

The Study of Salt Tolerance of Iranian Barley (*Hordeum vulgare* L.) Genotypes in Seedling Growth Stages

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Abstract: In order to study of salt tolerance of Iranian barley (*Hordeum vulgare* L.) genotypes in seedling growth stages, this study were conducted in the Agricultural Sciences Laboratory and Greenhouse of the Islamic Azad University of Miyaneh branch during summer 2006. 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 (Ca:Na ratio) and another factor was genotype involved 12 varieties from current barley varieties in Iran. The effects of salinity treatments were studied by sampling on dry weight of shoot, roots, shoot length and fresh weight of root and shoot as well as leaf area. There were a significant differences amongst the genotype \times 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 were decreased in all 12 barley varieties with increasing in salinity level. However varieties of SINA, GORGAN and DASHT showed the best response at all salinity levels.

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

INTRODUCTION

Salinity is a serious problem affecting one third of the irrigation land [1] and limiting the yield potential of modern cultivars. It has been estimated that salts affected nearly 950 million ha land in the world [2].

Salts accumulating in the soil profile are soils and seasonal variation in rainfall. Salt concentration is mainly chlorides, sulfates, bicarbonates, borates and in soils may vary greatly with horizontal or vertical most dominating salt in the soil profile, NaCl [3,4].

Salinity stress affects nutrient uptake [5] and metabolic activities in plant [6]. However, the magnitude of the effect of salinity varied with the plant, species type and level of salinity [7]. Even individual lines also differ at different growth and ontogenetic stages in salt tolerance which provide scope for selection of genotypes for salt tolerance [8,9].

Germination and seedling growth under saline environment are the screening criteria which are widely used to select the salt tolerance genotype [10,11]. As for better cropping highest plant population is required, which is only possible if seed germination is satisfactory under saline conditions [12].

Ahmad *et al.* [13], reported that the increase of sodium chloride and sodium sulfate concentration resulted in the reduction of number of tillers, length of spike, number of spikelets per spike, biomass per plant and grain yield per plant. They also, found that increasing of sodium chloride concentration resulted in greater damage to all cultivars than sodium sulfate. In other study Naseer *et al.* [12], reported that the germination percentage, root and shoot length and fresh and dry weights were decreased in barley varieties with increasing in salinity level. Babu *et al.* [2], reported that the callus growth was decreased with increasing NaCl concentration in the medium.

Development of new plant genotypes that are salt tolerant is a high-priority research area [14]. Salt tolerance is, however, a complex trait and affected by large number of mechanisms. Identification of a single criterion for ranking genotypes for their tolerance to salt stress is, therefore, very difficult [15].

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.

MATERIALS AND METHODS

This experiment were conducted in Agronomy Department, Faculty of Agriculture, Azad University of Miyaneh, Iran.

Twelve barley genotypes (ZAR, SINA, GORGAN4, TORSH, KAVEER, GOHAR JO, ERAM, DASHT, VALFAJR, ARAS, SHIRIN and JOE SYAH) were used. Seeds of these genotypes were provided by seed and plant Improvement Institute, Karaj. Iran.

In this experiment 12 barley varieties were selected for planting in greenhouse to study the seedling growth under four levels of NaCl salt ($S_0 = \text{control}$, $S_1 = 37.5$, $S_2 = 75$, $S_3 = 150$ and $S_4 = 225 \text{ m mol}^{-1}$). The experimental design was factorial experiment in complete design in three replicates. The seeds were planted in plastic vasles content with agricultural-perlit (< 2 mm diameter) and irrigated with $\frac{1}{2}$ Hoagland [16] solution. The effects of salinity treatments were studied by sampling on dry weight of shoot, dry weight of root, shoot length, fresh weight of stem and fresh weight of root as well as leaf area.

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.

RESULTS AND DISCUSSION

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

Leaf area was decreased with increasing in salt concentration in all barley varieties (Fig.1). The maximum leaf area was recorded under non-saline control and minimum at the highest salinity level. However, maximum

leaf area was recorded in SINA, GORGAN 4 and DASHT at all salinity levels. Also, minimum leaf area was recorded in ARAM and KAVEER varieties.

