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Studying the Effect of Hydro- and Halo-Priming on Germination Traits and Growth of Two Genotypes of Atriplex (Canensens-Lentiformis) in Saline Conditions

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ABSTRACT: In order to study the effect of hydro- and halo-priming on the germination and growth of two genotypes of atriplex in saline conditions, an experiment was implemented in summer, 2014 in a plant research greenhouse and in the greenhouse of the university in Neyshabour Branch of Islamic Azad University. This experiment was carried out in a laboratory in a factorial and completely randomized design with 4 replications and in the greenhouse in a completely randomized block design with 3 replications. Priming contained: 1. Halo-priming: (Soaking in inorganic salt solution), 2. Hydro-priming: (absorbing distilled water), 3. Control: (non-prime), and salinity (0, 25, 50, and 75 MM). The traits under study in greenhouse were comprised of percentage and rate of germination, stem length, fresh and dry weight of stem, fresh and dry weight of leaf, and the plant length. The pot experiment showed that the genotype had a significant effect on the rate and percentage of germination, plant length, fresh and dry weight of stem and leaf. Priming was also significant in all traits other than fresh and dry weight of stem. Likewise, salinity had a significant effect in all pot studied traits. The interaction between the genotype and priming was only significant in the rate of germination while that of genotype and salinity was so in the fresh and dry weight of stem. Lentiformis genotype had higher percentage of germination and more plant height and dry weight of leaf in comparison with canescens. In all significant traits, halo-prime and zero-milimollar salinity had the best results. Based on the results of the study, it can be said that lentiformis genotype has a better performance in saline conditions and that halo-prime seeds reduce the effects of salinity stress in atriplex seeds.

Key Words: Halo-Prime, Hydro-Prime, Atriplex, Salinity

INTRODUCTION

Fodder plants have a major role in animal feeding and is considered as one of the most important crops in the world. However in most of the countries comparing to the attention paid to other crops, little work is done in researching and developing the production and managing these plants. Regarding the dearth of rich pastures and the high number of livestock, studying on the cultivating such crops is significantly important in our country (Mirlohi *et al.,* 2000). Atriplex can be considered as a good supply of protein production in Iran since 10 out of 90 million hectare of pastures are arable lands for this plant; with the average production of 1500 fodder units per hectare, 15 billion fodder units (15 million tons of barley) can be annually added to the pasture production of Iran. Regarding these statistics, we can see the real value and importance of this plant and try to invest on its production and development. Based on the reported statistics by FAO, from per hectare of Atriplex cultivation, Tunisia and Algeria have harvested 5-15 tons of fresh and usable materials (young leaves and branches) and 2-11 tons of green wood. Since major lands of Iran are considered as marginal soils, practically, absence of optimum conditions for seedbed is one of the reasons for yields loss. It can be mainly compensated by appropriate, scientific management. One of the mentioned techniques is the treatments before sowing which is generally known as seed priming. Based on conducted studies, the mentioned technique has high efficiency especially in inappropriate conditions of seedbed and environment (Ghassemi *et al.,* 1995). It can be said that salinity issue is one of the most important agricultural issues in Iran which is actually the most important threatening factor of stability of crops production in many areas of the country (Ghassemi-Golezanik, *et al.*, 2008). Heavy elements, salt in water and soil, oxidative, ultra-violet rays, and high- and low-temperatures are among the non-live stresses that plants are exposed to (Amini and Ehsanpour, 2004). After the Soviet Union, China, India, and Pakistan, Iran has the most saline soil in Asia (Heydari Sharifabad, 2001).

METHODOLOGY

This experiment was carried out in summer in 2014 in a plant research greenhouse in Neyshabour Branch of Islamic Azad University. In the laboratory, the experimental design was a factorial arranged in a completely randomized design with 4 replicates, and in the greenhouse, it was employed with 3 replications. priming was directed as 1. Halo-prime: (Soaking in inorganic salt solution), 2. Hydro-prime: (absorbing distilled water), 3. control: (non-prime). The traits under study in greenhouse included percentage and rate of emergence, plumule length, fresh weight of plumule, dry weight of plumule, fresh and dry weight of leaf, and the number of leaves (upto 7-leaves).This experiment was done in plastic pots and twice-washed sand was also used. The reason for using sand is due to the presence of different salts in typical soil which causes error in the experiment. Plastic pots with 10 cm diameter and 25 cm height were chosen and the bottom of all pots were filled by pebbles, appropriate for drainage. Then 10 seeds, already primed in the laboratory, were cultured next to control treatment (non-primed seed) in 2-3 cm depth in each pot; since sand lacks any nutrition, solutions containing macro- and micro-nutrients were used. Then salinity treatments of four different levels were put in pots mixing with nutrients after 3 days in a way that a small part of it sticks partly out of the pot. The above solution contains 12 nutrients and the mineral and components of water were measured during watering. In order to achieve a standard solution which is in accordance with plant need, excessive elements in the water should be taken into consideration in designing food formula. The length of the stem was measured using a ruler in cm. After isolation, each sample was put in a small paper bag then in an oven with 70 degree for 48 hours and was measured by a digital scale with 0.0001 accuracy.

