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The Effects of Different Levels of Salinity on Varieties of Mung Seed Germination in Pot Condition

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ABSTRACT

In order to investigate the effect of different levels of salinity on varieties of mung seed germination in pot conditions a research was performed in summer 2013 in the Research Laboratory of Agriculture and Natural Resources University of Ahvaz. These experiments were performed in factorial mode in the form of completely randomized designs with two treatments and four replications. The first treatment included hybrid VC6371A, hybrid VC6371B and local Parto varieties. The second treatment included different levels of salinity based on electrical conductivity (EC) of the medium including: zero (control), 16, 12, 8 and 4 ds/m. The analysis was performed in the pot. In these experiments the germination traits such as germination percentage (G%), rate of germination (ROG), mean daily germination (MDG), the mean time of germination (MTG) and daily germination speed (DGS). The results showed that the interactive effects of varieties and different levels of salinity have significant effect on most of the traits under study. Also the varieties and levels of salinity had significant effect on ROG and G% ($P<0.05$). In this experiment the specific variables such as ROG and G% of Parto variety were higher than the hybrid varieties; thus germination of the local Parto variety had greater resistance than the mentioned varieties under high salinity. Thus this appropriate trait could have a significant impact on increasing the final yield of this variety.

Keywords: Parto variety, Salinity, Rate of germination, Germination percentage, Pot cultivation

INTRODUCTION

Legumes were known as valuable a source of protein in many parts of the world. The US Department of Protein Counseling has introduced legumes reform initiatives as part of critical studies. Solving protein deficiency in the diet through adding legumes' protein was one of the most important solutions in solving protein and calorie deficiency in developing countries (Bagheri and Zand, 1997). Countries that were facing a shortage of animal protein solve this problem of malnutrition and protein deficiency with the right combination of plant protein.

Legumes with 17-35% protein may play a major role in the human diet. Proteins in basic products like wheat, rice and corn were low and about 7-13% but the legumes not only have larger amounts of protein than grains and tuberous plants but also their protein was very desirable in terms of quality (Ganjali *et al*., 1999).

According to the UN Food and Agriculture Organization, more than 6 percent of the world's land was affected by salinity phenomenon which includes more than 800 million hectares (Yadav, Irfan, and Hayat, 2011). Salinity affects plants by general and specific mechanisms. General mechanisms were associated with reduced osmotic potential of the soil that was linked to photosynthesis and transpiration. But the specific mechanisms were associated with ion absorption and reduction, toxicity or changes in the balance of minerals that eventually will change physiological processes (Chen, 2006).

Fateh *et al* (2011) investigated the effect of different levels of priming and levels of salinity (zero, 16, 12, 8, 4 ds/m) on the germination specifications of mung seed and stated that the interaction between priming and salinity treatments caused by NaCl was significant on germination characteristics. Kazerouni Monfared et al (2013) in the analysis of the physiological effect of salinity (0, 6, 12, 18 dS/m) on germination and different genotypes' seedling growth showed that it has a significant effect on the germination of mung beans on Dezful variety. Agheipoor et al (2013) examined the effect of seed priming with indole butyric acid on the germination features of pinto beans in salinity found the different and significant impact on the characteristics.

Very little research has been done on mung. One of agronomical factors that affect the yield was the proper germination characteristics of the seeds. This factor with its effect on the growth of a seedling ultimately affects the yield. Thus finding suitable varieties that lead to the maximum yield was very useful.

MATERIALS AND METHODS

This experiment was done in summer 2013 in Research Laboratory of Agriculture and Natural Resources University of Ahvaz in 43, 617 951°E31, 63 155°N. The experiment was done in the pot as completely random designs with two treatments with three replications. The first treatment (V) included three varieties of Hybrid VC6371A (V1), Hybrid VC6371B (V2) and local Parto variety (v3). The second treatment was different levels of salinity based on electrical conductivity (EC) that included (S1) with EC equal to 4(ds/m), (S2) with EC equal to 8(ds/m), (S3) with EC equal to 12(ds/m), (S4) with EC equal to 16(ds/m) and zero control treatment (S0).

