==
BIODICON
www.biodicon.com
ISSN 1308-5301 Print ; ISSN 1308-8084 Online

Biological Diversity and Conservation
Biyolojik Çeşitlilik ve Koruma
1 / 2 (2008) 53-58
==

The study of salt tolerance of Iranian barley (*Hordeum vulgare* L.) genotypes in seedling growth stages

Farhad TAGHİPOUR [1], Mohammad SALEHİ [*1]

[1] Stress Physiology Lab, Department of Agronomy and Plant Breeding, Azad University, Tehran, Iran

Abstract

This study was carried out in factorial experiment design on the basis of completely randomized design in 3 replications. Salinity treatments involved in 5 levels: S_0=control, S_1=37/5, S_2=75, S_3=150, S_4=225 mmol/l from calcium chloride and sodium chloride with 2:1 ratio (Ca:Na) and other factors were 4 barley genotypes. The effects of salinity treatments were studied by sampling on dry weight of shoot, dry weight of roots, shoot length, leaf area and fresh weight of root and shoot. There were significant differences among genotype×stress interaction for all characters. The results showed that leaf area, dry weight of shoot, dry weight of root, shoot length, fresh weight of steam and fresh weight of root decreased in all barley varieties with increasing in salt level. However SINA and GORGAN 4 varieties in all levels of salinity have the highest tolerance at all salinity levels and ZAR and TORSH were the lowest tolerance.

Key words: Barley, Salinity Tolerance, Seedling Growth, *Hordeum vulgare*.

1. Introduction

Salinity is a serious problem affecting one third of the irrigation land (Mass and Hoffman, 1977.) and limiting the yield potential of modern cultivars. It has been estimated that salts affected nearly 950 million ha^{-1} land in the world (Babu, et al. 2007). The salts accumulating in the soil profile are soils, and seasonal variation in rainfall. Salt concentration mainly chlorides, sulfates, bicarbonates, borates, and the insoils may vary greatly with horizontal or vertical most dominating salt in the soil profile, NaCl (Richards, 1954; Jeschenke, 1984).

[*] *Corresponding author* / Haberleşmeden sorumlu yazar: mohsale@gmail.com

© 2008 *All rights reserved* / Tüm hakları saklıdır

Stress salinity affects nutrient uptake (Dua, 1998) and metabolic activities in plant (Singh and Hoque, 2007). However, the magnitude of the effect of salinity varied with the plant, species type and level of salinity (Bishnoi, et al 1987). Even individual lines also differ at different growth and ontogenetic stages in salt tolerance which provide scope for selection of genotypes for salt tolerance (Ashraf and Mcneilly 1992; Kingsburg and Epstein 1984).

Germination and seedling growth under saline environment are the screening criteria which are widely used to select the salt tolerance genotype (Ashraf et al, 1990; Khan and Naqvi 1993). As for better cropping highest plant population is required, which is only possible if seed germination is satisfactory under saline conditions (Naseer et al, 2007).

Ahmad et al, (2003), reported that increase in rate of sodium chloride and sodium sulfate resulted reduction in number of tillers, length of spike, number of spikelets per spike, biomass per plant and grain yield per plant. They also, found that the sodium chloride resulted in greater damage to all cultivars than sodium sulfate. In other study Naseer et al, (2007), reported that in barley varieties, germination percentage, root and shoot length, and fresh and dry weights decreased with increasing in salt level. Babu et al, (2007), reported that the callus growth decreased with increasing NaCl concentration in the medium.

Development of new plant genotypes that are salt tolerant is a high-priority research area (Colmer and et al, 2006). Salt tolerance is, however, a complex trait and affected by large number of mechanisms. Therefore, identification of a single criterion for ranking genotypes for their tolerance to salt stress is very difficult (Ashraf and Haris, 2004). Thus, by manipulating the heritable variation present in the germplasm, we can develop saline tolerant cultivars through breeding technique, but it is a cumbersome and time-consuming process. The present investigation was to determine the salt tolerance potential of barley varieties at germination and early seedling growth stages.

2. Materials and methods

This experiment was conducted factorial experiment design on the basis of completely randomized design with three replications in Agronomy Department, Faculty of Agriculture, Azad University of Miyaneh, Iran. In this experiment four levels of NaCl salt (S_0 = control, S_1 = 37.5, S_2 = 75, S_3 = 150 and S_4 = 225 m mol\ l) and four barley genotypes (ZAR, SINA, GORGAN4 and TORSH) that provided by seed and plant Improvement Institute, Karaj Iran, were used.

