Journal BiNET
Scientific Publication

Published with Open Access at Journal BiNET
Vol. 24, Issue 02: 2012-2019
Journal of Bioscience and Agriculture Research

Journal Home: www.journalbinet.com/jbar-journal.html

Effect of salinity (NaCl) on germination and seedling growth of mungbean (*Vigna radiata* L.)

Subroto Podder, Joyanti Ray, Debesh Das and Bidhan Chandro Sarker

Agrotechnology Discipline, Khulna University, Khulna-9208, Bangladesh

✉ For any information: joyaku2005@yahoo.com (Roy J)
Article received: 26.04.2020; Revised: 07.05.2020; First published online: 15 May 2020.

ABSTRACT

Soil salinity adversely affects crops at the critical stages of growth, which in severe cases causes total yield loss. So screening of salt tolerant genotypes is very important and it can be done during germination and early growth stage by quick and easy method. An experiment was conducted to investigate the effect of salinity on germination and seedling growth of mungbean genotypes. The experiment comprised two factors viz. genotypes (BARI Mung-6, Binamoog-5, Binamoog-8 and Tila Mung) and salinity levels (0 mM/L, 40 mM/L, 80 mM/L, 120 mM/L and 160 mM/L). Among the seed germination parameters, no significant genotypic difference observed at 0 mM /L and 40 mM/L. At 120 mM/L, the highest germination capacity (93%) and germination percentage (94%) was found in Binamoog-8 followed by BARI Mung-6 (91% and 92% respectively) and the lowest value was in Tila Mung (73% and 76% respectively). At 160 mM/L, BARI Mung-6 showed the highest germination capacity (95%) and germination percentage (95%) and Tila Mung showed the lowest value (51% and 52% respectively). At 160 mM/L, the highest shoot length (2.8 cm), seedling vigor index (488.26), seedling dry weight (45.9 mg) found in BARI Mung-6 while the lowest in Tila Mung (1.56 cm, 180.93 and 32.52 mg respectively). Regarding all the germination and seedling growth parameters, BARI Mung-6 was found superior to other genotypes. Study should be conducted in the field for better understanding the effects of salinity stress on growth and yield performance of mungbean.

Keywords: Mungbean, NaCl, Germination and Seedling growth

Cite Article: Podder, S., Ray, J., Das, D. and Sarker, B. C. (2020). Effect of salinity (NaCl) on germination and seedling growth of mungbean (*Vigna radiata* L.). Journal of Bioscience and Agriculture Research, 24(02), 2012-2019.
Crossref: https://doi.org/10.18801/jbar.240220.246

I. Introduction

Mungbean (*Vigna radiata L.*) is an important eco-friendly crop belongs to Leguminosae family, well adapted in dry and upland agriculture and having a high content of proteins, vitamins and minerals (Ketinge et al., 2011). The present area under mungbean cultivation of Bangladesh is 54.98 thousand ha with a total production of 34.40 thousand tons (BBS, 2015). About 60-65% of the total mungbean is grown under the boro rice-mungbean-aus rice (Rainfed) cropping system in five southern districts:

EISSN: 2312-7945, © 2020 The Authors, Research paper

Patuakhali, Barisal, Madaripur, Noakhali, and Cox's bazar from mid-January to April (BBS, 2015). The agricultural productivity of this crop is limited due to salinity stress which is one of the most appalling environmental factors for the most salt sensitive legume crops resulting in >70% yield loss in arid and semiarid regions (Hasanuzzaman et al., 2013).

The coastal region covers almost 29,000 km^2 or about 20% of the country. In Bangladesh, out of 2.85 million hectares of the coastal and offshore areas of which about 0.833 million hectares of the arable lands, constitute nearly 30 percent of total cultivable land of this country. Agricultural land use in this area is very poor, which is much lower than the country's average cropping intensity (Haque, 2006). For utilization of the vast land for crop production, considerable success may be achieved through screening of salt tolerant crop mutant (varieties or genotypes).