In this experiment first 60 uniform plastic pots with a capacity of 2 kg and the height of 25Cm were considered. A hole was considered at the bottom of the pot as the drainage. Then they were washed with water and washing liquid and kept in the oven at 120°C for 24h to remove all microbial and fungal contaminations. Then they were filled with farm soil. Pots were irrigated with 50 cc of distilled control water and solution of water and salt with certain concentrations of NaCl (4, 8, 12 and 16 ds/m) prepared based on equation (11).

(1) NaCl value in mg $TDS_{mgr/lit} = EC \times 640$

The seeds were kept in sodium hypochlorite (with 5% activated chlorine) for 5 minutes to disinfect from fungal infections and then sterilized with distilled water 3 times for 15 minutes. Then they were dried at room temperature on filter paper whatman aualitativel 9.0cm (Dianati Tilaki *et al.,* 2008). After that mung bean seeds were disinfected against fungal infections, 20 seeds were put in the pot. 10 cc of distilled water and also solution of water and salt with certain concentrations of NaCl were added to the pots and put in the open air. The germinated seeds were counted on a daily basis during germination (8 days). Seeds with the root length of 2 mm or greater were considered as germinated seeds. Then the 8-day seedlings were removed from the pots and the wet weight of the radicle and plumule was measured by an accurate scale. Then the radicle and plumule and seedling were placed in small paper bags for 48 hours and to completely dry the samples they were located in an electric oven and the temperature of 72°C. Then the dry weight of radicle and plumule was measured by an electric scale and recorded in Tables (Majnoon Hosseini *et al.,* 1996). So after counting the germinated seeds and measuring the weight and length of seedlings, radicles and plumules as well as the number of germinated seeds within the 1^{st} to 8^{th} days and recording them in specific forms the germination percentage (G%), rate of germination (ROG), mean daily germination (MDG), the mean time of germination (MTG) and daily germination speed (DGS) were calculated by the following equations (Bagheri, 1997).

(2) G% =The number of cultivated seeds/ the number of germinated seeds

(3) $ROG=\sum/\sum(d \times n)$ (4) MDG = FGP / D

n: The number of germinated seeds FGP: final germination percentage

d: the number of days passed since the beginning of germination d: total number of days

(5) $MTG =\sum(d \times n)/ \sum N$ (6) $CVG =\sum Gn/ \sum (n \times Gn)$

d: the number of days passed since the beginning of germination G1-Gn: The number of germinated seeds from the first to the final day

n: The number of germinated seeds

For the analysis of the data Spss application was used. The comparison of the means was done by Duncan's multiple range test at the probability level of 5% and to plot the diagram the Excel software were used (Bagheri, 1997).

RESULTS AND DISCUSSION

Germination percentage and daily germination speed

In examining Table (1) the analysis of variance related to the effect of treatments on the variables showed that the effect of variety treatment on germination percentage and daily germination speed was insignificant at 5% but the effect of salinity treatment was significant at 1% level. Table 2 of mean comparison showed that the impact of different levels of salinity

treatment was significant at 5% level on the germination percentage and daily germination speed. In examining Table 3 the mean comparison showed that the effect of different varieties on germination percentage in hybrid VC6371A and VC6371B had significant at 5% level in terms of the mentioned variable. But the local Parto variety had no significant difference compared with hybrid VC6371A. Also the germination variable did not present a significant difference at 5% in all varieties. In diagram (1) related to the effect of salinity on germination it was indicated that by increasing the level of salinity the curve of germination percentage of germination was reduced respectively. At the salinity of S0 (0 ds/m) the mean germination percentage of the varieties was 88% and at the salinity of S4 (16 ds/m) the mean germination percentage of the varieties was 78%. But the ratio of mean germination percentage of other varieties was different. The highest the mean germination percentage was associated with local Parto variety wuth 90% and the variety with the lowest mean germination percentage was hybrid VC6371B with 80%. In diagram (4) the daily germination speed of the cultivation was presented that the levels of salinity treatment had a significant impact on daily germination speed and this trait was increased by increased salinity. The varieties had no significant difference with each other in terms of daily germination speed. So that the highest mean daily germination speed of 0.18 was at the salinity of S4 (16 ds/m) and the lowest mean was 0.07 at the salinity of S0 (0 ds/m).

