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ORIGINAL ARTICLE

The Effect of Osmo and Hormone Priming on Germination and Seed Reserve Utilization of Millet Seeds under Drought Stress

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The objective of this research was to evaluate the effect of seed priming with osmo and hormone priming on growth and seed reserve utilization of millet seeds under drought stress. Treatments were combinations of 4 levels of drought stress (0, -4, -8 and -12 bar) and 3 levels of seed priming and control with 3 replications. Results showed that with increase in drought stress, germination components such as germination percentage, germination index, mean time to germination, normal seedling percentage, seedling length, seedling dry weight, weight of utilized (mobilized) seed and seed reserve utilization efficiency decreased, but seed priming showed lower reduction. The highest germination characteristics and seed reserve utilization was obtained by priming in control conditions. It is concluded that priming results in improvement in germination components of millet in drought stress conditions.

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Seed germination is usually the most critical stage in life cycle successful crop production (Almansouri *et al*., 2001). Drought stress has become a critical problem worldwide due to its dramatic effects on plant physiology and performance.

Drought stress delays the onset stage of germination, reduces the rate and increases the dispersion of germination characteristics, resulting in reduced plant growth and final crop yield (Anari *et al*., 2012). Also Rouhi *et al*. (2011) reported that increases drought stress lead to growth reduction. Ansari and Sharif Zadeh, (2012) reported that stress conditions lead to reduction of growth and plant developments.

Seed treatments for enhances germination characteristics are an efficient method for increasing seed vigor and germination uniformity, as well as the growth of seedlings of many crops under stress conditions (Bajehbaj, 2010, Ansari and Sharif Zadeh, 2012). Ansari *et al*. (2012) reported that seed priming can be taken to counteract the adverse effects of abiotic stress. Many researchers reported that seed treatments improvement seed germination indexes under stress conditions (Ansari *et al*., 2013; Rouhi *et al*., 2011). Seed priming techniques have been used to increase germination, improve germination uniformity, improve seedling establishment and stimulate vegetative growth in more field crops (Iqbal and Ashraf, 2007; Soltani *et al*., 2006; Kaya *et al*, 2006; Kaur *et al*, 2002; Ansari *et al*., 2012) under stressed conditions. 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 heterotrophic 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 priming on seed reserve utilization of millet seeds under drought stress.

MATERIALS AND METHODS

The study was conducted in the Faculty of Agricultural Sciences, University of Mohaghegh Ardabili. Ardabil, Iran.

Drought stress at osmotic potentials of 0 (as control), - 4, -8 and -12 bar were adjusted using PEG 6000 before the start of the experiment.

For osmo-priming, seeds were immersed in density of -10 bar PEG 6000 for 15 h at 10°C and for hormone priming, seeds immersed in salicylic acid in density 50 ppm 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 0 MPa. Fifty seeds per dish were used for each treatment. Seeds were incubated in the dark at 25 ± 1 ◦C in an incubator for 7 days. 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 (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. 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

Analyze of variance for priming showed that Treatment × Drought stress interaction was significantly ($P < 0.01$) for all traits (Data not shown).

Our results showed that, the highest germination percentage was attained from priming in control conditions (Fig 1). The minimum germination percentage was obtained from unprimed in osmotic pressure -12 bar (Fig. 1), but priming increases germination percentage in this conditions. Also, results showed that the highest germination index (Fig 2), normal seedling percentage (Fig 4), seedling length (Fig 5) and the minimum mean time to germination (Fig 3) were attained from as osmo-priming in control conditions. Therefore, our results showed that increases drought stress, lead to growth reduction. Ansari *et al*. (2012) reported that increases drought stress lead to growth reduction. Ansari and Sharif Zadeh (2012) reported that drought stress lead to reduction of growth and plant developments. Also, the results are in agreement with the earlier study who reported that the significant reduction in the germination as well as growth of other crops under drought stress (Okçu *et al*., 2005; Ansari *et al*., 2012; Soltani *et al*., 2006), also reported that priming increased germination percentage under drought stress. Seed priming techniques have been used to increase germination, improve germination uniformity, improve seedling establishment and stimulate vegetative growth in more field crops such as: wheat (Iqbal and Ashraf, 2007; Soltani *et al*., 2006), sunflower seeds (Kaya *et al*, 2006), Chickpea (Kaur *et al*, 2002) and mountain rye (Ansari *et al*., 2012) under stressed conditions.