Salt stress inflicts considerable adverse effects on physiology and performance of the crop plants which ultimately lead to plant death as a consequence of growth arrest and metabolic damage (Hasanuzzaman et al., 2013). Reduction of dry matter accumulation and grain yield, which is invariably accompanied by pronounced changed in the ionic composition is the ultimate result of salt stress effects on crop plants (Flowers and Flowers, 2005). For expanding mungbean production in Bangladesh, it is urgently needed to cultivate mungbean in all possible locations of Bangladesh. As the coastal area of Bangladesh has very low cropping intensity so production of mungbean can be increased there. Due to the shortage of salinity resistant varieties, crop production is difficult in saline prone areas. Salt tolerant mungbean genotype may be an alternative for greater yield potential in the saline soils of Bangladesh. Considering this fact, this work was undertaken to study the salt tolerance efficiency of mungbean genotypes on germination and seedling stage.

II. Materials and Methods

An experiment was conducted at the Agronomy Laboratory of Agrotechnology Discipline, Khulna University, Khulna from 24th January to 15th February, 2016 to determine the effect of salinity on germination and the seedling growth of four mungbean genotypes. The experiment consists of two factors namely genotypes (V_1= BARI Mung-6, V_2= Binamoog-5, V_3= Binamoog-8 and V_4= Tila Mung) and five salinity levels [T_0= Control (distilled water), T_1= 40 mM/L, T_2= 80 mM/L, T_3= 120 mM/L , T_4= 160 mM/L]. Completely randomized designs (CRD) with 4 replications were used to conduct this experiment.

Preparation of petri dishes

Glass petri dishes with a tight fitting lid were used to conduct this experiment. These petri dishes were firstly washed by detergent followed by rinsing with distilled water. Then the petri dishes were air-dried followed by oven-dried for 24 hours. Petri dishes were sterilized with 70% ethanol after drying. Filter papers were used as a matrix for seed germination. Three filter papers were soaked in respective concentrations of salt solution (control, 40, 80, 120, 160 mM/L NaCl) and 25 treated seeds were placed on each petri dish. For preparing different concentrations of salt solutions, 1000 ml distilled water was kept in a beaker. The respective amount of salt (NaCl) was then added gradually with the water to assure the concentrations. Before placing, the seed was treated with Vitavex 200 @ 3 g kg-1 and kept in an airtight container for 24 hours. The numbers of germinating seeds were counted and recorded everyday from each petri dish. A seed has considered having germinated at the emergence of the radical (Chartzoulakis and Klapaki, 2000).

Germination percentage

The germination percentage was calculated at 10 days after placement for germination through the following formula-

$$\text{Germination percentage (\%)} = \frac{\text{No of seed germinated}}{\text{Total number of seeds set in the petri dish}} \times 100$$

Germination energy: Percentage of seeds germinated at 72 h (Bam et. al., 2006).

Germination capacity: Percentage of seeds germination at 168 h (Bam et. al., 2006).

Published with open access at journalbinet.com
EISSN: 2312-7945, ©2020 The Authors, Research paper

Root and shoot length

After 10 days of placing the seeds, the length of root and shoot were measured by a scale in centimeter unit.

Dry weight

After measuring the root and shoot length at 10 days after placing the seeds, the seedlings of each petri dish were dried in oven at 60^0C till a constant weight was obtained and then weighted.

Seedling vigor index (SVI)

Seedling vigor index can be expressed by the following equation (Sagar et al., 2019)-
Seedling vigor index = (average shoot length+ average root length) × germination percentage

Statistical analysis

All the recorded data were compiled, calculated and analyzed statistically with the help of computer package program MSTAT-C, Microsoft Excel and the means were separated with Duncan's New Multiple Ranges Test (Gomez and Gomez, 1984).

