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THE EFFECTS OF SALINITY STRESS ON SEED RESERVE UTILIZATION AND GERMINATION PERCENTAGE OF TREATED SEEDS OF BARLEY (*HORDEUM VULGARE* L.)

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ABSTRACT. In order to investigate salinity stress on seed reserve utilization and seedling growth of treated seeds of barley (*Hordeum vulgare* L.), an experiment was carried out. Factorial experiment was carried out in completely randomized design with three replicates. To create salinity stress, NaCl in osmotic levels at 0 (as control), -4, -8, -12 and -16 bar were used. For seed priming, gibberellin (GA) 50 ppm was used. Our results showed that treatment × drought interaction on these traits: germination percentage, weight of utilized (mobilized) seed, seed reserve utilization efficiency, seedling dry weight and seed reserve depletion percentage were significant. The highest germination percentage, weight of utilized (mobilized) seed, seed reserve utilization efficiency, seedling dry weight and seed reserve depletion percentage were attained from priming by gibberellin at control conditions. Thus, priming increased characteristics as compared to the unprimed. Priming improved seed reserve utilization such as: weight of utilized (mobilized) seed reserve, seed reserve depletion percentage, seed reserve utilization efficiency and seedling growth in barley under salinity stress.

Key words: Salinity stress; Seed reserve utilization; Gibberellin; *Hordeum vulgare* L.

INTRODUCTION

Barley is one of the most widely grown crops in arid and semiarid regions of the world. The seeds of barley show a delayed or reduced germination when the water potential of surrounding medium decreases. Stress conditions are widespread problem around the world. Seed germination negatively affected by stress conditions in more crops (Patade *et al.,* 2011; Ansari and Sharif-Zadeh, 2012). Seed germination is the most sensitive stage to abiotic stress (Patade *et al.,* 2011; Redmann, 1974; Ansari *et al.,* 2012). Seed reserve utilization, seedling growth and weight of

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mobilized seed reserve decreased with increasing drought and salt intensity (Soltani *et al.,* 2006; Ansari *et al.,* 2012). Ansari *et al.* (2012) reported that seed priming can be taken to counteract the adverse effects of abiotic stress. Seed priming techniques have been used to increase germination characteristics and improve germination uniformity in more field crops under stressed conditions (Iqbal and Ashraf, 2007; Kaya *et al.,* 2006; Patade *et al.,* 2011; Sağlam *et al.,* 2010; Ansari *et al.,* 2012). Seed priming increases seed reserve utilization, seedling dry weight and seed reserve depletion percentage in mountain rye (Ansari *et al.,* 2012) and wheat (Soltani *et al.,* 2006). In monocotyledon plants like wheat (Soltani *et al.,* 2006) and mountain rye (Ansari *et al.,* 2012), gibberellic acid after synthesis in the scutellum migrates in to the aleurone layer. The hetrotraphic seedling growth (mg per seedling) could be quantitatively described as the product of the following two components: the weight of mobilized seed reserve (WMSR; mg per seed), and the conversion efficiency of mobilized seed reserve to seedling tissue (mg mg-1) (Soltani *et al.,* 2006; Ansari *et al.,* 2012). Although effects of stress conditions and seed priming in wheat, mountain rye and perisian silk tree (*Albizia julibrissin* Durazz.) are documented, no reports are available on barley seeds under salinty stress. Therefore, in the present study, we investigated seed reserve utilization and seedling growth of treated seeds of barley as affected by salinity stress.

MATERIALS AND METHODS

The study was conducted in the Faculty, Agricultural and Natural Resources Research Center of Yazd, Iran.

Salinity stress at osmotic potentials of 0 (as control), - 4, -8, -12 and -16 bar were adjusted using NaCl before the start of the experiment.

For hormone-priming, seeds were immersed in density of 50 ppm gibberellin for 15 h at 10°C under dark conditions. Then, the seeds were rinsed with distilled water three times. The treated seeds were surface-dried to match their original moisture content at 15°C for 24 h (Ansari *et al.,* 2012).

