BIABAN

BIABAN (Desert Journal)
Online at http://jbiaban.ut.ac.ir

BIABAN 12 (2007) 17-21

Effect of water stress on seed germination of *Artemisia spicigera* & *Artemisia fragrans*

H. Azarnivand[a*], M. Souri[b], V. Etemad[a]

[a] *Assistant Professor, Faculty of Natural Resources, University of Tehran, Iran*
[b] *Ph.D. Student of Range Management, Faculty of Natural Resources, University of Tehran, Iran*

Received 19 November 2005; received in revised form 31 April 2006; accepted 7 November 2006

Abstract

Physiological effect of five levels of water stress (0,-0.3,-6,-9 and -1.2MP) was studied on seed germination and tigella as well as radicule growth length in two different Artemisia species namely: Artemisia spicigera and Artemisia fragrans. Polyethylene glycol (PEG) was used to provide appropriate water potentials. A total of 50 seeds were sown from each Artemisia species. Experimental design was a factorial one of complete randomized design. Maximum germination rate was obtained at -0.3 MP. Germination rate, and tigella & radicule growth lengths declined with decreasing water potential level. Artemisia spicigera was more resistant to water stress in comparison with Artemisia fragrans.

Keywords: Water stress; Polyethylene glycol; Germination; Tigella; Radicule

1. Introduction

About 45 million square kilometers or one third of all land stand in dry lands category. Arid land and semi-arid lands of Iran estimated about 100 million hectares, cover about 64 percent of the area of the county (Javadi, M. 2003). Water stress affects different aspects of plant growth (morphology, physiology and anatomy) and causes many changes such as decrease or delay in germination, aerial organ growth reduction, decrease in dry biomass and in rate of growth, etc (Garwood, E.A. 1979, Huang, B, 1997). The extent of damage to plant depends on water stress period, soil properties, environmental characteristics as well as plant species.

Regarding the fact that the most sensitive life stage of a plant is germination period that successful passing of this stage seriously affects plant stability and establishment (Koochaki, A. 1991), so this study was carried out on *Artemisia fragrans* and *A. spicigera* because of their importance among medic as well as range plants and as related to their resistance to water stress during the germination period. There are many environmental factors that negatively affect germination mechanism. These factors disturb metabolic reactions and consequently adversely affect plant germination (Basra, A. 1997). One of these factors is when the seed is placed in a dry position. Increase in osmotic pressure decreases matric potential and makes plant germination difficult (Naseri, H. 2003). Many scientists have done different researches on this topic.

Maginz (1960) studied water stress in *Lolium prenne* and concluded that germination percent and rate, tigella and radicule length decrease with reduction in water potential.

Sony & Park (1991) studied *Astragalus.* spp seed germination and concluded that germination rate and tigella length decrease with water potential reduction (Saeedian, F. 1996).

Javadi (2003) studied water stress in *Salsola species, Salsola dendroides* was found to be the most resistant species among the studied species.

* Corresponding author. Tel.: +98 261 2223044; fax: +98 261 2227765
E-mail address: hazar@ut.ac.ir

He also he concluded that water potential reduction decreases all the studied characteristics (Zehtabian, G. 2003). It is aimed in this study to determine water stress resistance during the germination period of *Artemisia spicigera* and *Artemisia fragrans*. The results can be employed in choosing suitable species in range management and improvement in arid and semi-arid regions.

2. Materials and Methods

2.1. Botanical characteristics

Artemisia genus belongs to composite family. More than 400 species in the world belong to this genus. The main habitat of this genus is in Asia and Europe. There are 33 species of this genus in Iran that are scattered in the Irano-Turanian region.
Most *Artemisia* species are perennial and constitute the vegetation cover of dry and semi-arid regions. *Artemisia fragrans* willed is a ligneous plant that is about 25-50 centimeters tall. Bottom of the plant is divided and woody. Its different flowering branches are completely erected covered with white papill as at first and while decreasing to the end they are green, angular, with branches at the top.
Artemisia spicigera is a ligneous plant that is 25-50 centimeters tall, bottom of plant is woody and divided, its different flowering branches are completely erected, covered with papill as, white and highly densed at the start while decreasing towards the end.
They are green and occasionally yellow, angular and have branches at the top.

