46 at control condition produced the highest number of pods plant^{-1} (10.87) and Barimoog-6 with 6 dSm^{-1} salinity produced the lowest (2.50). The results of the present study indicated that number of pod plant^{-1} in mungbean decreased with increasing salinity levels. Patil *et al.* (1996) reported similar result in mungbean.

Among the genotypes the number of seed plant^{-1} was statistically significant (Table 1). The highest number of seeds plant^{-1} (60.53) was in the advanced line MB-46 and the lowest (34.59) was in Barimoog-6. Salinity showed significant variation in the production of number of seeds plant^{-1}. The number of seeds plant^{-1} decreased with increasing salinity levels. The highest number of seeds plant^{-1} (68.81) was recorded in the control and the lowest (33.95) in 6 dSm^{-1} salinity. The interaction effect between genotypes and salinity on the number of seeds plant^{-1} was statistically significant. The highest number of seeds plant^{-1} (82) was recorded in MB-46 with control (V_3T_0) and the lowest (10) was recorded in Barimoog-6 with 6 dSm^{-1} salinity (V_1T_3). Results of this experiment confirmed that number of seeds plant^{-1} gradually decreased with increasing salinity level. Similar results were also observed by Dua (1992).

Significant genotypic variation was observed in 1000-seed weight (Table 1). Among the genotypes MB-46 produced the highest (58.73 g) 1000-seed weight and the lowest (37.02 g) was in Barimoog-3. Thousand seed weight was significantly varied due to the effect of NaCl salinity. The seed weight varied from 61.57 g to 31.97 g. The highest 1000-seed weight (61.57 g) was obtained in 2 dSm^{-1} salinity which was statistically similar to that of control and 4 dSm^{-1} salinity levels. The lowest 1000-seed weight (31.79 g) was recorded from 6 dSm^{-1} salinity level. The interaction effect of genotypes and salinity levels in relation to 1000-seed weight was significant. The highest 1000-seed weight was obtained in V_1T_0 and the lowest was recorded in V_2T_3 followed by V_1T_3 with same statistical rank. From this study it was observed that 1000-seed weight gradually decreased with increasing salinity. Similar result was also observed by Rabbi (2004).

A significant variation was observed among the genotypes in relation to seed yield $plant^{-1}$ (Table 1). Seed yield $plant^{-1}$ was the highest (3.05 g) in MB-46 and the lowest (1.64 g) in MB-300 which was identically followed by Barimoog-6 and Barimoog-3. The difference in seed yield $plant^{-1}$ due to salinity treatment was statistically significant. The highest seed yield $plant^{-1}$ (3.28 g) was obtained from control condition which was statistically identical to that of 2 dSm^{-1} salinity and the lowest (0.96 g) was in 6 dSm^{-1} salinity. The interaction of genotypes and salinity on seed yield $plant^{-1}$ was statistically significant. MB-46 at control condition produced the highest seed yield $plant^{-1}$ (4.11 g) and Barimoog-6 with 6 dSm^{-1} salinity produced the lowest (0.10 g). The result showed that the seed yield of mungbean progressively decreased with increasing salinity levels. The negative relationship between seed yield and salinity levels was also reported in mungbean by Dubey *et al.* (1992) and Singh *et al.* (1993).

Among the genotypes HI was not statistically significant (Table 1). However, numerically the highest HI was found in MB-46 (43.26%). Salinity showed a significant influence on harvest index (HI). The highest HI (43.14%) was recorded in 2 dSm^{-1} salinity level which was statistically similar to control condition and 4 dSm^{-1} salinity level. The lowest HI (31.78%) was obtained from 6 dSm^{-1} salinity level. The interaction effect of genotypes and salinity levels in relation to HI was statistically significant. At highest salinity level (6 dSm^{-1}), MB-46 maintained highest HI (37.92%) and Barimoog-6 showed the lowest one (8.92%). Higher HI indicates higher translocation ability to sink organ. Result showed that HI gradually decreased with increasing salinity. Similar result was also observed by Hossain (2004).

Among the genotypes Na^+ content in leaves under different salinity levels was found significant (Table 2). Na^+ content in leaves was the highest (0.18%) in Barimoog-6 which was statistically similar to that of advanced line MB-300 and the lowest (0.11%) was in MB-46 which was identically followed by Barimoog-3. Different levels of salinity significantly increased the Na^+ content in leaves over the control plant. The highest Na^+ content (0.23%) in leaves was recorded at 6 dSm^{-1} soil salinity level which was statistically similar to that of 4 dSm^{-1} salinity level and the lowest (0.05%) was recorded in the control. The interaction between genotypes and salinity on Na^+ content in leaves was statistically significant. The highest (0.33%) Na^+ content in leaves was observed in Barimoog-6 at 6 dSm^{-1} salinity level (V_1T_3) and the lowest (0.16%) was in MB-46 at same salinity level (V_3T_3).

Among the genotypes K^+ content in leaves under different salinity levels was statistically significant. K^+ content in leaves was the highest (1.12%) in advanced line MB-46 and the lowest (0.88%) was recorded in Barimoog-6. The K^+ content in leaves was significantly affected by salt stress. The highest amount of K^+ (1.23%) in leaves was observed at control condition which was identical to that of 2 dSm^{-1} level of soil salinity and the lowest (0.74%) was recorded in 6 dSm^{-1} salinity level which was statistically similar to that of 4 dSm^{-1} level of soil salinity. The interaction effect of genotypes and salinity levels in relation to K^+ content in leaves was statistically significant (Table 2). MB-46 at control condition contained the highest amount of K^+ (1.27%) and Barimoog-6 with 6 dSm^{-1} salinity contained the lowest (0.51%).