III. Results

Interaction effect of salinity levels and genotypes on seed germination parameters of mungbean genotypes

Germination energy: Germination energy significantly varied from 20.00% to 86.00% due to the interaction of genotypes and salinity levels (P<0.01). The highest germination energy (86.00%) was found in Binamoog-8 at 40 mM/L which was statistically similar with other three genotypes at 0, 40, 80 and 120 mM/L salinity level except for Tila Mung (61% and 60%) at 80 and 120 mM/L respectively. The lowest germination energy 20.00% was found in Binamoog-8 at 160 mM/L which was statistically similar to BARI Mung-6 (22.75%), Binamoog-5 (22.00%) and Tila Mung (20.25%) (Figure 01).

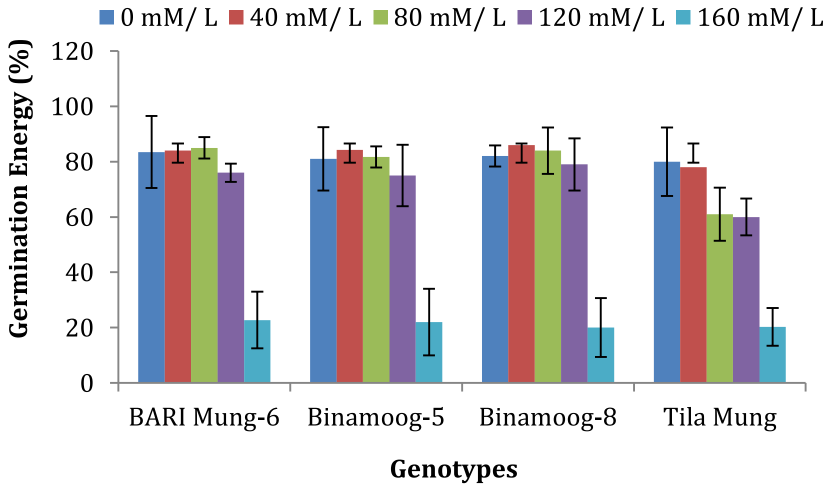

Figure 01. Salinity effects on germination energy (%) of different mungbean genotypes (Vertical bar represents standard error bar).

Germination capacity: The interaction between salt concentration and genotypes emphasizes the significant variation (P<0.01) in germination capacity. Germination capacity ranged from 51.00% to 98.00%. Germination capacity was reduced with increasing salinity levels. At 160 mM/L, the highest germination capacity was found in BARI Mung-6 (95%) which was statistically different from other genotypes while the lowest was recorded in Tila Mung (51.00%) (Figure 02).

Germination percentage: Genotypes and salinity levels interaction showed significant variation (P<0.01) in germination percentage and was varied from 52.00% to 99.00%. The maximum germination percentage (99.00%) was found in BARI Mung-6 in 0 mM/L which was statistically similar to Binamoog-5 (92.00%), Binamoog-8 (93.00%), Tila Mung (93.75%) at 0 mM/L, BARI Mung-6

(98.00%), Binamoog-5 (95.00%) and Binamoog-8 (97.00%) at 40 mM/L, BARI Mung-6 (95%), Binamoog-8(95%) at 80 mM/L, BARI Mung-6 (92%), Binamoog-8(94%) at 120 mM/L and BARI Mung-6 (95%) at 160 mM/L . The lowest germination percentage was recorded in Tila Mung (52.00%) at 160 mM/L (Figure 03).

