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Comparison of Seed Characteristics in Even-aged Accessions of *Atriplex canescens* under Exclosure and Non-exclosure Conditions in Rangelands of Zarand-Shahriar, Iran

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Abstract To compare the seed characteristics in accessions of *Atriplex canescens* under exclosure and non-exclosure conditions, two even-aged sites were selected with an area of 400 ha as the exclosure and 1000 ha as non-exclosure area. To conduct the study, 30 species were randomly selected in autumn 2009 in reference area of the sites and seeds were collected. Some important seed characteristics were studied in the laboratory. Data analysis was conducted using SPSS 17 software and mean comparisons were performed by Duncan's Multiple Range Tests. Results showed that the winged seeds did not germinate under all studied treatments in both sites. Moreover, maximum seed germination was recorded for the seeds soaked in cold water for 24 hours and placed in the shade for 48 hours. According to the results of the independent t-test, no significant differences were observed for germination percentage, germination rate, and vigor index in both sites at both 1 and 5% probability levels. In other words, the seeds collected from the exclosure and non-exclosure areas were similar in terms of the mentioned characteristics. However, seed yield, 1000-seed weight and seed moisture content showed significant differences at 1% probability level with higher amount in exclosure area.

Keywords: *Quantitative evalution, Exclosure, Water treatment, Grazing*

1 INTRODUCTION

Low rainfall and its poor distribution together with prolonged hot and dry periods have caused difficult environmental conditions for germination and establishment of desert and rangeland species. Soil salinity in most parts of the country increases environmental constraints and strongly affects vegetation diversity and number of compatible plant species under the mentioned conditions. Consequently, cultivation of the species compatible with these conditions is required for rehabilitation and improvement of arid and semi-arid rangelands.

Plant species of Chenopodiaceae show great adaptability against harsh conditions and are distributed in desert regions of the world. Genus *Atriplex* is one of the most important species of this family as most of the species

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have a wide tolerance range and resist harsh environmental conditions. They show great adaptability to drought and soil salinity as two constraining factors of arid and desert regions. Moreover, *Atriplex* species have been used extensively due to the high palatability, high forage volume and being evergreen. More than 20 species of *Atriplex* grow in Iran; most of them are forbs while *A. griffithi*, *A. leucoclada*, and *A. verrucifera* are shrubs. Also, *A. nummularia*, A. *halimus*, *A. lentiformis* and especially *A. canescens* have been cultivated and *A. canescens* has been widely distributed due to its adaptation to the cold conditions prevailed in some cold regions (Koocheki, 2000). Despite having native species of *Atriplex* in Iran, mostly non-native species have been used due to the low growth of native species. For this reason, some of these non-native species have been entered to rangelands and desert regions of the country and have been widely cultivated in different vegetation zones since 1965. (Puri *et al.*, 1981) studied growth, flowering, seeding and germination of seven *Atriplex* species in Saudi Arabia and showed that significant differences were recorded among studied species.(Wasser, 1982) showed that germination of lighter seeds were lower than that of heavier seeds. (Srivastava, and Niym, 2008) stated that seedling emergence percentage and rate were of important factors that affected yield of crops. (Puri *et al*., 1978), (Peterson *et al.*, 1989), (Mian *et al*., 1992) also believes that strong seeds cause a better establishment for shrubs and bring increased performance. (Khan, 2003) expressed that strong seeds had better germination and establishment and could produce seedlings with strong vigor. In the arid grazing lands of central Australia, a previous study found that the size of seed were changed by heavy grazing (Kinloch and Friedel, 2005).

This research aimed to study the effects of exclosure and grazing treatments on germination percentage, mean germination time, germination rate, seed vigor, seed yield, 1000-seed weight and seed moisture percentage of *A. canescens*. Two sites of 400 and 1000 ha were respectively selected for exclosure and non exclosure areas. Despite expansion of cultivated areas, effects of exclosure and grazing on the mentioned characteristics of *A. canescens* have not been studied yet.

This research is necessary since using seeds with desirable characteristics which lead to fast growth rate and establishment are of priority programs of Desert Affairs Bureau of Forests, Rangelands and Watershed Management Organization of Iran.