Karimi (1993) on analyzing the effect of salinity on germination and its indicators mentioned that the effect of variety on the germination percentage and germination rate was significant at the level of 1%. Other studies showed that the germination percentage and rate was reduced by increasing salinity (Demir, *et al* 2006). Bagheri, 1997 in a study on the effect of polyethylene glycol and sodium chloride on germination and seedling of two corn varieties showed that the germination percentage and rate of corn was reduced which was consistent with the results of this study.

Accumulation of intermediate toxic ions in the context of plants disturbs the building of cell organelles, degradation of chlorophyll and reduced photosynthesis activity. The presence of harmful chlorine and sodium elements around the seed reduces water potential and thus the cell turgor was reduced which has a negative impact on germination and reduces its rate (Demir, *et al* 200). Studies conducted on various plants showed that by increasing Nacl concentration, germination was stopped and the germination rate was reduced (Bagheri, 1997). Kazerooni Monfared et al (2013) reported that the presence of toxic elements around the seed reduce water potential and thus water absorption and cell turgor are reduced which had a negative impact on germination and reduces its percentage and rate.

Table (1) analysis of variance related to the effect of varieties and levels of salinity on some mung germination traits

Source of change	Sum of squares				
	DF	FGP	MDG	MTG	DGS
Variety	2	317/92 ns	4/97 ns	1/04 ns	0/01 ns
Salinity	4	530/21 **	8/28**	33/18**	0/02**
Variety*salinity	8	151/77 ns	2/37 ns	8/41 ns	0/004 ns
Error	45	99/86	1/56	4/55	0/005
c.v		12/17	10/5	18/6	11/8

** ، *Significant at 1 and 5% ns : not significant c.v : Coefficient of variation %

Mean daily germination

In examining Table 1 the analysis of variance showed that the effect of variety on mean farm germination percentage was insignificant at 5% but the salinity effect was significant at 1%. Table 2 compares the mean effect of different levels of salinity on the mean farm germination percentage which had a significant difference at 5%. In examining Table 3 the mean comparison indicated that the impact of different varieties on the mean daily germination had no significant difference at 5%. In diagram (2) related to the impact of salinity on mean daily germination revealed that increasing salinity the curve of mean daily germination reduced. At salinity level of S0 (0ds/m) the mean daily germination was equal with 11 and at the salinity level of S4 (16 ds/m) the mean daily germination was equal with 7. However, the mean daily germination of varieties was different from each other. Parto local variety had the highest mean daily germination of 11 and the hybrid VC6371B variety had the lowest mean daily germination of 7.

Dunn et al (2004) investigated the ionic and osmotic effects of salinity on the plant seeds (Chenopodium glaucum L). Under laboratory conditions they showed that by increasing osmotic potential the germination rate was reduced which was significant at 1% level. Dadkhast (2008) in analyzing the impact of salinity of the growth of medicinal plants seedling that are exposed to salinity in most regions and particularly in arid and semi-arid areas indicated that the mean daily germination and seedling growth were significantly reduced by increasing salinity.

Salinity could affect seed germination through reducing the osmosis potential of the growth environment, toxicity of specific ions such as calcium and chlorine and reducing the nutritional ions such as calcium and potassium. In investigating this matter they stated that increasing salinity slows down water absorption by the seed and thus prevents daily germination (Kouchaki, Nasisri Mahallati and Sadrabadi, 1988). Other studies showed that

increasing salinity around the seed reduces the potential and water uptake by the seed was reduced and its germination ability was low (Karimi, 1993).