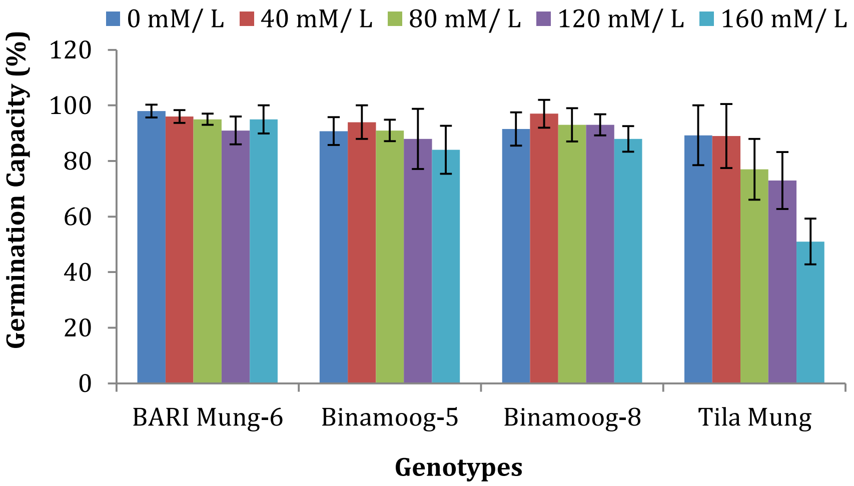

Figure 02. Salinity effects on germination capacity (%) of different mungbean genotypes (Vertical bar represents standard error bar).

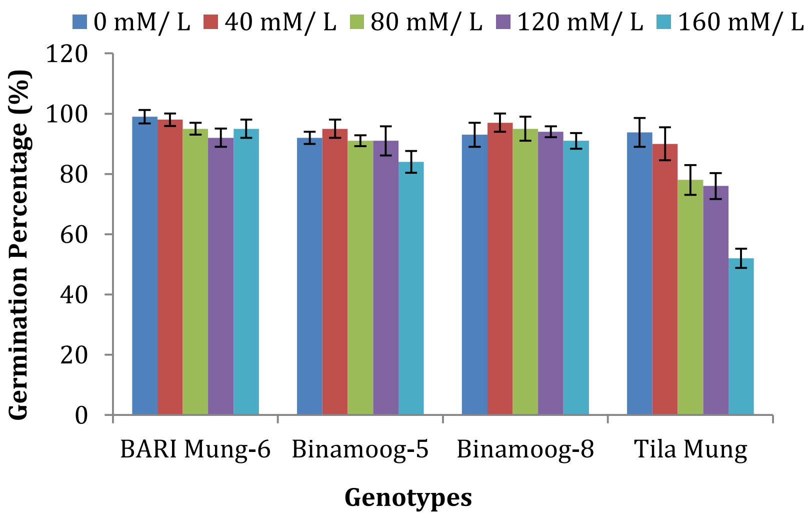

Figure 03. Salinity effects on germination percentage (%) of different mungbean genotypes (Vertical bar represents standard error bar).

Interaction effect of salinity levels and genotypes on seedling growth parameters of mungbean genotypes

Root length (cm): The interaction between salinity levels and genotypes concerning root length was significantly different. The highest root length was recorded in Binamoog-8 (6.95 cm) at 0 mM/L which was statistically similar to BARI Mung-6 (5.53 cm) and Binamoog-5 (5.33 cm) at 0 mM/L and Binamoog-8 (5.37 cm) at 40 mM/L. The lowest root length was noticed in Binamoog-8 (1.55 cm) at 160 mM/L (Table 01).

Shoot length (cm): The interaction between salinity levels and genotypes with shoot length was significantly different. The highest shoot length was found in Tila Mung (8.55 cm) at 40 mM/L which was statistically similar to BARI Mung-6 (7.38 cm) and Tila Mung (7.29 cm) at the control and BARI Mung-6 (6.88 cm) at 40 mM/L. The lowest shoot length was noticed in Tila Mung (1.56 cm) at 160 mM/L (Table 01).

Seedling vigor index: The interaction between salinity levels and genotypes in relation to seedling vigor index was significantly different. The highest seedling vigor index was found in BARI Mung-6

Published with open access at journalbinet.com
EISSN: 2312-7945, ©2020 The Authors, Research paper

(1280.10) at control which was identical to Binamoog-5 (1016.42) and Binamoog-8 (1239.10) at control and BARI Mung-6 (1180.79) at 40 mM/L whereas the lowest was noticed in Tila Mung (180.93) at 160 mM/L (Table 01).