Statistical analysis and drawing charts and tables were done by using SAS, Germin, and Excel. Duncan test was used for comparing means.

RESULT AND DISCUSSION

The effect of priming on fresh weight of radicle in 1% level was meaningful (Table 1) in a way that the fresh weight of radicle in halo-prime treatment was respectively 5.26 and 21.05 more than the time for hydro-prime and non-prime. The weight of radicle in halo-prime and hydro-prime were not significantly different; moreover, both were placed in one statistical group. In their study on sunflower. Demir *et al.,* (1999) reported that the treated seeds with KNO_3 were meaningfully heavier in dry and fresh roots in comparison with control seeds. In an experiment by, it was shown that priming causes an increase in fresh and dry weight of root (Shahrajabian and Moradi 2009). Priming with different materials caused an increase in weight of fresh and dry root and stem of sweet corn, yet the effect of priming with potassium nitrate was negative and all the traits decreased in comparison with the control (Mohseni *et al.,* 2010).

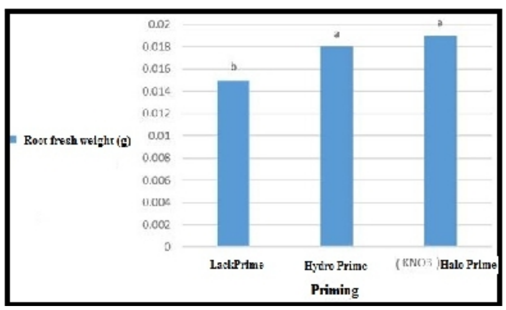

Fig. 1. The effect of priming on fresh weight of radical.

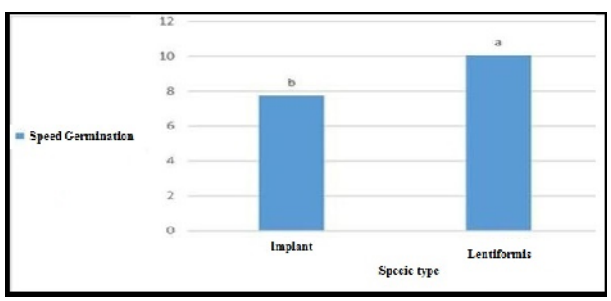

Fig. 2. Genotype effect on germination rate.

In 1% level, the effect of genotype on germination rate was meaningful (Table 1) in a way that germination rate in Lentiformis genotype was 23.01% more than Canensens genotype. As mentioned before, the ecology of seed germination in biotypes could be totally different (Bra¨ndel, 2004).

The result of this study confirms that effect of priming on germination rate in 1% level was significant (Table 1) in which the germination rate in halo-prime treatment (KNO_3) was respectively 8.86 and 21.55 percent more than time for Hydro-prime (water) and non-prime.

Table 1: Variance Analysis of effect of genotype (A) and priming (B) and salinity (C) on Atriplex in greenhouse conditions.

		Mean-square						
Change Sources	**Degree of freedom**	**Germinating percentage**	**Germinating rate**	**Plant height**	**Fresh weight of stem**	**Dry weight of stem**	**Fresh weight of leaf**	**Dry weight of leaf**
Block	2	298/2**	1/384**	0/302n.s	0/0019**	0/0004**	0/0002**	0/00007**
Genotype	1	4186/1**	96/83**	2/64**	0/0514**	0/012**	0/0041**	0/0010**
Prime	2	1598/7**	27/83**	4/60**	0/0000007n.s	0/0000001n.s	0/0015**	0/0003**
Salinity	3	1178/1**	13/96**	3/37**	0/014**	0/0036**	0/0011**	0/0002**
Prime*genotype	2	49/87n.s	0/892*	0/413n.s	0/00001n.s	0/000004n.s	0/00004n.s	0/00001n.s
Salinity*genotype	3	39/12n.s	0/235n.s	0/267n.s	0/0025**	0/00063**	0/000039n.s	0/000009n.s
Salinity*prime	6	41/50n.s	0/460n.s	0/113n.s	0/00002n.s	0/000005n.s	0/00004n.s	0/00001n.s
Salinity*prime*genotype	6	39/66n.s	0/361n.s	0/161n.s	0/00002n.s	0/000005n.s	0/00003n.s	0/000009n.s
Error	46	56/20	0/270	0/145	0/00013	0/00003	0/00004	0/00001
Coefficient of Variation		11/83	5/82	10/61	22/76	19/02	17/29	15/83

