Bangladesh J. Environ. Sci., Vol. 48, 31-36, 2025 **@ BAED ISSN 1561-9206**

EFFECT OF DIFFERENT SALINE REGIMES ON GERMINATION AND SEEDLING GROWTH OF MUNGBEAN (*Vigna radiata* L.)

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ABSTRACT

An experiment was conducted in the laboratory of Regional Agricultural Research Station, Bangladesh Agricultural Research Institute, Cumilla during the period from August 2019 to October 2019 to investigate the effect of salt stress on the germination and seedling growth of eight mungbean genotypes. The treatments were salt levels of 0 (control), 8, 12, and 16 dS m^{-1} and the mungbean genotypes were BARI Mung-7, BARI Mung-8, BM×K1-11004-3, MMA-T-V07, BM×K1-112009, BM×K1-112002, SM-2-134 and MM-L1-V12. The experiment was laid out in a completely randomized design (CRD) with three replicates. The results indicated that salinity affected seed germination and seedling growth significantly, and among the salinity treatments only 8 dS m^{-1} salt stress-imposed seeds were germinated and survived for few days. On the other hand, the radicle and plumule were damaged to all the genotypes after germination when applied the salt by 12 and 16 dS m^{-1}. Germination percentage, relative water content, seedling vigor index and salt tolerant index were significantly influenced by imposition of salt stress in all genotypes. However, among the genotypes studied, MM-L1-V12 performed better and BARI Mung-8 showed highest sensitivity to salt stress.

Key words: Saline regimes, germination, seedling growth, mungbean

Introduction

Salt stress is not only the most serious factor limiting legume productivity in arid and semi-arid condition (Lauchli *et al*., 2007; Rozema and Flowers, 2008; Abdel– Latef, 2010) but also resulting alterations in plant metabolism by reduction of water potential, ion imbalance and toxicity, and CO_2 assimilation (Munns and James, 2003). Salt stress has been shown to decrease the germination percentage and rate, vigor seed and seedling growth of some crops (Shitole and Dhumal, 2012). Germination and seedling growth are reduced in saline soils with varying responses for species and cultivars (Rahim *et al*., 2013). Salt stress causes a substantial growth reduction in mungbean. For example, salt stress was found to reduce seed germination, fresh and dry biomass, shoot and root lengths and yield attributes of mungbean (Ahmad, 2009). This reduction in mungbean growth increases with increase in saline regimes (Chakrabarti and Mukherji, 2003). The most common salinity effect is a general stunning of plant growth. Salinity is a polygenic trait which adversely affected the biometric, morpho-physiological, biochemical and biophysical characters of mungbean (Mahajan and Tuteja, 2005). Due to the complex nature of salinity stress and lack of appropriate techniques for introgression little progress has been made in developing salt tolerant mungbean varieties (Mahdavi and Sanavy, 2007). Therefore, the present study focuses on the development of improved varieties for saline soils regarding sustainable pulse production in Bangladesh.

Materials and Methods

The experiment was conducted in the Plant physiology laboratory of the Regional Agricultural Research Station (RARS), Bangladesh Agricultural Research Institute (BARI), Cumilla during the period from August 2019 to October 2019 with eight mungbean genotypes and four levels of salt. The treatments were salt levels of 0 (control), 8, 12 and 16 dS m-1 and the mungbean genotypes were BARI Mung-7, BARI Mung-8, BM×K1-11004-3, MMA-T-V07, BM×K1-112009, BM×K1-112002, SM-2-134 and MM-L1-V12. The genotypes were collected from Pulse Research Sub-Station, BARI, Cumilla. The experiment was laid out in a two factorial completely randomized design (CRD) with three replications. Salinity levels were maintained by dissolving commercial salt (NaCl) at the rate of 640 mg L^{-1} distilled water for getting 1 dS m^{-1} salinity level. During this period, 5 mL of appropriate salt solution was applied to each Petridish every day for maintaining constant salinity levels (Cokkizgin, 2012). The control (0 dS m^{-1}) treatment was maintained by using tap water on the petridish. Data regarding germination of mungbean and saline regimes were collected and analyzed statistically by using two-way analysis of variance with the statistical software (Statistix10) and comparisons with $P \leq 0.05$ were considered significantly different by using LSD values (Tukey's Test).