The mean time required for germination

Analysis of variance in Table 1 showed that the effect of variety treatment on the mean time required for farm germination was insignificant at 5% but the effect of salinity treatment was significant at 1%. Also the analysis of the mean comparison in Table 2 showed that different levels of salinity treatment on the mean time required for farm germination were significantly different at 5%. But the analysis of the mean comparison in Table 3 the effect of different varieties on the mean time required for farm germination was not significantly different at 5%. In the mean time for farm germination diagram 3 it was observed that the salinity level treatment had a significant effect on the mean time required for germination and this trait was increased by increasing salinity. However, the varieties had no significant difference with each other in terms of the mean time required for germination. The highest mean time required for germination was 4.2 at the salinity level of S4 (16 ds/m) and the lowest mean time was 2.8 at the salinity level of S0 (0 ds/m).

Table 2. The comparison of the mean effect of different levels of salinity on some mung germination traits

Salinity Ds/m	Traits			
	FGP(%)	MDG	MTG (days)	DGS (seed/day)
0	87/50 [a]	5/8 [a]	2/1 [a]	0/06 [a]
4	86 [a]	5/2 [a]	2/3 [ab]	0/06 [a]
8	82 [a]	5 [a]	2/5 [ab]	0/08 [a]
12	79 [b]	3/9 [b]	3/1 [b]	0/11 [b]
16	75/5 [b]	3/7 [b]	3/8 [b]	0/13 [b]
Different latters indicate significant difference at 5% (P<0.05)				

Dianati Tilaki et al., 2008 in a study titled "The impact of NaCL priming on germination and growth of Festuca ovina under salinity" showed that the mean germination time is significantly affected by the interactive effect of salinity +priming such that the increased salinity raised the time required for field germination.

The increased salinity and sodium and chlorine ions around the seed reduce water absorption which has a direct negative effect on seed metabolism and reduces fetus cell

division. Thus high concentration of sodium and chlorine ions in the seed enhances the absorption of these elements by hypocotyl and has an inhibiting effect on seed germination; thus the time necessary for seed germination increases (Kouchaki, Nasisri Mahallati and Sadrabadi, 1988).

Table 3. comparing the mean impact of different varieties on some mung germination traits

Variety	traits			
	FGP(%)	MDG	MTG (days)	DGS (seed/day)
Hybrid VC6371A	85[a]	5/19[a]	5/77[a]	0/18[a]
Hybrid VC6371B	[b]78	3/9[a]	6/22[a]	0/23[a]
Parto	86[a]	4/8[a]	6/01[a]	0/19[a]
Different latters indicate significant difference at 5% (P<0.05)				

Shajie *et al* (2015) in their statistical results showed that the impacts of salinity treatment were significant on germination percentage and other germination variables. In general, germination percentage is reduced by increasing salinity. But Aghaeipoor *et al* (2012) in a similar experiment on Jiroft beans concluded that the germination rate and percentage were not affected by the levels of salinity. Results of other researchers were consistent with the present study. Dadkhast (2008) in analyzing the impact of salinity quantity and quality of the medicinal plants found that that germination was significantly reduced by increasing salinity. The analyses conducted by Masoumi, Kafi and Khazaei (2005) on peas and Kazerouni Monfared *et al* (2013) on mung and lentil showed that germination percentage was decreased with increasing salinity which is consistent with the results of the present study. The results of the researchers in this case showed that germination percentage and seedling growth was significantly decreased by increasing salinity. Also the type of salt that causes negative potential, affected germination percentage and seedling growth significantly. Many researchers of salinity impact on plants reported that water and soil salinity prevents glycophyte plants from growing. Salinity can reduce seed germination through reducing osmotic potential of the growth medium, the toxicity of specific ions such as sodium and chlorine ions and reducing essential nutrients such as calcium and potassium. There is certain water potential for each species in which germination cannot it be done (Fowler, 1991). A thorough understanding of germination reaction and seedling growth to salinity is useful in choosing salinity tolerance. Agricultural crops could tolerate salinity to a threshold and then by salinity the yield is reduced linearly (Fowler, 1991). Understanding the tolerance of crops

and the study of varieties as well as the study of their salinity tolerance could provide the best choice in the region based on the soil salinity.