Seedling dry weight (mg): The interaction between salinity levels and genotypes with seedling dry weight was significantly different. The highest seedling dry weight was found in BARI Mung-6 (107.10 mg) in control which was similar to BARI Mung-6 (95.77 mg), Binamoog-5 (86.49 mg) at 40 mM/L and BARI Mung-6 (89.95 mg) at 80 mM/L. The lowest seedling dry weight was noticed in Tila Mung (32.52 mg) at 160 mM/L (Table 01).

Table 01. Interaction effect of salinity levels and genotypes on seedling growth parameters of mungbean genotypes

Genotypes	Salinity Level (mM/L)	Root length (cm)	Shoot length (cm)	Seedling vigor index	Dry weight (mg)
BARI Mung-6	0	5.53 ab	7.38 ab	1280.10 a	107.10 a
Binamoog-5	0	5.33 abcd	5.71 bcde	1016.42 abc	82.40 bcd
Binamoog-8	0	6.95 a	6.37 bc	1239.10 a	83.45 bcd
Tila Mung	0	3.01 efghi	7.29 ab	966.50 abcd	67.82 def
BARI Mung-6	40	5.16 bcd	6.88 ab	1180.79 a	95.77 ab
Binamoog-5	40	4.06 bcdef	6.16 bcd	971.43 abc	86.49 abcd
Binamoog-8	40	5.37 abc	5.95 bcde	1096.23 ab	77.04 bcde
Tila Mung	40	3.25 efgh	8.55 a	1062.06 abc	70.74 cdef
BARI Mung-6	80	4.31 bcde	5.70 bcde	952.07 abcd	89.95 abc
Binamoog-5	80	3.71 cdefg	3.97 efg	698.66 bcde	56.86 efg
Binamoog-8	80	3.00 efghi	4.22 def	686.05 cdef	55.25 fgh
Tila Mung	80	2.30 ghi	3.23 fgh	432.40 efg	68.10 def
BARI Mung-6	120	3.64 defg	4.46 cdef	742.12 bcde	67.27 def
Binamoog-5	120	4.30 bcde	3.55 fgh	712.07 bcde	45.56 gh
Binamoog-8	120	2.56 fghi	3.45 fgh	568.27 defg	49.63 fgh
Tila Mung	120	2.15 ghi	3.97 efg	465.47 efg	69.50 cdef
BARI Mung-6	160	2.42 ghi	2.82 fgh	488.23 efg	45.86 gh
Binamoog-5	160	3.01 efghi	2.00 gh	402.35 efg	35.87 gh
Binamoog-8	160	1.55 i	1.91 h	283.35 fg	39.66 gh
Tila Mung	160	1.56 hi	1.56 h	180.93 g	32.52 h
Level of significance		*	*	**	**

*- different letter(s) in a column are significantly different at 5%, **- different letter(s) in a column are significantly different at 1% level and means having same letter(s) in a column are similar by DMRT.

IV. Discussion

Mobilization of seed reserves during seed germination is crucial because it supplies substrate for proper functioning of different metabolic processes that essential for growth of embryonic axis which contributes translocation of assimilates from seed, resulting in seed germination. Salinity might affect water availability, mobilization of seed reserves and structural organization of protein which leads to diminishing in seed germination (Machado Neto et al., 2004). Salinity might induce numerous effects on germination energy. Firstly, it reduces the imbibitions of water by lowering the osmotic potential of the solution. Secondly, it causes mineral imbalance and ion toxicity which affect germination energy, germination capacity and germination percentage (Munns et al., 2006). According to Ayaz et al. (2000), the reduction in total seed germination under conditions of salt stress is due to some metabolic disorders. It seemed that the decrease of total germination percentage is related to the reduction in water absorption into seeds. Gulzar and Khan (2001) also reported that NaCl stress prevents water absorption by seeds and decreases significantly total germination percentage. Salinity affects germination in two ways, first by decreasing the osmotic potential which retards or prevents the uptake of water and second by toxic accumulation of ions which damages the embryo.