Results and Discussion

Germination percentage (GP): The increasing levels of salt concentration had significant increased effect on germination percentage (Fig. 1). In each genotype, salt stress significantly affected germination percentage and germination decreased with the increase in salt level. Maximum GP was recorded in the control condition while the minimum was recorded in the highest salt level (16 dS m^{-1}). At salt stress maximum GP was observed in MM-L1-V12 which was statistically identical to BM×K1-11004-3 and minimum GP was observed in SM-2-134 and BARI Mung-7. The osmotic effect due to salinity was presumably the main inhibitory factor that reduced germination (Akbar and Ponnamperuma, 1982). Salinity is one of the most important factors limiting plant growth and delaying seed germination as well as final germination percentage (Rahman *et al*., 2001).

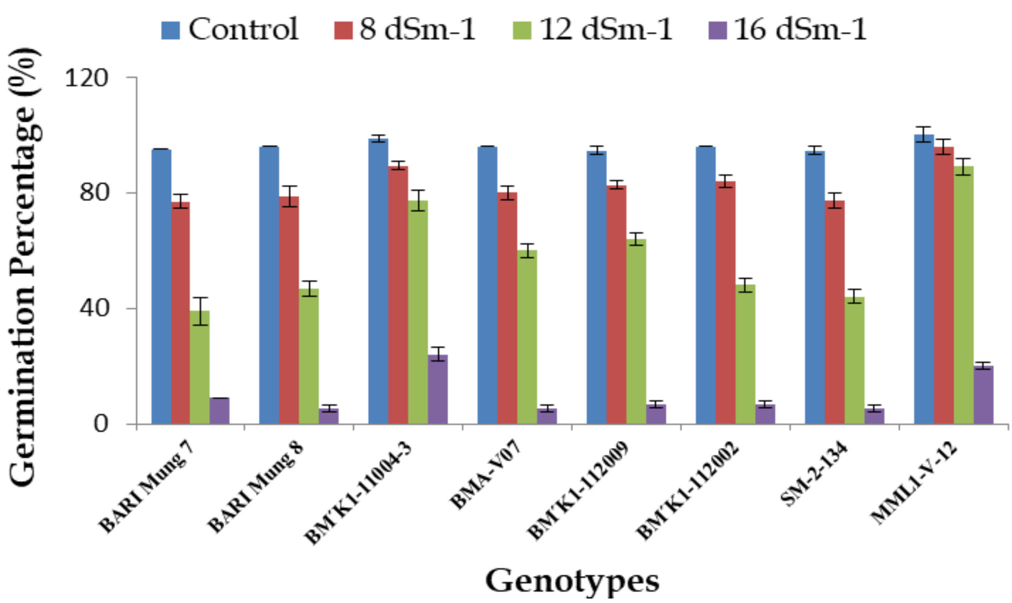

Fig. 1. Germination percentage (GP, %) of eight mungbean genotypes grown under four salt levels (0, 8, 12 and 16 dS m^{-1}). Vertical bar represents SEM (n=3) ($P \leq 0.05$).

Relative water content (RWC): Salinity had a profound effect on relative water content in all eight genotypes used in the present experiment (Fig. 2). However, the minimum variations were observed in control and stress condition in MM-L1-V12 and BM×K1-11004-3 and the maximum variation was observed in BM^xK1-112002. Relative water content of leaf tissue indicates the present water content in the leaf relative to its maximum water content at full turgidity. The RWC is related to water uptake by the roots as well as water loss through transpiration. Reduced water contents with increased salt stress was reported in fenugreek (Shadded and Zidan, 1989) while enhanced root moisture contents with increasing salinity levels was reported in Bur Clover (Ibrar and Hussain, 2003).