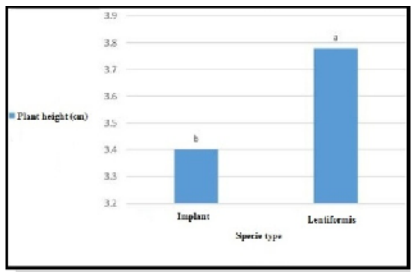

Fig. 3. The effect of genotype on plant height.

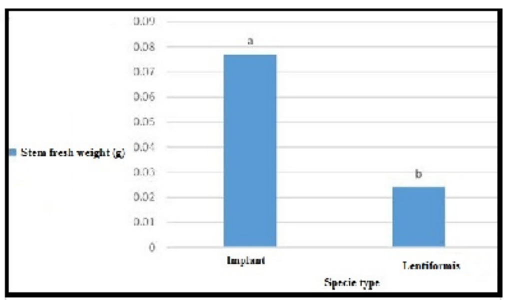

Fig. 4. The effect of genotype on fresh weight of stem.

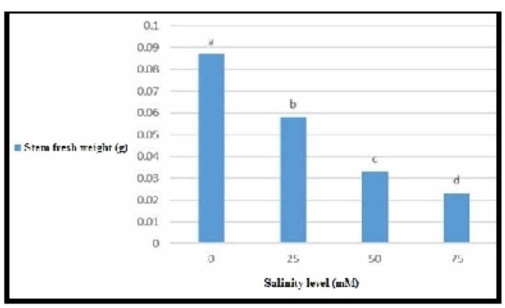

Fig. 5. The effect of salinity on fresh weight of stem

The effect of genotype on plant height in 1% level was meaningful (Table 1) in a way that the plant height in Lentiformis genotype was 10.05 % more than Canensen genotype. In 1% level, the effect of genotype on fresh weight of stem was significant (Table 1) in a way that the fresh weight of stem in Canensen genotype was 68.83% more than Lentiformis genotype.

Salinity effect on fresh weight of stem was meaningful in 1% level (Table 1) in which the fresh weight of stem in zero millimolar salinity was respectively 33.33, 62.06, and 73.56 percent more than 25, 50, and 75 MM salinity. The mutual effect of genotype and salinity on fresh weight of stem was significant in 1% level (Table 1).

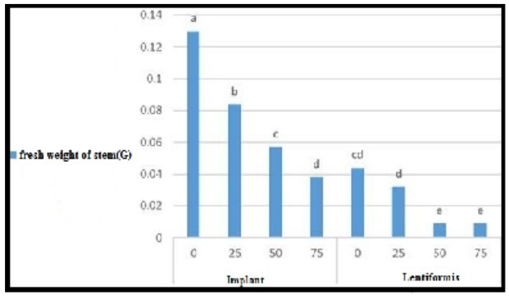

Fig. 6. The interaction between genotype and salinity on fresh weight of stem.

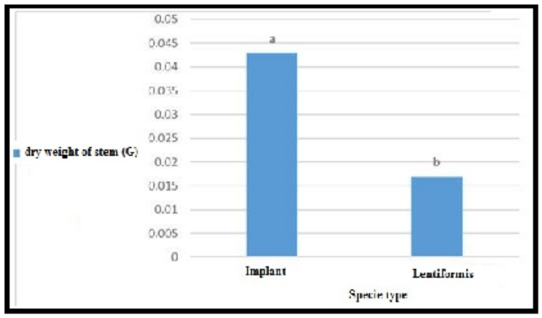

Fig. 7. Genotype effect on dry weight of stem.

In 1% level, genotype effect on dry weight of stem was meaningful (Table 1) in a way that the dry weight of stem in Canensen genotype was 60.46% more than Lentiformis genotype. Priming effect on dry weight of stem was not significant (Table 1). Salinity effect on dry weight of stem was significant in 1% level (Table 1) in which the dry weight of stem in zero millimolar salinity was respectively; 29.16, 56.25, and 66.66 percent more than 25, 50, and 75 MM salinity.