Seeds were germinated in 9 cm petri dishes with two Whatman No. 1 filter papers moistened with the appropriate solutions or distilled water for 0MPa. Fifty seeds per dish were used for each treatment. Seeds were incubated in the dark at 20 ± 1°C in an incubator. Three replicates of 50 seeds were weighed (W1), dried at 104°C for 24 h and then reweighed (W2). Seed water content was calculated as [(W1−W2)/W2]. The initial seed dry weight was calculated using the data for seed water content and W1. After, test time expiration, germination percentage. Also, after 7 days, oven-dried weight of seedlings was determined. The weight of utilized (mobilized) seed reserve was calculated as the dry weight of the original seed minus the dry weight of the seed remnant. Seed reserve utilization efficiency was estimated by dividing seedling dry weight by the utilized seed reserve. The ratio of utilized seed reserve to initial seed dry weight was considered as seed reserve depletion percentage (Soltani *et al.,* 2006; Ansari *et al.,* 2012).

The experimental design was two factors factorial (seed treatment × drought stress) arranged in a completely randomized design with three replicates. The first factor was the seed treatments (unpriming, hydro-priming and osmopriming) and the second represented by different drought stress levels (0, - 4, - 8, -12 and -16 bar). All data were analyzed statistically by analysis of variance using MSTAT-C software. Mean comparisons were performed using an ANOVA protected least significant difference (Duncan) (P < 0.01) test.

RESULTS AND DISCUSSION

Our results have shown that GA increased germination percentage, weight of utilized (mobilized) seed, seed reserve utilization efficiency, seedling dry weight and seed reserve depletion percentage as compared to the unprimed (*Table 1*). Also, priming improved germination percentage in barley under salinity stress (*Table 1*).

Table 1 - Means comparison of germination percentage (Gp), weight of utilized (mobilized) seed (Usr), seed reserve utilization efficiency (Srue), seedling dry weight (Sldw) and seed reserve depletion percentage (Srdp) in barley under salinity stress

S.O.V.	Gp	Srdp	Srue	Sldw (g)	Usr (g)
Treatment (T)	1432.44**	1934.65**	0.0018**	0.000007**	0.00039**
Stress (S)	3640.24**	1715.52**	0.041**	0.000022**	0.001**
S*T	125.5**	92.14**	0.00014**	0.0000002*	0.00025**
Error	1.7	0.76	0.00001	0.00000006*	0.000013
CV %	2.32	4.05	4.33	6.82	6.14

Note: * and ** indicate significant difference at 5% and 1% probability level, respectively.

The highest germination percentage (88%) was obtained from GA in control conditions (0 bar) (*Fig. 1*). The minimum germination percentage was obtained from unprimed in osmotic pressure -16 bar (*Fig. 1*) (12%), but GA increased germination percentage in this conditions. The results are in agreement with the earlier study who reported the significant reduction in the germination as well as growth of pea (Okçu *et al.,* 2005), mountain rye (Ansari *et al.,* 2012), wheat (Soltani *et al.,* 2006), also reported that priming increased germination percentage under stress conditions.

Our results showed that in NaCl osmotic pressures, GA had a greater weight of utilized (mobilized) seed reserve, seed reserve depletion percentage and seedling dry weight than unprimed (*Figs. 2, 3 and 4*). Other researchers reported that priming increased weight of utilized (mobilized) seed reserve and seed reserve depletion percentage as compared to unprimed seed also this traits decline under stress conditions (Ansari *et al.,* 2012; Soltani *et al.,* 2006).

The highest seed reserve utilization efficiency obtained from unprimed and – 12 bar osmotic pressure (*Fig. 5*), but in higher levels of osmotic pressures the highest seed reserve utilization efficiency was obtained from GA (*Fig. 5*). Thus GA lead to improvement in mentioned traits in barley under salinity stress.