2 MATERIALS AND METHODS

Seeds were collected from 30 shrubs in exclosure and non-exclosure sites and were dried naturally (four days in the sun). One thousand-seed weight was calculated for each site with 15 replications. The study was performed in a completely randomized design with four replications with the following treatments:

1- running cold water, 12 hours under running water and 24 hours in the shade
2- Running cold water, 24 hours under running water and 48 hours in the shade
3- Non-running cold water, 12 hours in non-running water and 24 hours in the shade
4- Non-running cold water, 24 hours in non-running water and 48 hours in the shade
5- Boiling water, 12 hours in boiling water and 24 hours in the shade.
6- Boiling water, 24 hours in boiling water and 48 hours in the shade.
7- control (no treatment)

Afterward, 15 seeds were placed on two layers of Whatman filter paper inside the Petri dishes of 10 cm in diameter containing 10 ml of distilled water. Counting germinated seeds was started from the second day and continued daily to end of the experiment. End of the experiment

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was when counting germinated seeds did not differ. Finally, based upon data of germination percentage, suitable treatment for calculating and comparing germination rate and percentage, germination period and seed vigor of both sites were determined.

In next stage, seeds were just exposed to the mentioned treatment with 15 replications and seed traits of exclosure and non-exclosure sites were measured by following methods and compared with each other.

Equation 1 and 2 (Ellis and Roberts, 1981):

$$MGT = \frac{\sum D.N}{n} \quad (1)$$

Equation 2:

$$GR = \frac{1}{MGT} \quad (2)$$

Germination percentage was recorded daily during the study period. Radicle and plumule lengths were measured by a precise ruler. Radicle and plumule weights were measured by a precise scale. Seedling length was also recorded as the sum of radicle and plumule length. Seed vigor was also calculated through multiplying germination percentage by plumule length. Seed moisture content was calculated by the following equation:

Equation 3:

seed moisture content= (fresh weight – dry weight)/ fresh weight (3)

3 RESULTS

Data analysis was performed by SPSS Ver17 software and Duncan's Multiple Ranges test ($p<0.05$) was applied for mean comparisons. Results are as follows:

In both sites, no germination was recorded for winged seeds. Non-winged seeds of both sites just germinated under running cold water (12 and 24 hours under running cold water and respectively 24 and 48 hours in shade). Between two successful treatments of germination mentioned in above, in both sites, maximum germination percentage was recorded for running cold water (24 hours under running cold water and 48 hours in shade). (Figure 1 and 2)

According to the results of t-test, no significant differences were recorded for traits of germination percentage, mean germination time, germination rate and vigor in both sites (exclosure and non-exclosure). 1000-seed weight and seed moisture content in both sites showed significant differences at 1% level of probability and higher values were recorded in exclosure site (Table 1).

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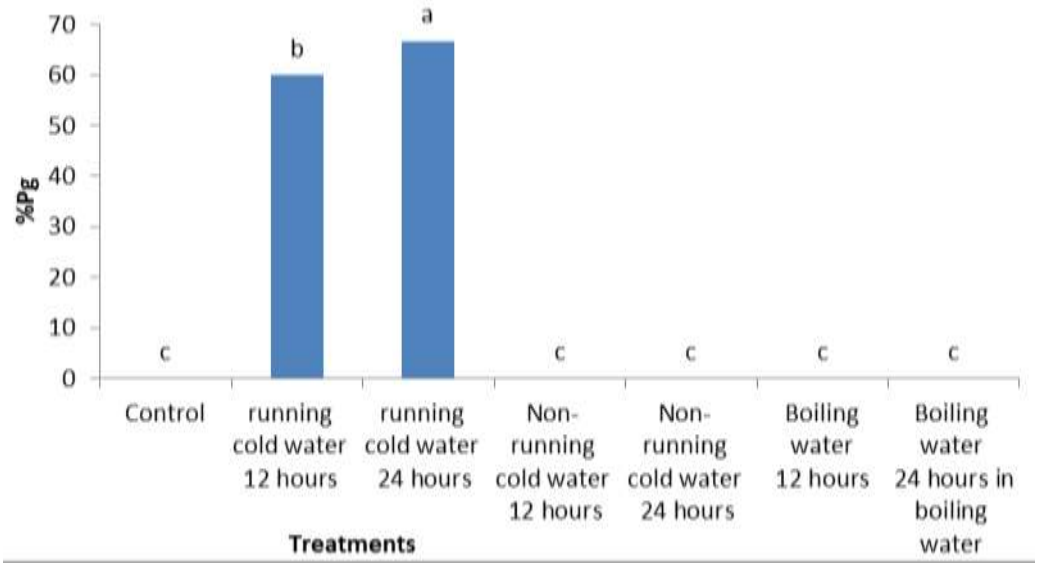

