**Cercetări Agronomice în Moldova**
**Vol. XLVII , No. 3 (159) / 2014**

# THE EFFECT HALO-AND HYDRO-PRIMING ON SEED RESERVE UTILIZATION AND SEED GERMINATION OF WHEAT SEEDS UNDER SALINITY STRESS

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Received November 1, 2013

**ABSTRACT.** Seed germination and seedling growth are critical stages in the life cycle of a plant, especially under adverse abiotic stresses. Seed germination negatively affected by stress conditions. Seed priming techniques have been used to increase germination characteristics and improve germination uniformity in more field crops under stressed conditions. This experimental aimed to evaluate the effect of salinity and halo-priming on seed reserve utilization and seed germination of wheat seeds. For create salinity stress, NaCl in osmotic levels at 0 (as control), -4, -8, - 12 and -16 bar was used. Seeds of were pretreated with halo-priming at 10 °C for 24 h and water at 10 °C for 24 h. 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 was obtained from halo priming in control conditions. Thus priming improved study traits in wheat under salinity stress. Priming increased germination percentage and seed reserve utilization as compared to the unprimed seeds. The highest germination percentage and seed reserve utilization were as obtained from halo priming in control conditions.

**Key words:** Halo priming; Hydro priming; Salinity stress; Seed reserve utilization; Wheat.

## INTRODUCTION

Seed germination negatively affected by stress conditions reported 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 mobilized seed reserve decreased with increasing drought and salt intensity (Soltani *et al.,* 2006; Ansari *et al.,* 2012). Seed priming techniques have been used to increase germination

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characteristics and improve germination uniformity in more field crops under stressed conditions (Iqbal and Ashraf, 2007; Kaya *et al.,* 2006; Patade *et al.,* 2011; Saglam *et al.,* 2010; Ansari *et al.,* 2012). The purpose of seed priming is to a partially hydrated with water (hydro-priming), various chemical solutions like polyethylene glycol (osmo-priming) or salts like CaCl2, CaSo4 and NaCl (halo-priming) the seeds to a point where germination processes are begun but not completed (Asfraf and Foolad., 2005), followed by drying of seeds to the original moisture level. Ansari *et al.* (2012) reported that seed priming can be taken to counteract the adverse effects of abiotic stress. 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).

Therefore, this experimental aimed to evaluate the effect of salinity and halo and hydro priming on seed reserve utilization and seed germination of wheat seeds.

## MATERIALS AND METHODS

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

Salinity stress at osmotic potentials of 0 (as control), - 4, -8, -12 and -16 bar were adjusted using NaCl. Seeds of were pretreated with halo-priming at 10 °C for 24 h and water at 10 °C for 24 h. Wheat seeds were exposure in 20 cm glass Petri dishes containing 15 ml solution. The imbibed seeds were then washed four times with tap water and dried on filter paper at 15±1°C for 24 h (Ansari and Sharif-Zadeh, 2012).

Standard germination test was carried out by place 50 seeds in 9 cm petri dishes at 20 °C. Seeds were observed daily until day $8^{th}$ and germinated seeds were recorded. 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, some germination indexes correlating to seed vigor were evaluated such as: germination percentage. Also, after 8 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 (SRDP) (Soltani *et al.,* 2006; Ansari *et al.,* 2012).

All data were analyzed statistically by analysis of variance using SAS 9.2 Software. Data for germination and normal germination percentages were subjected to arcsine transformation before analysis of variance was carried out with SAS 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 priming increases germination percentage, weight of utilized (mobilized) seed, seed reserve depletion percentage, seed reserve utilization efficiency and seedling dry weight as compared to the unprimed (*Table 1*).

**Table 1 - Analysis of variance of studied traits wheat seeds under salinity stress**

| S.O.V. | df | GP | USR | SRDP | SRUE | SDW |
|---|---|---|---|---|---|---|
| Priming | 2 | 319.2** | 0.0009** | 845.84** | 288.42** | 0.00038** |
| Salinity | 4 | 3901.2** | 0.0008** | 4176.88** | 3798.46** | 0.0005** |
| P x S | 8 | 37.2** | 0.00007* | 55.86** | 46.95** | 0.000015** |
| Error | - | 3.2 | 0.00003 | 18.07 | 3.1 | 0.0000014 |
| CV% | - | 2.24 | 8.76 | 10.2 | 2.23 | 8.75 |

* and ** indicate significant difference at 5 and 1% probability level.
GP: germination percentage; USR: weight of utilized (mobilized) seed; SRDP: seed reserve depletion percentage; SRUE: seed reserve utilization efficiency SDW: seedling dry weight.

Seed germination and seedling growth are critical stages in the life cycle of a plant, especially under adverse abiotic stresses. Seed priming is one of the methods that can be taken to counteract the adverse effects of abiotic stress (Patade *et al.,* 2011; Ashraf and Foolad, 2005). The results are in agreement with the earlier study Ansari *et al.* (2012), who reported the significant reduction in the germination as well as growth of rye. Also, earlier reports (Patade *et al.,* 2011; Ansari *et al.,* 2012; Rouhi *et al.,* 2011) have shown positive effect of priming in relation to seed performance, germination percentage and seedling indices.