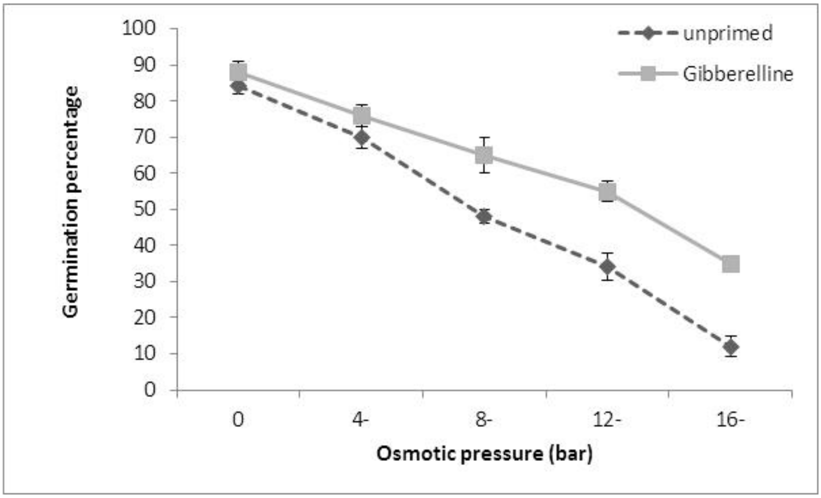

Figure 1 - Effect of treatment × drought interaction on germination of barley seeds

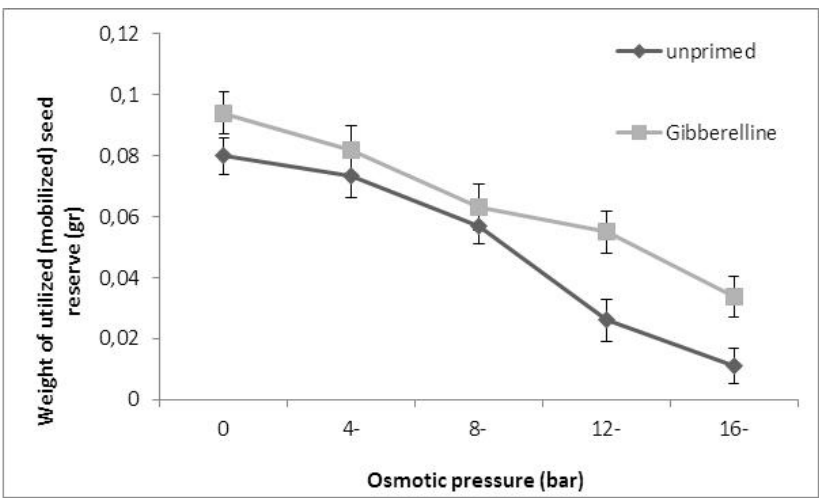

Figure 2 - Effect of treatment × drought interaction on weight of utilized (mobilized) seed reserve in barley seeds

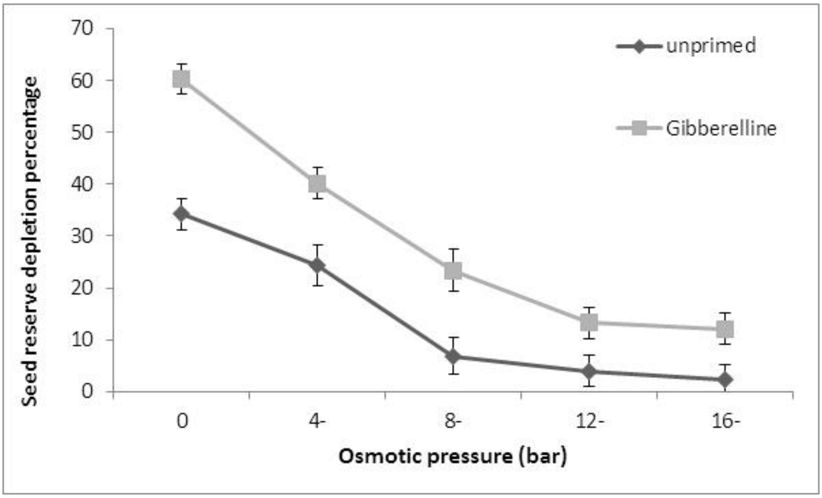

Figure 3 - Effect of treatment × drought interaction on seed reserve depletion percentage in barley seeds