Figure 1 Germination percentage of *Atriplex canescens* in exclosure site

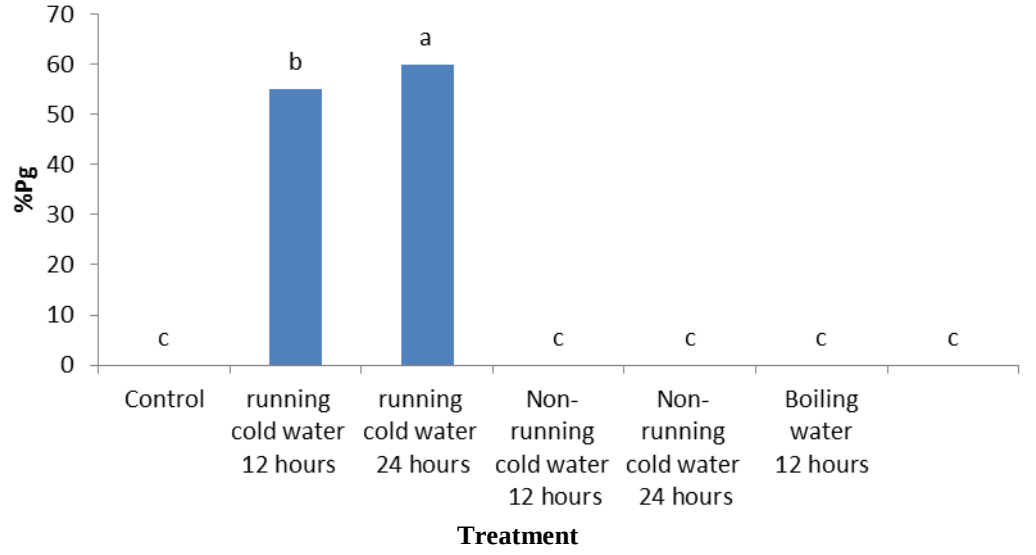

Figure 2 Germination percentage of *Atriplex canescens* in non-exclosure site

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Table 1 Mean comparisons of studied characteristics of *Atriplex canescens* in exclosure and non-exclosure sites

Seed parameters	Treatment	df	Mean	Sd	t	Sig
PG	Enclosure	14	55.1033	7.33566	0.911	NS
	non-enclosure		52.4300	8.68878		
	Enclosure	14	1.6720	1.62565	-2.066	NS
MGT	non-enclosure		3.8553	3.75682		
	Enclosure	14	1.9587	2.51710	0.582	NS
GR	non-enclosure		1.4893	1.85202		
VI	Enclosure	14	1.8473	0.72012	-0.180	NS
	non-enclosure		1.8947	0.72003		
Seed Weight	Enclosure	14	26.40	0.52316	34.513	**
	non-enclosure		19.39	0.57538		
seed moisture	Enclosure	14	55.1333	1.64172		**
(Dry weight / wet)	non-enclosure		60.2667	2.54858	-6.558	
Average seed production	Enclosure	14	.5600	0.09373	13.814	**
	non-enclosure		.1927	0.04267		