Results showed that priming increases weight of utilized (mobilized) seed reserve and seedling dry weight as compared to the unprimed seeds under drought stress (Fig 6 and 7). Also, other researchers reported that priming increased weight of utilized (mobilized) seed reserve and seedling dry weight as compared to unprimed seed also this traits decline under stress conditions (Ansari *et al*., 2012; Soltani *et al*., 2006).

Other our results showed that the highest seed reserve utilization efficiency obtained from unprimed in –8 bar osmotic pressure condition (Fig 8), but in higher levels of osmotic pressures the highest seed reserve utilization efficiency was attained from osmo and hormone priming (Fig 8). Thus priming lead to improvement in mentioned traits in millet seeds under drought stress.

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

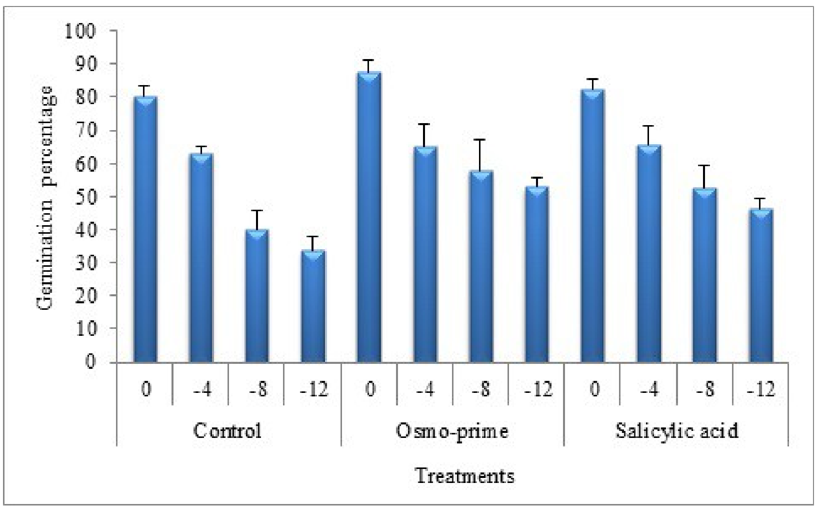

Figure 1 : The effect of priming on germination percentage of millet seeds under drought stress.

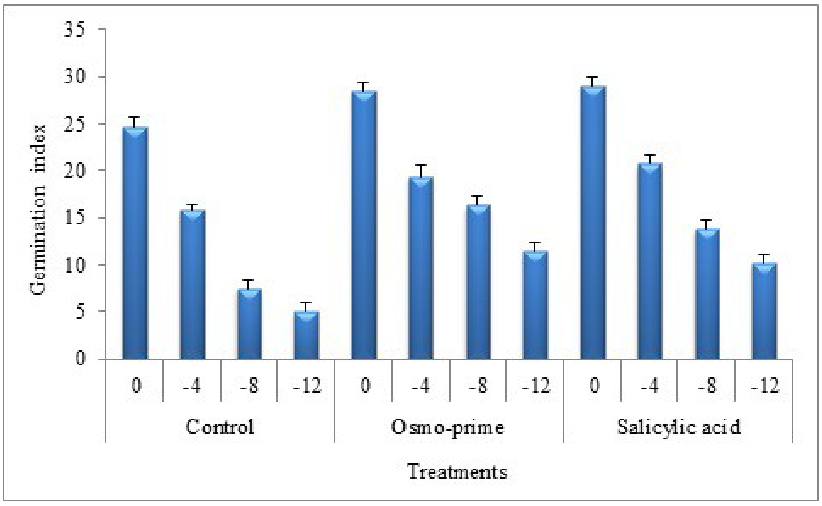

Figure 2 : The effect of priming on germination index of millet seeds under drought stress.

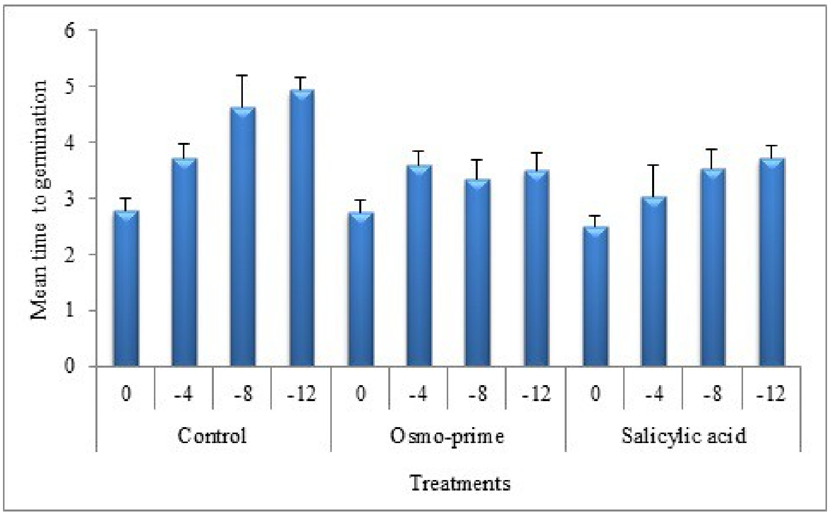

Figure 3 : The effect of priming on mean time to germination of millet seeds under drought stress.