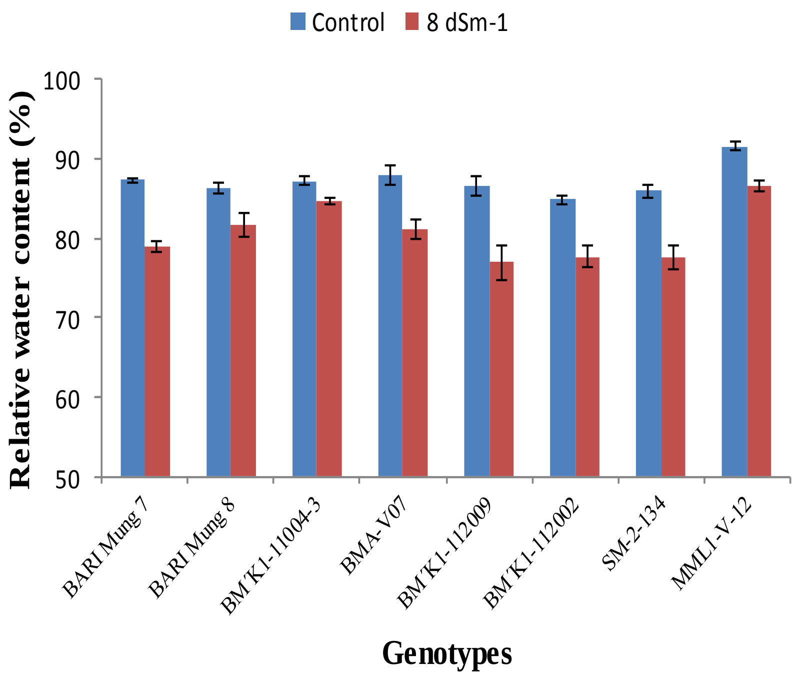

Fig. 2. Relative water content (RWC, %) of eight mungbean genotypes grown under two salt levels (0 and 8 dS m^{-1}) Vertical bar represents SEM (n=3) ($P \leq 0.05$).

Plumule length (PL): Salinity significantly influenced the plumule length for the genotypes (Fig. 4). However, the highest plumule length was achieved under control condition in MM-L1-V12 which was identical to BMK1-11004-3 and the lowest plumule length was observed in BARI Mung 8 which was at par with MMA-T-V07, BARI Mung-7, SM-2-134, BM×K1-112002 and BM×K1-112009 (Fig. 3).

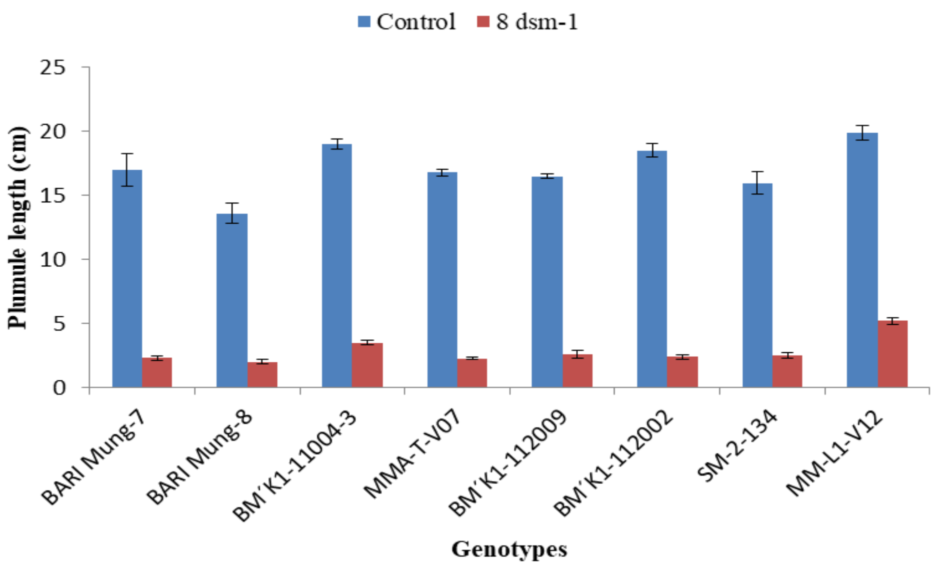

Fig. 3. Plumule length (cm) of eight mungbean genotypes grown under two salt levels (0 and 8 dS m^{-1}). Vertical bar represents SEM (n=3) ($P \leq 0.05$).