The seeds were planted in plastic vases content with agricultural-perlite (< 2 mm diameter) and irrigated with ½ Hoagland (Hoagland and Arnon, 1938.) solutions. The effects for salinity treatments were studied by sampling on leaf area, dry weight of shoot, dry weight of root, shoot length, fresh weight of steam and fresh weight of root.

Data were statistically analyzed using analysis of variance (ANOVA) using the MSTATC program. Probabilities of significance among treatment and interaction and LSDs (P 0.05) were used to compare means within and among treatments and designed diagram by Excel software.

3. Results

Analysis of data presented in Table 1. showed that salt stress had adverse effect on seedling growth of barley. There were significant differences between all traits in barley genotypes. Also, there were significant differences amongst the genotype×stress interaction for all characters.

Table 1. Analysis of variance summaries (mean squares) of data for seedling growth of barley under salt stress.

S.O.V	D.F.	Fresh weight of root	Fresh weight of shoot	Dry weight of root	Dry weight of shoot	Shoot length	Leaf area
Varieties	3	1.947**	4.225**	0.033**	0.229**	7.414**	392.659**
Treatments	4	54.624**	298.487**	1.039**	3.423**	580.758**	31835.437**
V ×T	12	0.579**	11.414**	0.018**	0.199**	1.946**	194.775**
Error	68	0.065	0.18	0.003	0.021	0.294	21.481
% C.V		13.37	9.05	12.98	16.14	7.73	7.61

* and ** : Significant at the 5% and 1% levels of probability, respectively.

Leaf area decreased with increasing in salt concentration in all barley varieties (Fig.1). The maximum leaf area was recorded under (non-salinized) control and minimum at highest salinity level. However, maximum leaf area was recorded in SINA and GORGAN 4 at all salinity levels. Also, minimum leaf area was recorded in ZAR and TORSH varieties.

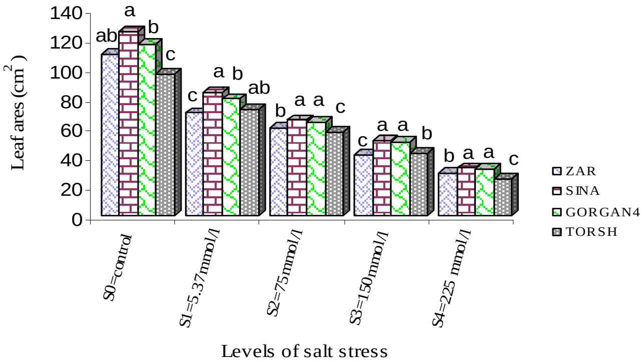

Fig1. Leaf area of 4 barley varieaties growen under salt stress

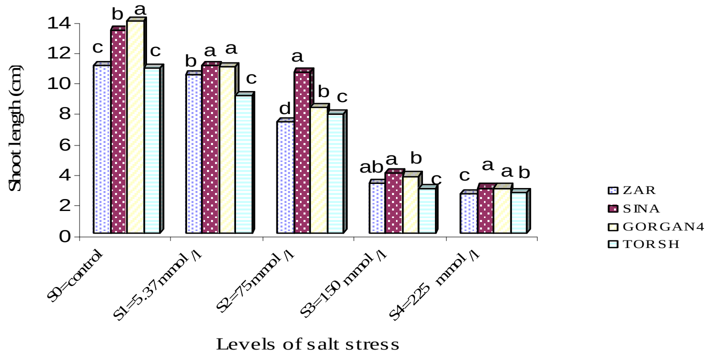

Fig2. Shoot length of 4 barley varieaties growen under salt stress

Highest shoot length were observed in control (non-salinized) treatment as compared to salinized treatment (Fig 2). However SINA and GORGAN4 genotypes had significantly greater shoot length under all levels of salt stress. The reduction in shoot length is due to excessive accumulation of salts in the cell wall elasticity. Further, secondary cell appears sooner and wall becomes rigid as a consequence the turgor pressure efficiency in cell enlargement decreases. These processes may cause the shoot to remain small (Aslam et al, 1993). These findings are parallel to those of Larik and AL-Saheal (1986).