These results have implications on the parameters of germination such as total germination percentage, germination index and the coefficient of velocity which are badly affected. Also,

Published with open access at journalbinet.com
EISSN: 2312-7945, © 2020 The Authors, Research paper

germination is delayed and Mean Germination Time increased with salt stress. The same results were reported by Zapata et al. (2003) on lettuce (*Lactuca sativa* L.) and Chartzoulakis and Klapaki (2000) on pepper. Salt stress caused low intra-cellular water potential and water scarcity around the root zone due to which roots failed to absorb sufficient water and nutrients for adequate plant growth (Mohammed, 2007; Sunil et al., 2012). A decrease in root and shoot growth under saline environment caused reduced total plant growth (Sehrawat et al., 2013a; 2013b). Growth inhibition under salt stress may be due to the diversion of energy from growth to maintenance (Greenway and Gibbs, 2003).

Plumule was comparatively more suppressed than radicle by salinity at all salt concentration levels. Similar results were found by Kaya et al. (2008) and Moud and Maghsoudo (2008). They reported that shoots of seedlings were more sensitive to salt stress than roots. This can be the result of a fast osmotic adjustment occurring in roots. The gradual decrease in plumule length with an increase in NaCl stress could be due to an inhibitory effect of NaCl salt in shoot growth compare with root. As the root is the first developing organ, reduced growth occurred here at first due to the limited O_2 under salinity which deprived the plants of energy source and gathering of higher ethylene that inhibit root growth (Akram et al., 2010). Reduced shoot development occurred due to the inhibition of leaf opening and spreading out as well as internode growth and by accelerating leaf abscission (Qu et al., 2012). Reduction in weights with increasing salinity may be due to limited supply of metabolites to young growing tissues, because metabolic production is significantly perturbed at high salt stress, either due to the low water uptake or toxic effect of NaCl (Akram et al., 2010).

V. Conclusion

From the findings of the present study, it is concluded that there are no significant differences among four genotypes in case of germination percentage at 0 mM/L and 40 mM/L. All the parameters regarding germination and seedling growth were affected by the increase of salinity levels though their reduction varied from genotype to genotype. At 160 mM/L, the highest germination percentage (95%), highest shoot length (2.8 cm), seedling vigor index (488.26), seedling dry weight (45.9 mg) was observed in BARI Mung-6 and the lowest germination percentage (52%), shoot length (1.56 cm), seedling vigor index (180.93), seedling dry weight (32.52 mg) was in Tila Mung. The variety of BARI Mung-6 is superior from other varieties considering their germination and growth attributes under salinity stress. Further field experiment along with other physiological aspects might be considered for determining the salinity resistant status and the genetic improvement of these genotypes.

Acknowledgement

The author expresses his heartfelt respect to Agrotechnology Discipline, Khulna University for managing funds and providing technical supports for conducting this research. The author also shows heartiest gratefulness and thanks to all the co-authors of this article for their valuable advice, suggestions and constructive criticism.

VI. References

[1]. Akram, M., Ashraf, M. Y., Ahmad, R., Waraich, E. A., Iqbal, J. and Mohsan, M. (2010). Screening for salt tolerance in maize (*Zea mays* l.) hybrids at an early seedling stage. Pakistan Journal of Botany, 42(1), 141-154.