The highest germination percentage was obtained from halo-priming in control conditions (*Fig. 1*). The minimum germination percentage was obtained from unprimed seeds in osmotic pressure -16 bar (*Fig. 1*), but priming increases germination percentage under salinity stress. The results are in agreement with the earlier study, who reported the significant reduction in the germination percentage (Ansari *et al.,* 2012; Soltani *et al.,* 2006). Also, Ansari *et al.* reported that priming increased germination percentage under stress conditions.

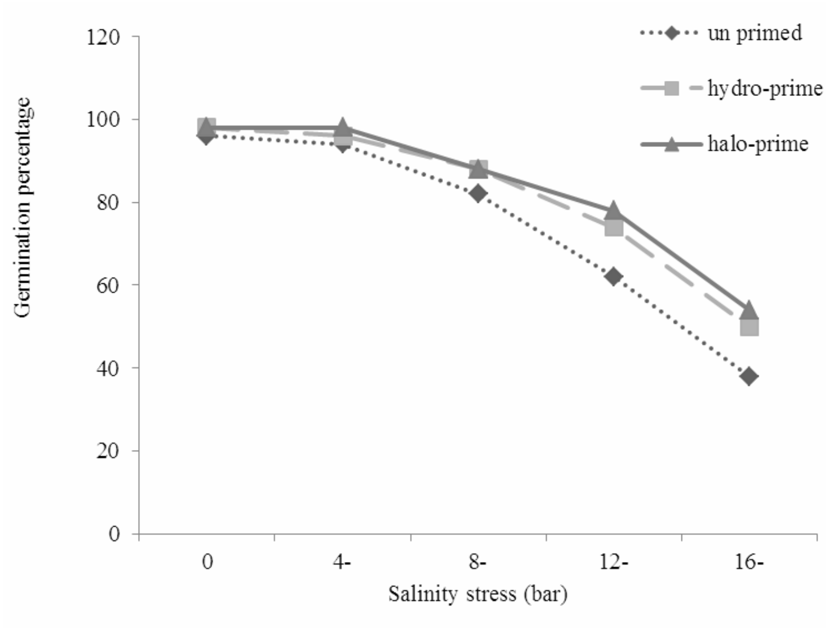


**Figure 1 - The effect of priming on germination percentage of wheat seeds under salinity stress**

Our results showed that in NaCl osmotic pressures, halo-priming had a greater weight of utilized (mobilized) seed reserve, seed reserve depletion percentage and seedling dry weight than unprimed (*Figs. 2, 3 and 4*). Priming increases 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).

The highest seed reserve utilization efficiency obtained from halo-priming treatment and control condition (*Fig. 5*), also in higher levels of osmotic pressures the highest seed reserve utilization efficiency was obtained from priming treatments (*Fig. 5*). Thus priming lead to improvement in mentioned traits in wheat under salinity stress.

Decline in seed reserve utilization efficiency to stress conditions were also reported by other researchers (Soltani *et al.,* 2006; Ansari *et al.,* 2012). Decline in seedling growth and different indices of seeds under stress conditions also reported for wheat (Soltani *et al.,* 2006), mountain rye (Ansari *et al.,* 2012).