According to, increase in salinity brings about reduction in dry weight of Fennel stems. Ion toxicity resulted from harmful elements augmentation causes disruption in all biologic and metabolic activities of plants; at long last, it causes loss or drastic reduction of overhead organs. In 1% level, the genotype effect on fresh weight of leaf was meaningful (Table 1) in which the fresh weight of leaf in Lentiformis genotype was 30% more than Canensens genotype.

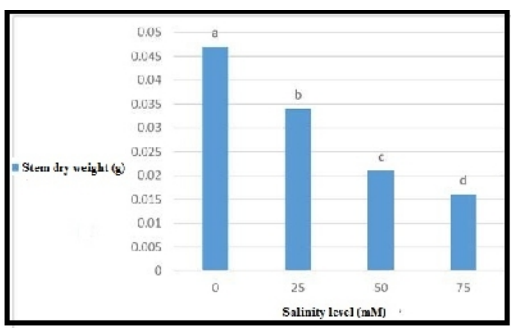

Fig. 8. Salinity effect on dry weight of stem.

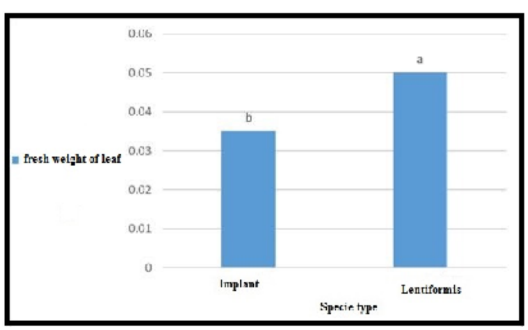

Fig. 9. Genotype effect on fresh weight of leaf.

In a 1% level, the priming effect on fresh weight of leaf was significant (Table 1) in a way that the fresh weight of leaf in halo-prime treatment (KNO_3) was respectively 2.08% and 31.25% more than in hydro-prime (water) and in non-prime. The increase in dry weight of leaf could be due to the synchronous germination and increase of DNA and RNA synthesis during seed priming, also due to overgrowth of the young plant. Seed priming in osmotic solution increases the amount of absorbed water in a seed, and consequently boosts the germination rate and growth rate of radicle and plumule. Accordingly, the plant grows faster, leaves become larger in size, and, therefore the dry weight of leaves increases. In a 1% level, saline effect was meaningful for weight of fresh leaf (table 1) where weight of fresh leaf in zero millimolar was 16.98, 24.52, and 35.84 percent more than 25, 50, and 75 MM of saline percent, respectively.

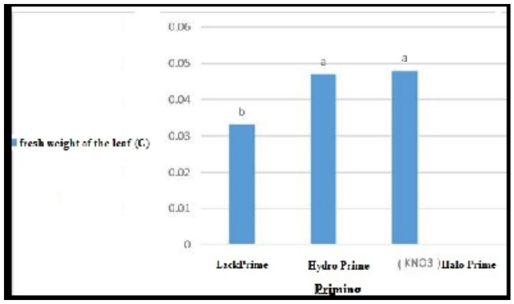

Fig. 10. Priming effect on fresh weight of the leaf.

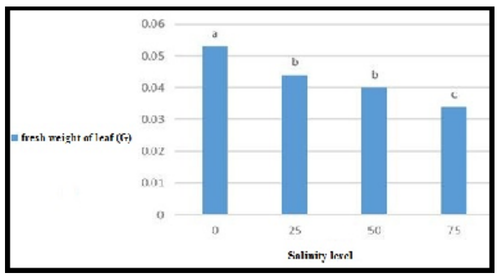

Fig. 11. Saline effect on fresh weight of leaf.

CONCLUSION

It was also shown in pot test that the genotype had a meaningful effect of rate and percentage of germination, length of the plant, and weights of fresh and dry stem and leaf. Moreover, priming was significant in all traits but in the fresh and dry weights stem and leaf. In addition, salinity, similarly, was significant for all traits of pot studies. The interaction between genotype and priming was meaningful only on germination rate. The interaction between genotype and salinity was meaningful only in fresh and dry weight of stem. Lentiformis genotype had a greater percentage and germination rate along with plant length and fresh and dry weight of leaf in comparison to Canensens. In all the significant traits, zero millimollar halo-prime and salinity caused the best result. Therefore, it seems Lentiformis genotype operates better in saline conditions, and halo-prime of seeds cause reduction in effects of saline tension in Atriplex seed.

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