Table 2. Effect of genotypes, salinity levels and their interactions on mineral ion content in leaves of mungbean genotypes

Characters	Na^+ (%)	K^+ (%)	Ca^{++} (%)	Mg^{++} (%)
Genotypes				
Barimoog-6 (V_1)	0.18 a	0.88 b	2.82 b	2.80 bc
Barimoog-3 (V_2)	0.13 bc	1.02 ab	3.02 b	3.01 ab
MB-46 (V_3)	0.11 c	1.12 a	3.52 a	3.04 a
MB-300 (V_4)	0.15 ab	0.96 b	2.94 b	2.63 c
Salinity (dSm^{-1})				
Control (T_0)	0.05 c	1.23 a	3.40 a	3.10 a
2 (T_1)	0.11 b	1.14 a	3.08 b	3.01 a
4 (T_2)	0.19 a	0.88 b	2.90 b	2.74 b
6 (T_3)	0.23 a	0.74 b	2.92 b	2.65 b
Interaction				
V_1T_0	0.08 de	1.18 ab	2.85 def	2.96 b
V_1T_1	0.07 de	1.12 ab	3.05 cdef	3.03 b
V_1T_2	0.24 b	0.69 cd	3.09 cde	2.57 cd
V_1T_3	0.33 a	0.51 d	2.75 def	2.65 c
V_2T_0	0.05 e	1.25 a	3.12 cd	2.96 b
V_2T_1	0.06 de	1.12 ab	3.20 bcd	3.25 a
V_2T_2	0.14 cd	0.92 bc	2.40 f	2.99 b
V_2T_3	0.20 bc	0.81 c	2.56 def	2.96 b
V_3T_0	0.05 e	1.27 a	3.79 ab	3.34 a
V_3T_1	0.10 de	1.18 ab	3.60 abc	3.14 ab
V_3T_2	0.13 cd	1.09 ab	3.55 abc	3.01 b
V_3T_3	0.16 cd	0.93 bc	3.15 cd	2.57 cd
V_4T_0	0.04 e	1.22 a	3.84 a	3.12 ab
V_4T_1	0.09 de	1.12 ab	2.45 ef	2.60 c
V_4T_2	0.16 cd	0.82 c	2.89 def	2.39 d
V_4T_3	0.19 bc	0.70 cd	2.88 def	2.39 d

Mean values followed by the same letter(s) in a column do not differ significantly at 5% level as per DMRT.

Among four genotypes Ca^{++} content in leaves differed significantly (Table 2). Ca^{++} content in leaves was the highest (3.52%) in MB-46 and the lowest (2.82%) in Barimoog-6. The influence of salinity on Ca^{++} content in leaves was statistically significant. The highest (3.40%) accumulation of Ca^{++} in leaves was found in control condition and the lowest (2.90%) at 4 dSm^{-1} which was statistically similar to that of 2 dSm^{-1} and 6 dSm^{-1} soil salinity levels. The interaction effect of genotypes and salinity levels in relation to Ca^{++} content of leaves was significant. Ca^{++} content in leaves was the highest (3.84%) in advanced line MB-300 at controlled condition (V_4T_0) and it was identically followed by MB-46 under non-saline control, 2 and 4 dSm^{-1} salinity levels. The lowest (2.40%) Ca^{++} content was recorded in Barimoog-3 at 4 dSm^{-1} level of soil salinity (V_3T_2). MB-46 contained higher amount of Ca^{++} than that of other genotypes under saline conditions. The result of this experiment supports the findings of Rabbi (2004) in mungbean and Varshney *et al.* (1998) in chickpea. They found that Ca^{++} uptake decreased with the increase of saline water irrigation.

The effect of salinity on Mg^{++} content in leaves was statistically significant (Table 2). Mg^{++} content decreased with increasing salinity. The highest (3.10%) Mg^{++} content in leaves was found at control condition which was statistically identical to that of 2 dSm^{-1} salinity level and lowest (2.65%) at 6 dSm^{-1} salinity level which was statistically similar to that of 4 dSm^{-1} salinity level. Among the genotypes, Mg^{++} content in leaves was significant (Table 2). The highest (3.04%) Mg^{++} content in leaves was found in MB-46 which was statistically similar to that of Barimoog-3 and the lowest (2.63%) was in advanced line MB-300, which was statistically identical to that of Barimoog-6. The interaction of genotypes and salinity levels in relation to Mg^{++} content in leaves was found statistically significant (Table 2). The highest (3.34%) Mg^{++} content in leaves was observed in MB-46 at controlled condition (V_3T_0) and the lowest (2.39%) was in MB-300 at 4 dSm^{-1} and 6 dSm^{-1} level of soil salinity (V_4T_3). The results indicated that the values of Mg^{++} contents in leaves significantly decreased with increasing salinity. Similar result was observed by Vashney *et al.* (1990).

Results showed that Na^{+} content in leaves significantly increased and K^{+}, Ca^{++}, Mg^{++} content in leaves decreased with increasing salinity. The results agreed with Chakrabarti and Mukherji (2002). Advanced line MB-46 accumulated less amount of Na^{+} and high amount of K^{+}, Ca^{++}, Mg^{++} in leaves. Singh and Singh (1999) observed that salt tolerant genotype generally contained less amount of Na^{+} and high amount of K^{+} in leaves.

In conclusion, the increase in soil salinity significantly reduced almost all the morpho-physiological, yield and yield contributing parameters of mungbean genotypes. Content of Na^{+} in leaves increased and those of K^{+}, Ca^{++} and Mg^{++} decreased with the increase of NaCl salinity. MB-46 contained less amount of Na^{+} and higher amount of K^{+}, Ca^{++}, Mg^{++} in leaves and showed better performance than other genotypes under above salinity levels. This genotype may be utilized for further breeding and crop improvement program for salt-affected regions.

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