[2]. Ayaz, F. A., Kadioglu, A. and Urgut, R. T. (2000). Water stress effects on the content of low molecular weight carbohydrates and phenolic acids in Cienanthesetosa. Canadian Journal of Plant Science, 80, 373-378. https://doi.org/10.4141/P99-005

[3]. Bam, R. K., Kumaga, F. K., Ofori, K. and Asieudu, E. A. (2006). Germination, vigor and dehydrogenase activity of naturally aged rice (*Oryza sativa* L.) seeds soaked in potassium and phosphorous salts. Asian Journal of Plant Science, 5, 948–955. https://doi.org/10.3923/ajps.2006.948.955

[4]. BBS (Bangladesh Bureau of Statistics). (2015). Yearbook of Agricultural Statistics of Bangladesh. Bangladesh Bureau of Statistics Division, Ministry of Planning, Government of the Peoples Republic of Bangladesh.

Published with open access at journalbinet.com
EISSN: 2312-7945, ©2020 The Authors, Research paper

[5]. Chartzoulakis, K. and Klapaki, G. (2000). Response of two greenhouse pepper hybrids to NaCl salinity during different growth stages. Scientia Horticulturae, 86(3), 247-260. https://doi.org/10.1016/S0304-4238(00)00151-5
[6]. Flowers, T. J. and Flowers, S. A. (2005). Why does salinity pose such a difficult problem for plant breeders? Agricultural Water Management, 78(1), 15-24. https://doi.org/10.1016/j.agwat.2005.04.015
[7]. Gomez, K. A. and Gomez, A. A. (1984). Statistical Procedures for Agricultural Research. John Wiley & Sons.
[8]. Greenway, H. and Gibbs, J. (2003). Mechanisms of anoxia tolerance in plants.II. Energy requirements for maintenance and energy distribution to essential processes. Functional Plant Biology, 30, 999-1036. https://doi.org/10.1071/PP98096
[9]. Gulzar, S. and Khan, M. A. (2001). Seed germination of a halophytic grass Aeluropus lagopoides. Annals of Botany, 87(3), 319-324. https://doi.org/10.1006/anbo.2000.1336
[10]. Haque, S. A. (2006). Salinity problems and crop production in coastal regions of Bangladesh. Pakistan Journal of Botany, 38(5), 1359-1365.
[11]. Hasanuzzaman, M., Nahar, K. and Fujita, M. (2013). Plant response to salt stress and role of exogenous protectants to mitigate salt-induced damages. In: Ahmad P, Prasad MNV (eds) Ecophysiology and responses of plants under salt stress. Springer, New York. pp. 25–87. https://doi.org/10.1007/978-1-4614-4747-4_2
[12]. Kaya, M., Kaya, G., Kaya, M. D., Atak, M., Saglam, S., Khawar, K. M. and Ciftci, C. Y. (2008). Interaction between seed size and nacl on germination and early seedling growth of some turkish cultivars of chickpea (*Cicer arietinum* L.). Journal of Zhejiang University Science B, 9(5), 371-377. https://doi.org/10.1631/jzus.B0720268
[13]. Ketinge, J. D. H., Easdown, W. J., Yang, R. Y., Chadha, M. L. and Shanmugasundaram, S. (2011). Overcoming chronic malnutrition in a future warming world: The key importance of mungbean and vegetable soybean. Euphytica, 180(1), 129-141. https://doi.org/10.1007/s10681-011-0401-6
[14]. Machado Neto, N. B., Saturnino, S. M., Bomfim, D. C. and Custodio, C. C. (2004). Water stress induced by Mannitol and Sodium Chloride in Soybean cultivars. Brazilian Archives of Biology and Technology. 47 (4): 521- 529. https://doi.org/10.1590/S1516-89132004000400004
[15]. Mohammed, A. H. M. A. (2007). Physiological aspects of mungbean plant (*Vigna radiate* L. Wilczek) in response to salt stress and gibberellic acid treatment. Research Journal of Agriculture and Biological Sciences. 3, 200-213.
[16]. Moud, A. M. and Maghsoudi, K. (2008). Salt stress effects on respiration and growth of germinated seeds of different wheat (*Triticum aestivum* L.) cultivars. World Journal of Agricultural Sciences, 4(3), 351-358.
[17]. Munns, R., James, R. A. and Läuchli, A. (2006). Approaches to increasing the salt tolerance of wheat and other cereals. Journal of Experimental Botany, 57(5), 1025-1043. https://doi.org/10.1093/jxb/erj100
[18]. Qu, C., Liu, C., Gong, X., Li, C., Hong, M., Wang, L. and Hong, F. (2012). Impairment of maize seedling photosynthesis caused by a combination of potassium deficiency and salt stress. Environmental and Experimental Botany, 75, 134–141. https://doi.org/10.1016/j.envexpbot.2011.08.019
[19]. Sagar, A., Tajkia, J. E., Haque, M. E., Fakir, M. S. A. and Hossain, A. K. M. Z. (2019). Screening of sorghum genotypes for salt-tolerance based on seed germination and seedling stage. Fundamental and Applied Agriculture, 4(1), 735–743. https://doi.org/10.5455/faa.18483
[20]. Sehrawat, N., Bhat, K. V., Sairam, R. K. and Jaiwal, P. K. (2013a). Screening of mungbean (*Vigna radiata* L. Wilczek) genotypes for salt tolerance. International Journal of Plant and Environmental Science, 4, 36-43.
[21]. Sehrawat, N., Bhat, K. V., Sairam, R. K., Tomooka, N., Kaga, A., Shu, Y. and Jaiwal, P.K. (2013b). Diversity analysis and confirmation of intra-specific hybrids for salt tolerance in mungbean (*Vigna radiata* L. Wilczek). International Journal of Integrated Biology,14, 65-73.
[22]. Sunil, K. B., Prakash, M., Narayanan, S. and Gokulakrishnan, J. (2012). Breeding for salinity tolerance in mungbean. In: 2nd International Conference on Asia Agriculture and Animal (ICAAA 2012). APCBEE Procedia 4. pp. 30-35. https://doi.org/10.1016/j.apcbee.2012.11.006
[23]. Zapata, P. J., Pretel, M. T., Amorós, A. and Botella, M. Á. (2003). Changes in ethylene evolution and polyamine profiles of seedlings of nine cultivars of *Lactuca sativa* L. in response to salt