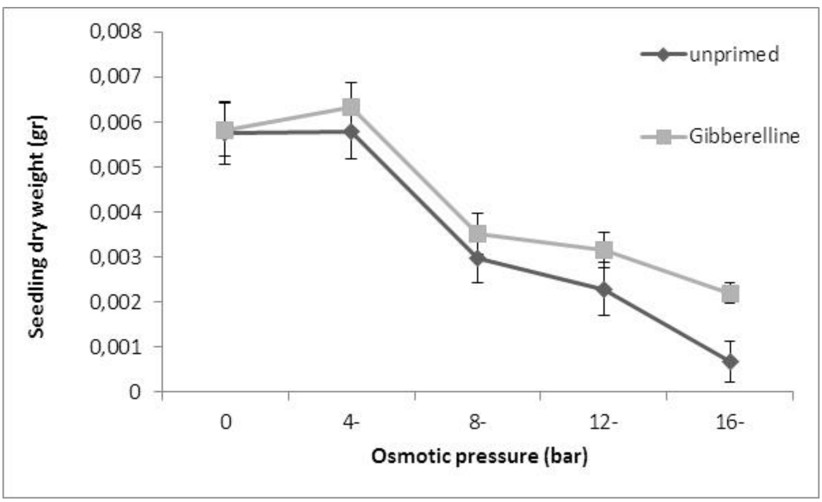

Figure 4 - Effect of treatment × drought interaction on seedling dry weight in barley seeds

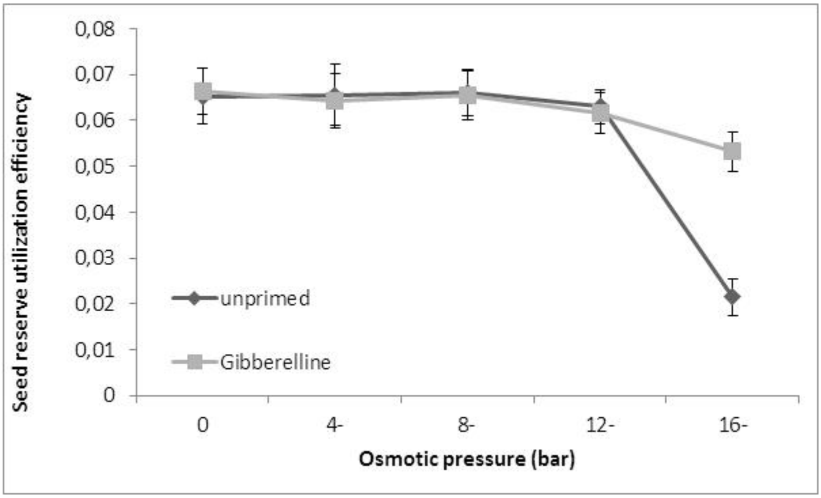

Figure 5 - Effect of treatment × drought interaction on seed reserve utilization efficiency in barley seeds

These results agree whit those of Patade *et al.* (2011), Ansari *et al.* (2012) and Ansari and Sharif-Zadeh (2011). Decline in seed reserve utilization efficiency to stress conditons were also reported by other researchers (Soltani *et al.,* 2006; Sadeghi *et al.,* 2011; Ansari *et al.,* 2012). Decline in seedling growth and different indices of seeds under drought stress also reported for wheat (Soltani *et al.,* 2006), tomato (Bhatt and Srinivasa-Rao, 1987), mountain rye (Ansari *et al.,* 2012) and mung bean (De and Kar, 1995).

CONCLUSION

Priming increased characteristics as compared to the unprimed. The highest germination percentage was obtained from gibberellin in control conditions. Priming improved seed reserve utilization such as: weight of utilized (mobilized) seed reserve, seed reserve depletion percentage, seed reserve utilization efficiency and seedling growth in barley under salinity stress.

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