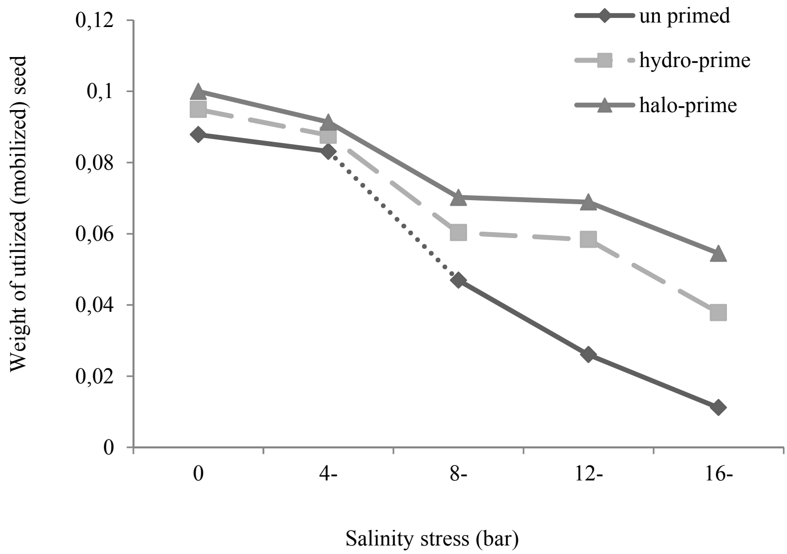


**Figure 2 - The effect of priming on weight of utilized (mobilized) seed of wheat seeds under salinity stress**

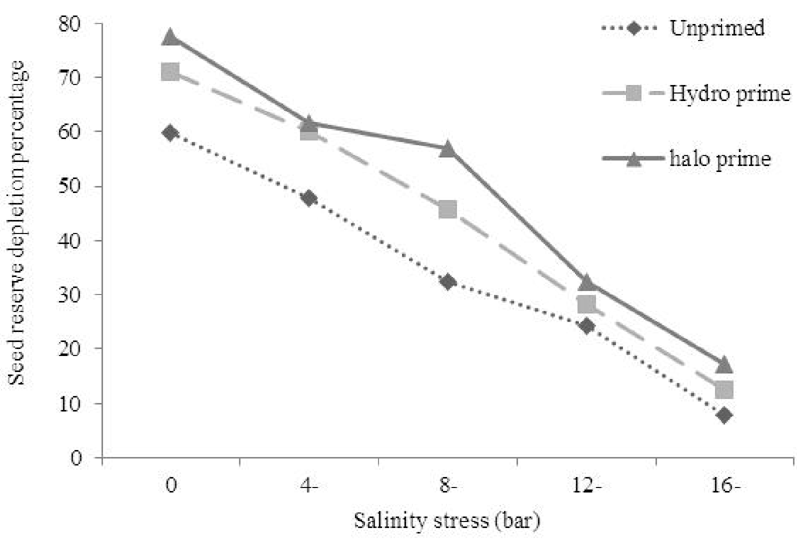


**Figure 3 - The effect of priming on seed reserve depletion percentage of wheat seeds under salinity stress**

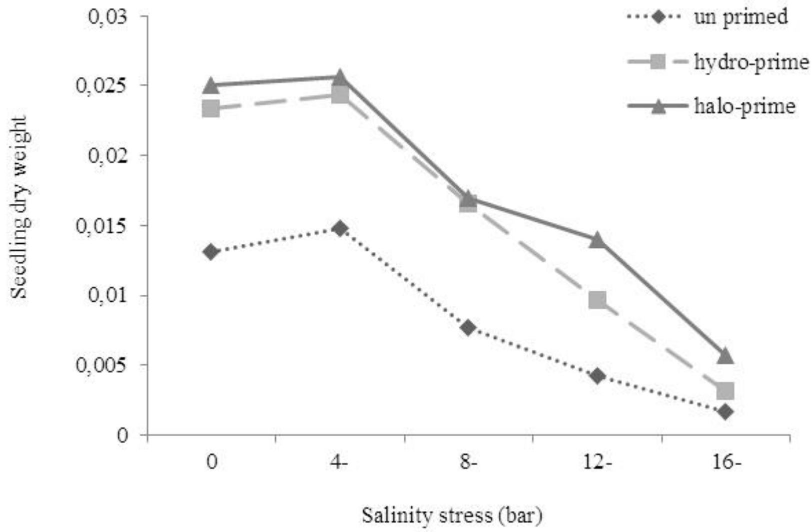


**Figure 4 - The effect of priming on seedling dry weight of wheat seeds under salinity stress**

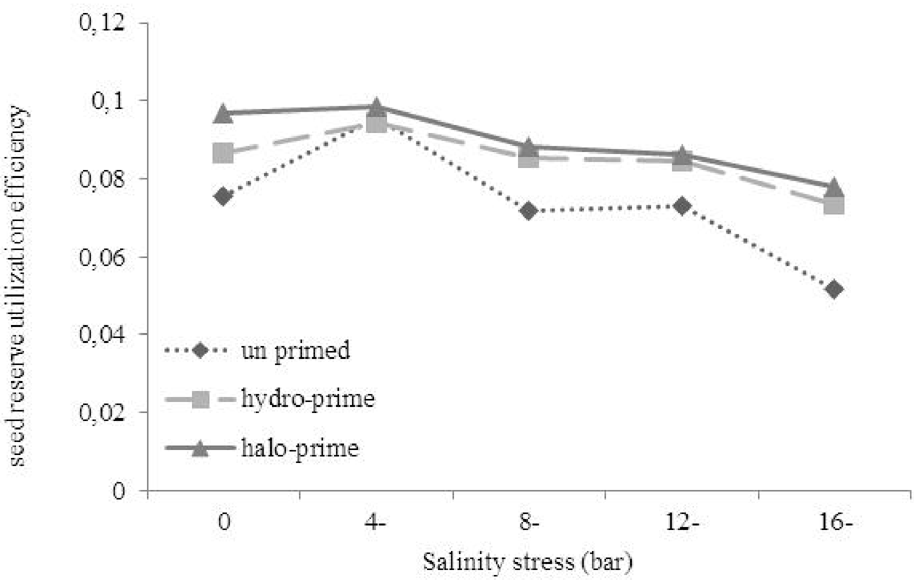


**Figure 5 - The effect of priming on seed reserve utilization efficiency of wheat seeds under salinity stress**

## CONCLUSIONS

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.

Hydro- and halo-priming 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 seeds.

The highest germination percentage and seed reserve utilization were as obtained from halo-priming in control conditions, also in higher osmotic pressures the highest all traits were attained from halo-priming as compared to hydro-priming and control.

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