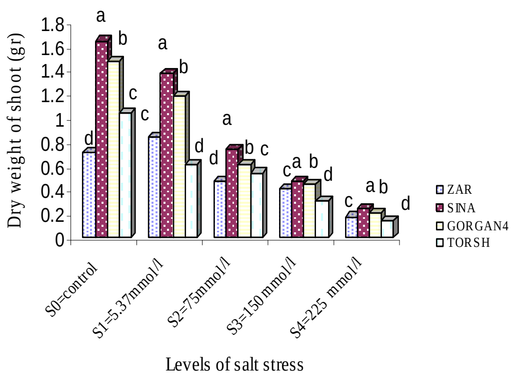

Fig 3.Dry weight of shoot of 4 barley varieaties growen under salt stress

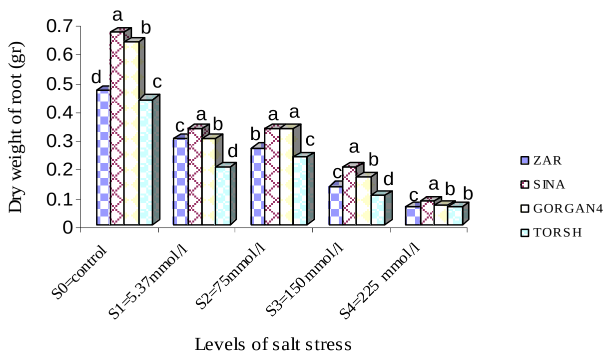

Fig 4. Dry weight of root in 4 barley varieaties growen under salt stress

Comparison of dry weight of root and shoot under various stress situations is obviously essential to define their physiological potentiality as well as to study the reasons for their better yield owing to tolerance. Also, selection of genotypes with height dry weight of root and shoot was the important objective among the breeder for the improvement of yield and other traits in a breeding programs. In the present study dry weight of root and shoot showed almost similar pattern reduction under NaCl levels (Fig 3, Fig 4) and SINA and GORGAN 4 genotypes were screened under different saline stress. In this case, varieties also showed significant difference in shoot dry weight as in root dry weight (Table 1).

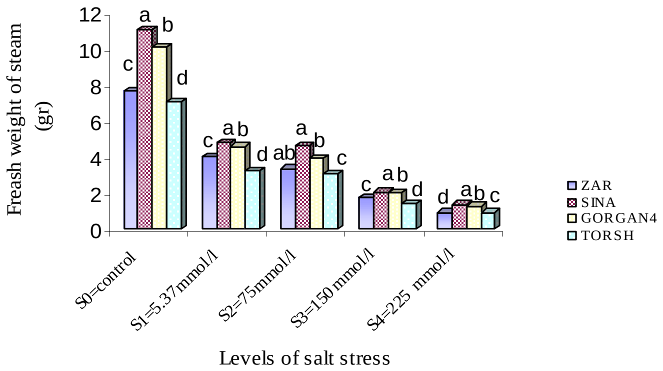

Fig 5. fresh weight of steam in 4 barley varieaties growen under salt stress

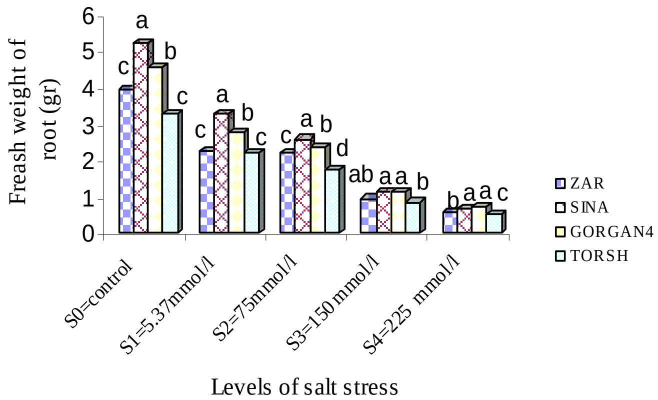

Fig 6. fresh weight of root in 4 barley varieaties growen under salt stress

Fresh weight of root and shoot of four varieties decreased significantly under salt stress (Fig 5 and 6). Varieties differed significantly in case of root and shoot fresh weight. Maximum fresh weights recorded in SINA and GORGAN 4. Our results showed that under salt stress, fresh weights of root and shoot decreased. This 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 (Waisel, 1972). Decreased of fresh weight of root and shoot of barley varieties were increased with in salt level reported by Naseer et al (2007).

Total, results of this study indicate that all treats decreased in response to salinity in all four barley varieties. These results are close conformity with the earlier findings of Ashraf et al. (1990), Kingsburg et al. (1984), and Ahmad et al. (2003). In which they reported that increasing salinity decreased all seedling growth on in sorghum, wheat and barley. Also, we showed that SINA and GORGAN 4 varieties in all levels of salinity have the highest tolerance and ZAR and TORSH were the lowest tolerance in all levels of salinity.