Published with open access at journalbinet.com
EISSN: 2312-7945,

stress during germination. Plant Science, 164(4), 557-563. https://doi.org/10.1016/S0168-9452(03)00005-0

HOW TO CITE THIS ARTICLE?

Crossref: https://doi.org/10.18801/jbar.240220.246

MLA

Podder, et al. "Effect of salinity (NaCl) on germination and seedling growth of mungbean (*Vigna radiata* L.)". Journal of Bioscience and Agriculture Research, 24(02), (2020):2012-2019.

APA

Podder, S., Ray, J., Das, D. and Sarker, B. C. (2020). Effect of salinity (NaCl) on germination and seedling growth of mungbean (*Vigna radiata* L.). *Journal of Bioscience and Agriculture Research*, 24(02), 2012-2019.

Chicago

Podder, S., Ray, J., Das, D. and Sarker, B. C. "Effect of salinity (NaCl) on germination and seedling growth of mungbean (*Vigna radiata* L.)". Journal of Bioscience and Agriculture Research, 24(02), (2020):2012-2019.

Harvard

Podder, S., Ray, J., Das, D. and Sarker, B. C. 2020. Effect of salinity (NaCl) on germination and seedling growth of mungbean (*Vigna radiata* L.). Journal of Bioscience and Agriculture Research, 24(02), pp. 2012-2019.

Vancouver

Podder, S, Ray, J, Das, D, and Sarker, BC. Effect of salinity (NaCl) on germination and seedling growth of mungbean (*Vigna radiata* L.). Journal of Bioscience and Agriculture Research, 2020 May 24(02), 2012-2019.

EISSN: 2312-7945,