2.2. Methods

Prior to performing the tests, seeds were stratified for two months using "between paper method" and their germination capacity determined, which was 69% in *A. fragrans*.
The test was performed in three replications and five treatments. In each Petri dish, the healthy seeds were cultivated. Before cultivation, the seeds were disinfested by sodium hypocholoride 50% and were then washed with distilled water. The seeds were placed Petri dishes, sterilized with alcohol. To study water stress, different levels of PEC 6000 were added to Petri dishes equaling to 0, 0.3, 0.6, 0.9 and 1.2 mega Pascal of dryness. In order to reduce evaporation, Petri dishes were placed in plastic bags and then put in the germinator. They were checked every 48 hours for the number of seeds germinated to be recorded. It took 18 days for following variables to be finally measured (Fig.1).

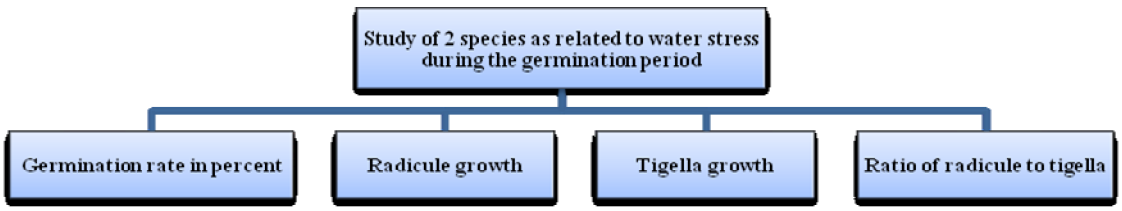

Fig. 1. Measured variables regarding water stress resistance

3. Results

Comparing the replicates in each treatment for either one of the species, the 0.3 mega Pascal (mp) treatment benefited from the highest germination rate that was 71% in *A. spicigera* and 53.4% in *A. fragrans*. In total, germination rate decreases while water stress increases. The least germination rate was observed in 1.2 mega Pascal treatment in either one of the species. The highest radicule length was observed in 0 (Zero) mega Pascal treatment in both species while the highest tigella length in 0.3 mega Pascal treatment. Water potential reduction caused reduction in radicule and tigella length. The least of these two parameters were observed in 1.2 m.P. treatment (Javadi, M. 2003).
The highest ratio of radicule to tigella length was detected in zero mega Pascal treatment in either of the species (Zehtabian, G. 2003).
This ratio decreases with water potential reduction, so that the least occurs in 1.2 mega Pascal treatment. Each variable was determined and statistically analyzed through Minitab software using Kolomogrov-Smirnov and Ryan-Joiner tests. The results showed the normality of the data.
Statistical analysis of data using SAS software showed that the effects of treatments on germination, radicul length and tigella length were significant in two probability levels of 1% and 5%. The interaction of different treatments and studied species in germination period and in

radicule length was not significant but it was significant for tigella length within two probability levels of 1% and 5%.

4. Conclusion

The results of this research indicated that germination rate, radicule and tigella length decrease with reduction in water potential. The least germination rate, tigella and radicul length were observed in -1.2 mega Pascal treatment while the highest observed in 0.3 mega Pascal. PEG density increase to 6000 osmotic pressure, and potential increase could be the reason for the above results. This caused absorption reduction by seeds, inhibithing or slowing down some other natural activities of plant.

Javadi (2003) studied three species of *Salsola* and concluded that germination rate, tigella and radicul length decrease whit increasing water stress rate. Kouchaki and Zarifketabi (1997) proved the direct negative relationship between water stress rate and germination percent, tigella and radicul length.

Based upon the results of this study and Azarinvand's research (2004), it is recommended to use *A. spicigera* as and improving species in semi-arid lands.

This is because it is resistant to water stress in addition to its essence being medic and of industrial value. The plants that are resistant and have higher rate of radicul and tigella growth during the germination period, exhibit higher resistance to water stress in other stages of growth too (Basra, A. et al., 1997). One can detect other resistant species to water stress by doing similar research to be recommend for cultivation in arid and semi-arid regions. These special would consequently increase the herbaceous reservoir in these regions. On the other hand, due to the high medic and industrial value of these species, their cultivation and propagation would have an important role in increasing exploiters, income. Prevention of the damaging and degrading trend of vegetation and prevention of soil erosion, would be some other of the valuable obtained results.