NS: Not significant

4 DISCUSSION

Results of practical experiences and researches carried out by (Spring field,1970) shows that it is necessary to apply treatments before planting the seeds of *Atriplex canescens* since wings removal of the seeds not only reduces the size and weight of the seeds but also leads to easy transport, better contact with the soil and higher germination. Consequently, different treatments have been examined and proposed by several experts as (Lenoir and Pihlgren, 2006), stated that wings removal with manual or mechanical devices, soaking of seeds in water for 2 hours, washing the seeds with distilled water and then drying the seeds for seven days in open air were considered as effective treatments in establishment of the species. Our results showed that the wings removal was essential for germination. Also, among studied treatments the seeds germinated under running cold water as maximum germination percentage was recorded for the seeds under running cold water for 24 hours and then in the shade for 48 hours. According to the results, no significant differences were observed for germination percentage, mean germination time, germination rate and vigor. One thousand-seed weight, seed moisture content and average seed yield of *Atriplex canescens* significantly differed in both sites at 1% level of probability as higher values were recorded for exclosure site. Therefore, it could be concluded that exclosure treatment had positive effects on studied traits of *Atriplex canescens* and could increase their values. These characteristics are effective in establishment of the species; consequently exclosure plays a key role in producing large, heavy and strong seeds. One thousand-seed weight is also of important qualitative criteria as the mentioned quality depends on amount of material stored for germination and growth. A higher 1000-seed weight leads to increased germination percentage and more shrubs with spikes would be preserved until harvest time. (Khan, 2003) showed that higher 1000-seed weight caused increase in seed weight and higher vigor. Using seeds with high vigor increase the yield of the species because the percentage of green seedlings and also growth rate are higher

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compared to weak seeds. On the other hand, the effect of 1000-seed weight on germination and seed vigor has been demonstrated. (Latifi, 2004) also stated that using seeds with high vigor in agriculture resulted in rapid, uniform and full germination of seeds and consequently plant density would be increased. Several results have been reported on relation between seed size and yield. Some studies showed that large seeds led to limitation in early stages of growth and did not increase the yield. Srivastava *et al,* (1973), Puri (1978), Mia *et al.* (1992) and Damavandi (2007) believed that using large seeds resulted in better establishment of the species and higher production. The result is consistent with results of the exclosure site. Low seed moisture content in non-exclosure site could be incorporated to sodium absorption. When the seeds absorb water in presence of sodium, sodium content increases in seeds and seed water potential is reduced. Soliman and Barrow (2010) also confirmed this result and noted that the effect of seed size on germination percentage and germination rate were affected by salinity. In other words, there is a significant interaction effect between seed size and salinity.

5 CONCLUSION

The overall results of the study indicated that there were no significant differences in terms of studied traits between exclosure and non-exclosure sites except seed weight, seed moisture content and seed yield.

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مقایسه برخی از صفات بذور توده‌های همسال آتریپلکس کانسنس تحت شرایط قرق و غیر قرق در مراتع زرند شهریار

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چکیده به منظور مقایسه برخی از صفات بذر آتریپلکس کانسنس تحت شرایط قرق و غیر قرق در مراتع زرند شهریار دو سایت همسال قرق شده و قرق نشده هر یک به مساحت ۴۰۰ و ۱۰۰۰ انتخاب و در پاییز سال ۱۳۸۸، و در مناطق معرف هر یک از سایت‌ها، تعداد ۳۰ بوته به صورت تصادفی انتخاب و ضمن جمع‌آوری بذور، برخی از صفات مهم بذر به شکل آزمایشگاهی مورد مطالعه قرار گرفتند. تجزیه و تحلیل داده‌ها، با استفاده از نرم‌افزار SPSS ver 17 و مقایسه میانگین آن‌ها با آزمون چند دامنه‌ای دانکن صورت پذیرفت. نتایج حاصله نشان داد که اولا، در هر دو سایت بذور بالدار تحت هیچ تیماری جوانه نزدند و ثانیاً بذور تحت تیمار ۲۴ ساعت زیر آب سرد جاری و ۴۸ ساعت در سایه، بالاترین میزان جوانه‌زنی را از خود نشان داد. در برآورد، صفات مورد مطالعه بذر در دو سایت و با استفاده از تی تست مستقل، نتایج حاصله نشان داد که، درصد جوانه زنی، متوسط مدت جوانه زنی، سرعت جوانه زنی و بنیه بذر، در دو سطح ۱و ۵ درصد معنی‌دار نبوده است. به‌عبارت دیگر بذور دو سایت قرق شده و قرق نشده از لحاظ این صفات شبیه هم هستند، ولی میزان بذر تولیدی، وزن هزار دانه و درصد رطوبت بذر، در سطح احتمال ۱ درصد معنی‌دار بوده و میزان آنها در سایت قرق شده بیش‌تر بود.

کلمات کلیدی: ارزیابی کمی، قرق، تیمار آب، چرا

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