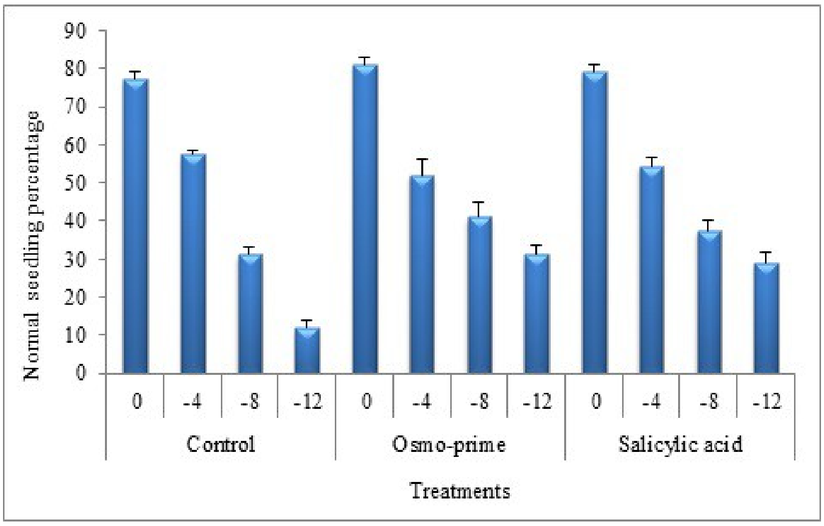

Figure 4 : The effect of priming on normal seedling percentage of millet seeds under drought stress.

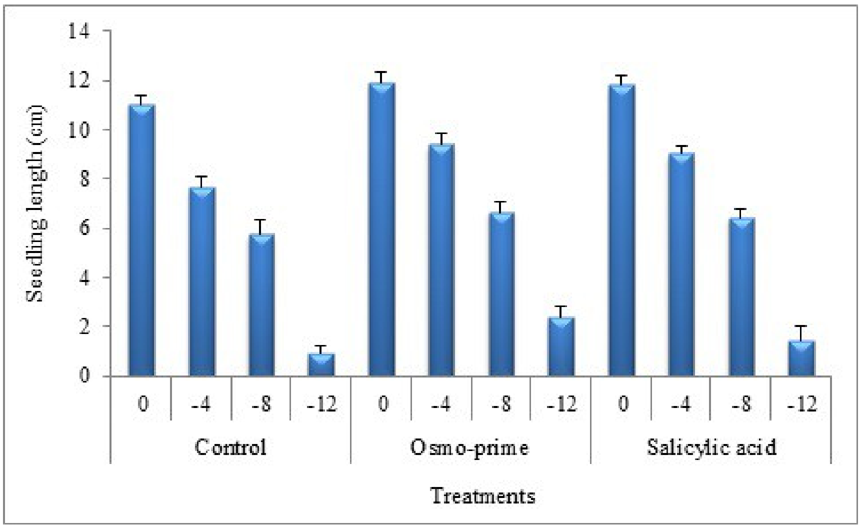

Figure 5 : The effect of priming on seedling length of millet seeds under drought stress.