The highest shoot length was observed in control (non-salinized) treatment as compared to salinized treatment (Fig. 2). However SINA, GORGAN and DASHT 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 turgo pressure efficiency in cell enlargement decreases. These processes may cause the shoot to remain small [17]. This findings are parallel to those of Larik and AL-Saheal [18].

Comparison of dry weight of root and shoot under various stress situation 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 heigh dry weight of root and shoot was the important objective among the breeder for the improvement of yield and other traits in breeding programs. In the present study dry weight of root and shoot showed almost similar pattern reduction under NaCl levels (Fig.3 and 4) and SINA, GORGAN 4 and DASHT genotypes were screened under different saline stress. In this case varieties also showed a significant difference in shoot dry weight as in root dry weight (Table 1).

Fresh weight of root and shoot of 12 varieties significantly decreased under salt stress (Fig 5 and 6). Varieties significantly differed in case of root and shoot fresh weight and the maximum fresh weights were recorded in SINA, GORGAN 4 and DASHT. Our results showed that under salt stress, fresh weights of root and shoot were 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 [19]. The reduction of fresh weight of root and shoot of barley varieties with increasing in salt level was also reported by Naseer *et al.* [12].

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	11	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 \times T	44	0.579**	11.414**	0.018**	0.199**	1.946**	194.775**
Error	120	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