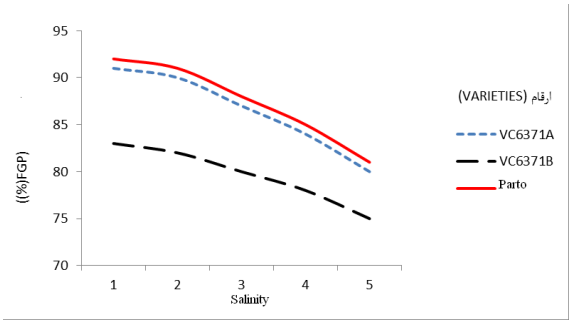

Figure 1. The effect of salinity on farm germination percentage

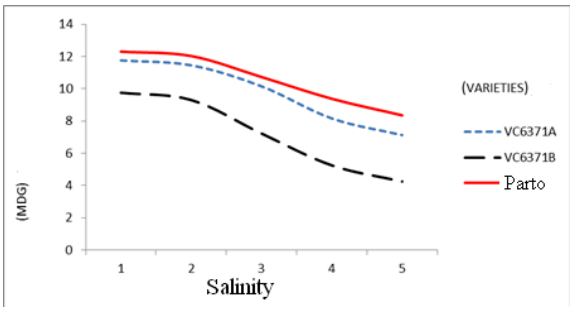

Figure 2. The effect of salinity on mean daily germination (seed /day)

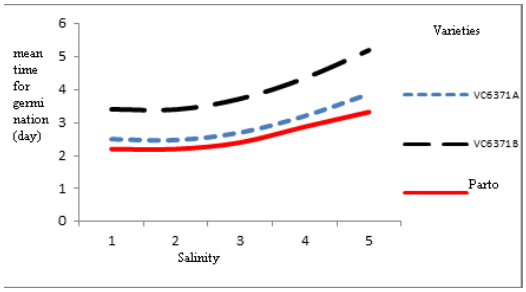

Figure 3. The effect of salinity on the time for germination

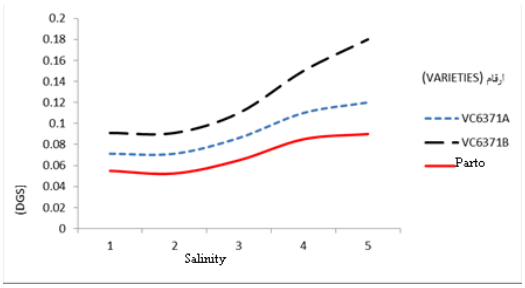

Figure 4. The effect of salinity on daily germination speed

In this study, the analysis of the effect of different levels of salinity and varieties on the variables presented in mean comparison table showed that increasing the salinity levels reduced the level of variables. Thus this study showed that the germination percentage and mean was reduced. However, with increasing salinity other variables such as mean time for germination and daily germination speed were increased.

Most variables in hybrid varieties VC6371A and VC6371B had no significant difference with each other at 5%. But this study Parto variety presented significant differences at 5% between most variable compared to hybrid varieties VC6371A and VC6371B. Therefore it can be concluded that Parto variety germinate had higher resistance than hybrid varieties VC6371A and VC6371B under high salinity conditions. And, finally, this proper trait of this variety could have a great effect on the final yield. Generally the results of this study showed

that all traits were increased by increasing salinity while Parto variety with variables with high levels had the highest resistance against salinity.

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