4. Conclusions

Based on the present results, there were significant differences amongst the genotype×stress interaction for all characters. Dry weight of shoot, dry weight of root, shoot length, fresh weight of steam and fresh weight of root decreased in all barley varieties with increase in salt level. Varieties of SINA and GORGAN showed better response at all salinity levels.

References

Ahmad A.N., Intshar U.H.J, Shamshad A et al. 2003. Effects of Na, SO_4 and NaCl salinity levels on different yield parameters of barley genotypes. International Journal of Agriculture and Biology. 5: 2, 157-159.

Ashraf M.Y, Khan M.A, and Ahsan S.A. 1990. Effect of salinity (NaCl) and polyethyleneglycol (PEG) on germination, seedling growth and water uptake of sorghum. Pak. J. Agric., Agril. Engg., Vet. Sci. 6: 33-36,

Ashraf, M and Mcneilly T. 1992. The potential for exploiting variations in salt tolerance in pearl millet (Pennisetum americanum (L.) Leeke), Plant Breeding. 108: 234-240,.

Ashraf, M. and Haris P.J.C. 2004. Potential biochemical indicators of discrimination in salinity tolerance in plants. Plant Science. 166: 3-16.

Aslam, M.P, Qureshi, R.H, and Ahmed, N. 1993. A rapid screening technique for salt tolerance in rice (*Oryza sativa* L.). Plant and soil. 150 : 99-107.

Babu, S., Sheeba, A., Yogameenakshi, P. et al. 2007. Effect of salt stress in the selection of salt tolerance hybrids in rice (*Oryza sativa* L.) under in-vitro and in-vivo conditions. Asian J. of Plant Sciences: 6 (1): 137-142.

Bishnoi, N.R., Siddiqui, S., Kumar, S. 1987.Effect of salinity, salinization and desalinization on the various aspects of dry matter production at vegetative stage in pea and gram. Frontier Botany, 1: 1-11.

Colmer, T.D, Flowers, T.J., and Munns, R. 2006. Use of wild relatives to improve salt tolerance in wheat. Journal of Experimental Botany. 57: 1059-1078.

Dua, R.P. 1998. Salinity tolerance in chickpea (*Cicer arietimum* L.) . Indian. J. Pl. Physiol. 3:102-106.

Hoagland, D.R. and Arnon, D.I. 1938. The water–culture method for growing plants without soil Colif. Agr. Expt.Sta. Cir. 347. Berkeley, Calif.

Jeschenke, W.D. 1984. K+-Na+ exchange at cellular membranes, intracellular compartmentation of cations, and salt tolerance. In: Salinity Tolerance in Plants, Strategies for Crop Improvement (Eds: R. C. Staples and G. H. Teonniessen). A. Wiley - Interscience Publication. John Wiley and Sons. Toronto. Singapore. PP: 37-66.

Khan, M.Y. and Naqvi, S.S.M. 1993. Influence of salinity on protein, RNA and alpha amino nitrogen of wheat seedling. In: Current development in salinity and drought tolerance of plants. Naqvi, S. S. M., M. R. Ansari, T. J. Flower and A. R. Azmi: editors, PP: 89-93,

Kingsburg, R.W. and Epstein, E. 1984.Selection for salt tolerant spring wheat. Crop Science. 24: 310-315.

Larik, A.S. and Al-saheal, Y.A. 1986. Effect of salt stress on germination and seedling growth of wheat , triticale and barley. J. Collage of Sci. 17 : 37-44,

Mass, E.V., Hoffman, GJ. 1977. Crop salt tolerance current assessment. ASCEJ. Irri. Drainage Div. 103: 115- 135.

Naseer, S., Nisar, A. and Ashraf, M. 2007. Effect of salt stress on germination and seedling growth of barley (*Hordeum vulgare* L.). Pakistan Journal of Biological Sciences. 4 (3); 359-360.

Richards, L.A. 1954. Origin and nature of saline and alkali soils. In: Diagnosis and Improvement of Saline and Alkali Soils. Agricultural Handbook No: 60. USDA, Washington, D.C., USA. PP: 1-6..

Singh, R.A.N.K., Hoque, M.S. 2007. Changes in growth and metabolic activity in seedling of lentil (Lens culinaris Medik.) genotypes during salt stress. Indian J. Pl. Physiol., 6: 406-410.

Waisel, Y. 1972. Biology of halophytes. Academic press Inc., New York. PP:395.

(Received for publication 06 November 2008)