Reduced growth under salt stress might also be due to reduced transport of essential nutrient to the shoot (Dagar *et al.*, 2004). The length of radicle and plumule are decreased with increasing salt concentration level in all landraces of clover (Jajarmi, 2009).

Radicle length (RL): Root length (cm) decreased due to the effect of NaCl application. The longest root was achieved in MM-L1-V12 and the smallest was obtained from BARI Mung-8 under both control and salt stress condition (Fig. 4). It might be noted that, application of NaCl stress might hit the elongation of radicle as observed by Kagan *et al*. (2010). The presence of unexpected salt concentration in the growth medium can reduce the absorption of water due to lessening of the osmotic potential and affects cell division (Ashraf and Harris, 2013).

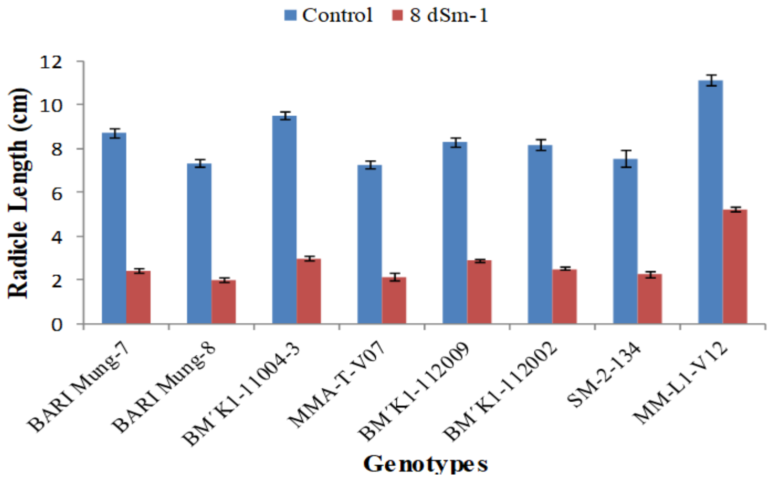

Fig. 4. Radicle length (cm) of eight mungbean genotypes grown under two salt levels (0 and 8 dS m^{-1}). Vertical bar represents standard error ($P \leq 0.05$)

Seedling vigor index (SVI): The highest seedling vigor index was achieved in MM-L1-V12 and the lowest in BARI Mung-8 under salt stress condition (Fig. 5).