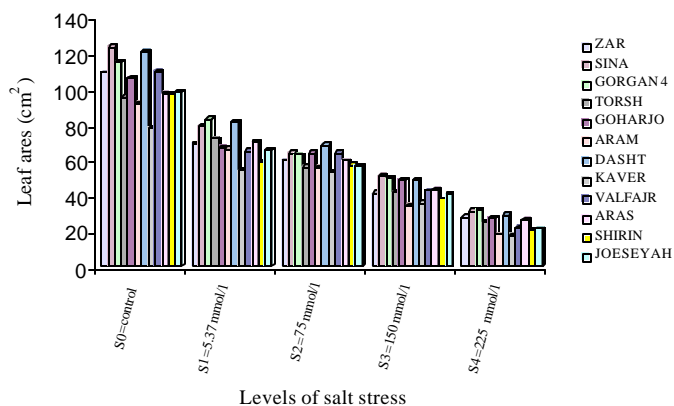


Fig. 1: Leaf area of 12 barley varieties grown under salt stress

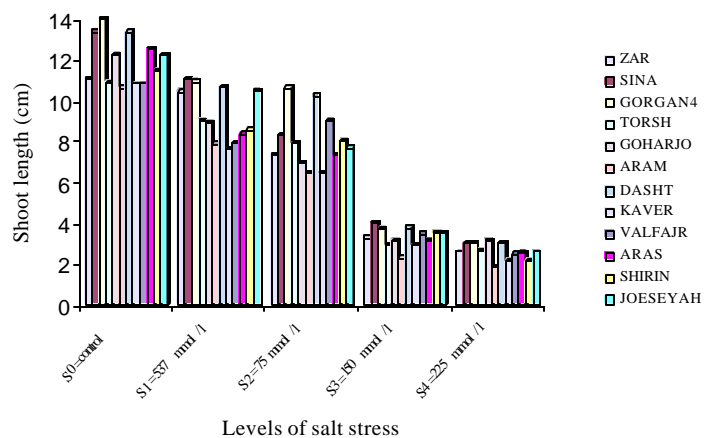


Fig. 2: Shoot length of 12 barley varieties grown under salt stress

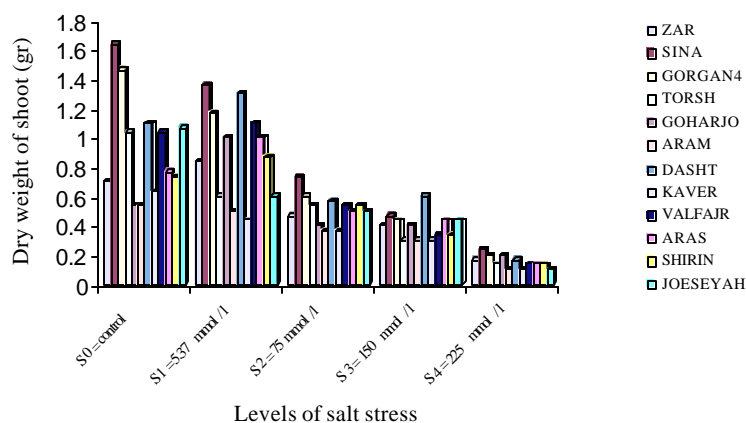


Fig. 3: Dry weight of shoot of 12 barley varieties grown under salt stress

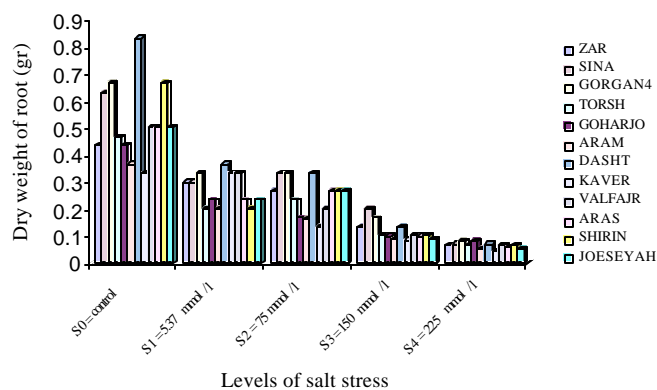


Fig. 4: Dry weight of root in 12 barley varieties grown under salt stress

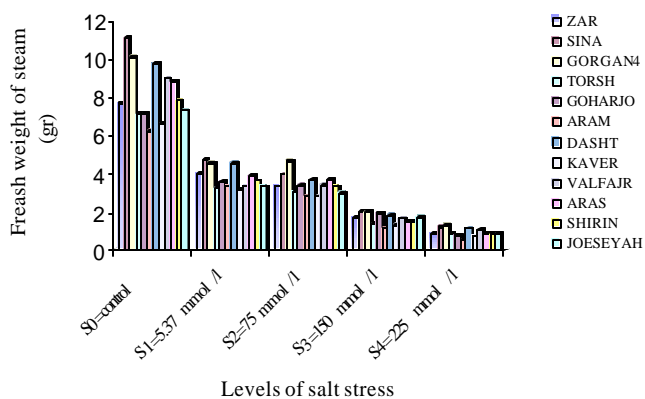


Fig. 5: Fresh weight of stem in 12 barley varieties grown under salt stress

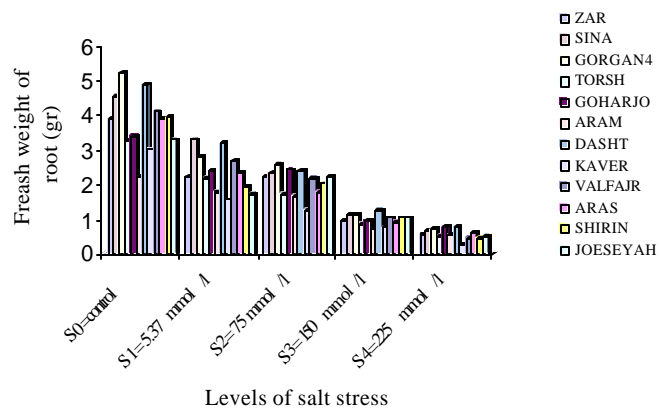


Fig. 6: Fresh weight of root in 12 barley varieties grown under salts stress

In general this study indicate that all treats were decreased in response to salinity in all 12 barley varieties. These results are close conformity with the earlier findings of Ashraf *et al.* [10]. Kingsburg and Epstein [9] and Ahmad *et al.* [13]. In which they reported that increasing salinity level decreased all seedling growth in sorghum, wheat and barley. Also, we show that SINA, GORGAN 4 and DASHT varieties at all salinity levels had the highest tolerance while ARAM and KAVEER seem to be the lowest tolerance under the same condition of salt stress.

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