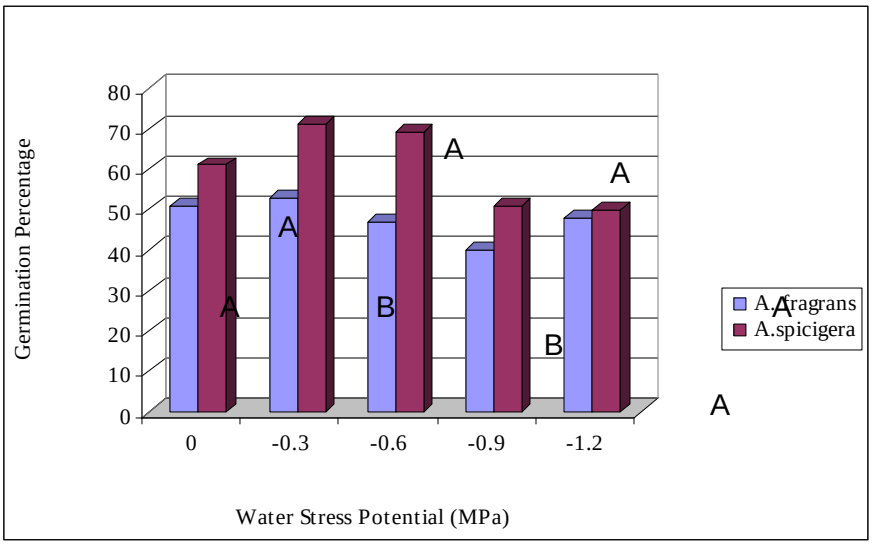

Fig. 1. Effect of Water Stress on Germination

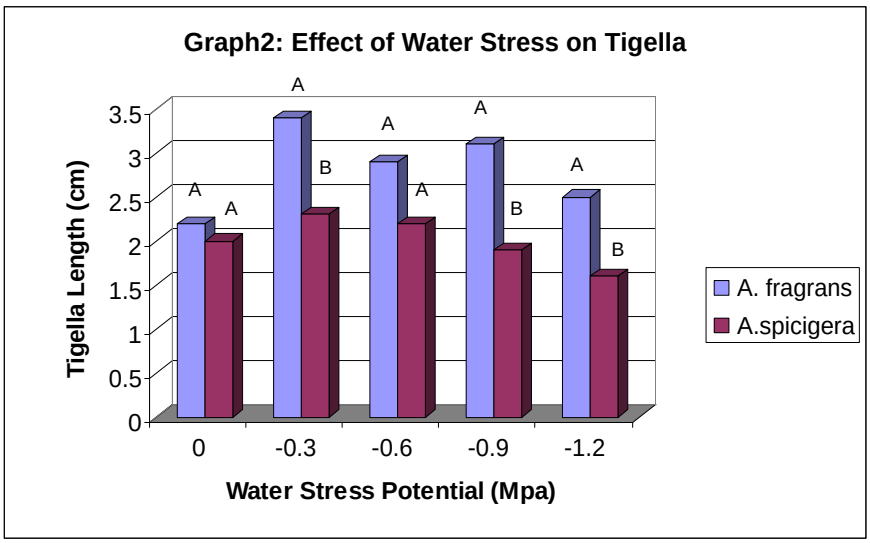

Fig. 2. Effect of Water Stress on Tigella

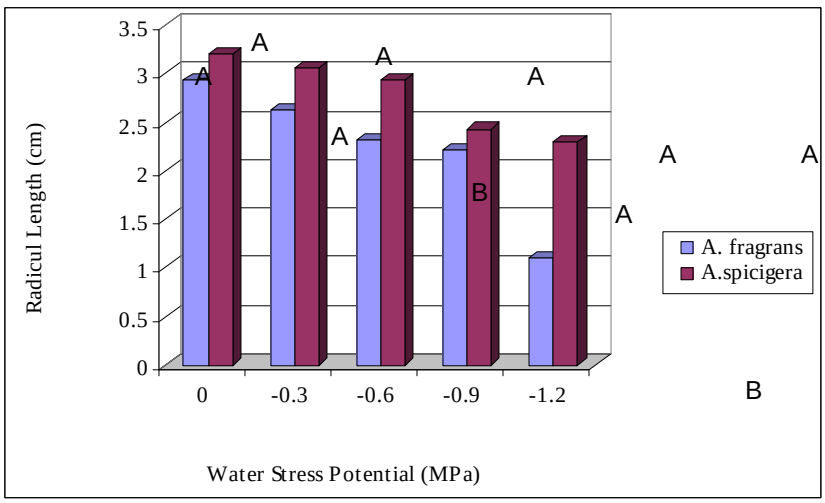

Fig. 3. Effect of Water Stress on Radicule

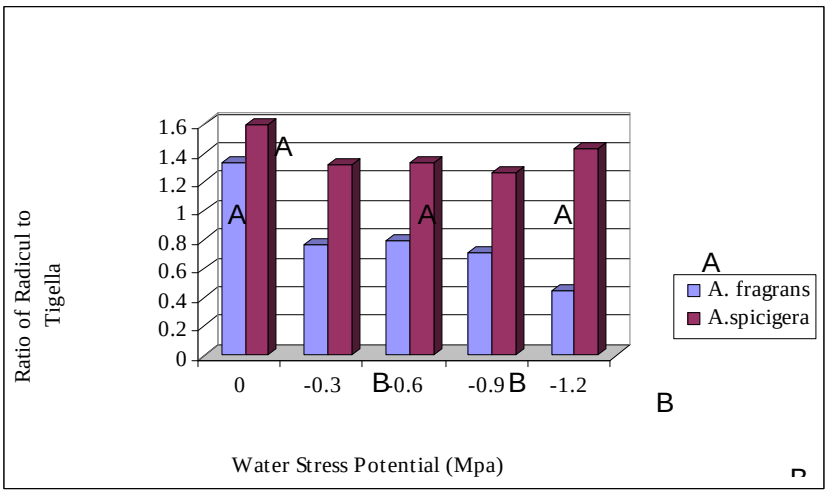

Fig. 4. Effect of Water Stress on Ratio of Radicule to Tigella

Table 1. Variance Analysis of Germination, Factorial Test

Pr>F	F	MSE	Emancipation	Source
0.0001**	87.91	0.00647120	1	V
0.0001**	8.15	0.00263121	4	D
0.1087^{ns}	0.81	0.00006548	4	V*D
0.1276^{ns}	0.95	0.00008453	2	R

** There are considerable discrepancies, among the treatments, with a probability of 99%
* There are differences among the treatments, with a probability of 95%
ns: No differences observed among the treatments
V: Variety D: Dry Treatment R: Replication

Table 2. Variance Analysis of Radicule Length, Factorial Test

Pr>F	F	MSE	Emancipation	Source
0.0922 ns	3.15	675.51201100	1	V
0.0037**	2.23	858.73224000	4	D
0.5100 ns	0.75	104.90725178	4	V*D
0.0935 ns	0.89	387.35237441	2	R

Table 3. Variance Analysis of Tigella Length, Factorial Test

Pr>F	F	MSE	Emancipation	Source
0.0001**	3.59	874.051781001	1	V