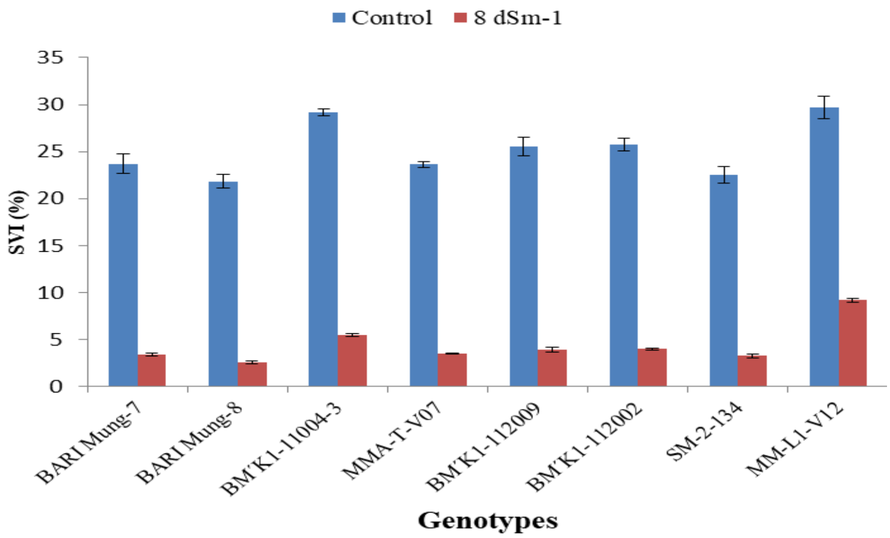

Fig. 5. Seedling vigor index of eight mungbean genotypes grown under two salt levels (0 and 8 dS m^{-1}). Vertical bar represents SEM (n=3) ($P \leq 0.05$).

Seedling vigor index of maize was also significantly affected under different salt stresses (Janmohammadi, 2008). It was reported that under stress conditions there was a decrease in water uptake during imbibition and seedling establishment and in the case of salt stress; this could be followed by uptake of harmful ions (Prisco and Vieira, 1976).

Salt tolerant index (STI): Salt tolerance index (STI) decreased with increasing salinity stress (Fig. 6). The mean data of the experiment was given that the genotype MM-L1-V12 showed the highest STI while SM-2-134 and BM×K1-112002 showed the lowest STI at 8 dS m-1 salinity stress.

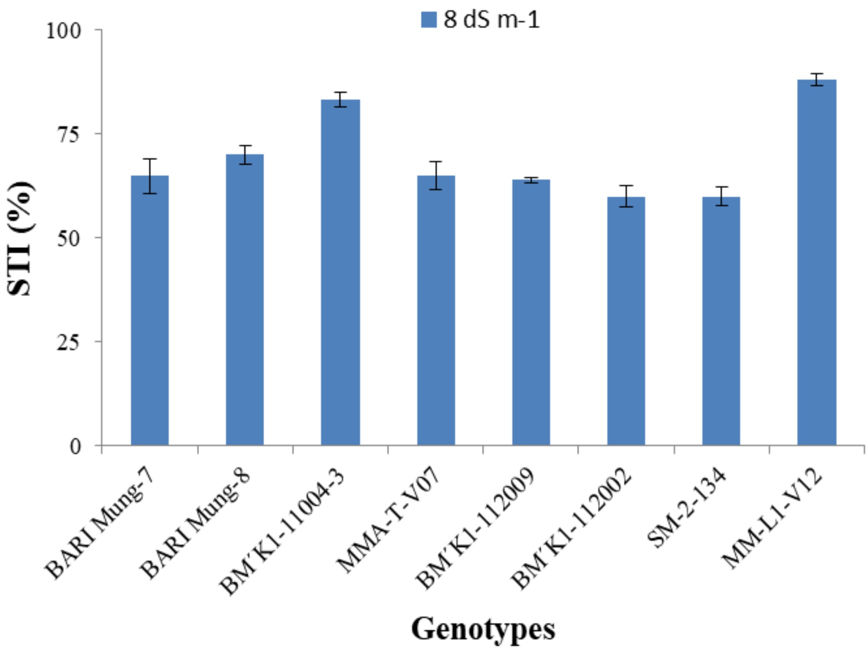

Fig. 6. Salt tolerant index of eight mungbean genotypes grown under salt level (8 dS m^{-1}). Vertical bar represents SEM (n=3) (P≤0.05).

Awasthi *et al.* (2016) also observed that salt tolerance index decreased with increasing salinity stress. They showed that, the highest STI at 50 mM salt stress level was in *Vigna mungo* (46.5%), while *Vigna radiata* showed the lowest STI (20.8%) at 100 mM salt stress level.

Conclusion

Based on experimental results, it may be concluded that salt stress significantly declined Germination percentage (GP), seedling vigor index (SVI), salt tolerant index (STI) in all mungbean genotypes. Among the genotypes studied MM-L1-V12 performed better than the other genotypes under salt stress condition.

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