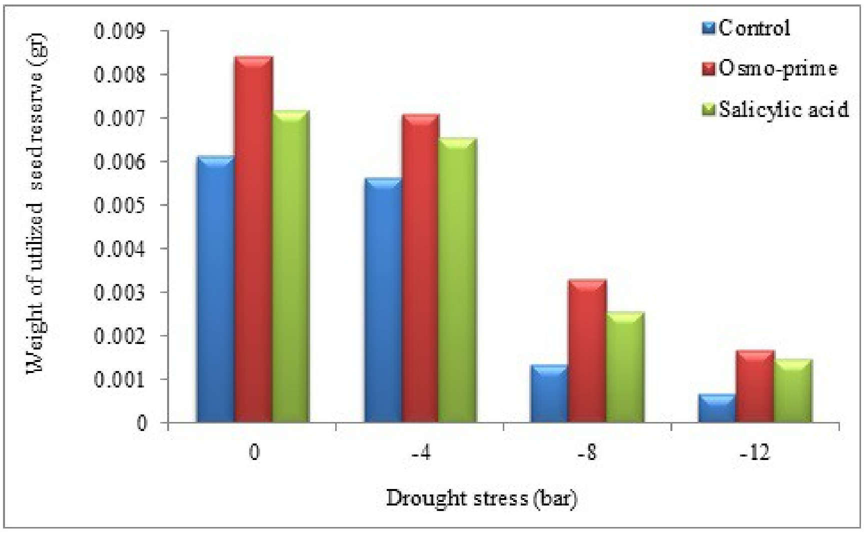

Figure 6 : The effect of priming on weight of utilized seed reserve of millet seeds under drought stress.

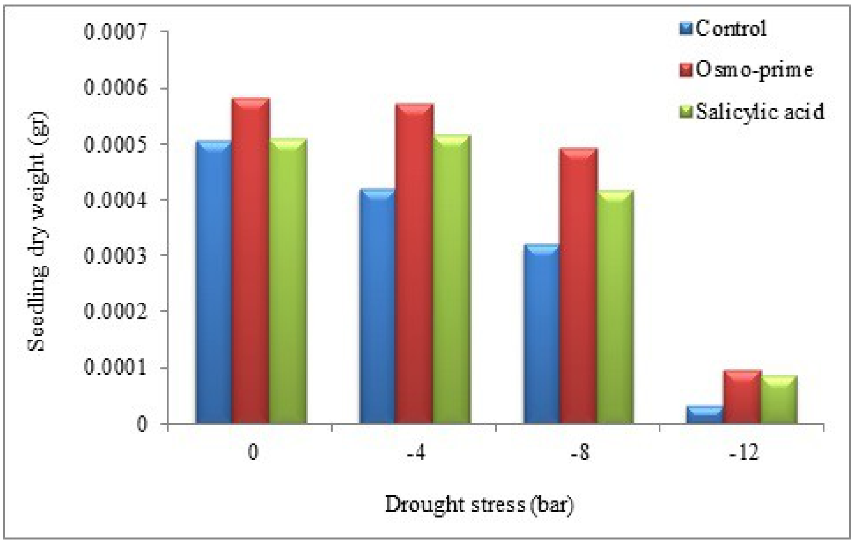

Figure 7 : The effect of priming on seedling dry weight of millet seeds under drought stress.

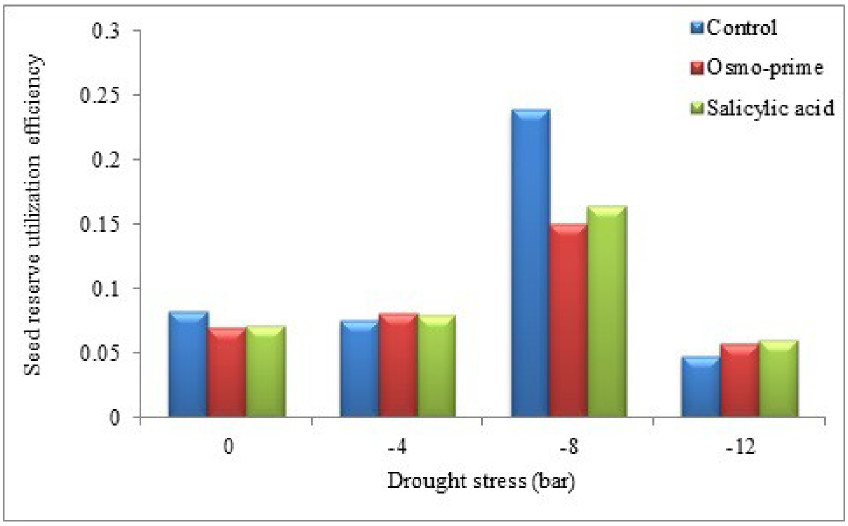

Figure 8 : The effect of priming on seed reserve utilization efficiency of millet seeds under drought stress.

CONCLUSION

Priming by PEG 6000 and salicylic acid increased germination characteristics as compared to the unprimed seeds. The highest germination characteristics were obtained from priming by PEG 6000 and salicylic acid in control conditions. Priming improved seed reserve utilization such as: weight of utilized (mobilized) seed reserve, seed reserve utilization efficiency and seedling growth in millet seeds under stress and control conditions.

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