0.0052**	2.15	743.52345543	4	D
0.0001**	1.12	974.53936123	4	V*D
0.5132 ns	0.84	154.04531435	2	R

References

Basra, A. sand R.K Basra, 1997. Mechanism of environmental stress responses in plants. Harwood academic publisher.

Dwyer, D.D and K. Wolde-Yohannis, 1972. Germination Emergence, Water stress use, and Production of Russian Thistle (Salsola Kali)- Agron. J. (64). P:52-55.

Garwood, E.A., 1979. Water use by six grass species and use of soil water. Journal of Agricultural Science. vol:93. p :25-35.

Huang, B., 1997. Drought resistance mechanisms of seven warm season turf grass under surface soil drying. Crop Science. vol :37.p:1858-1863.

Javadi, M., 2003. Investigation on Water Stress Effect on Seed Germination of three Rangeland Spices. MSc. Seminar. Faculty of Natural Resources, University of Tehran.

Koochaki, A., 1991. Farming Plant Germination Physiological Fundamentals. Astane Ghodse Razavi Publication.

Naseri, H., 2003. Investigation on Botanical and Ecological Characteristics of *Artemisia* Spices in East Azarbayjan. MSc. Thesis. Faculty of Natural Resources, University of Tehran.

Saeedian, F., 1996. Investigation on Dry Resistance and Water Use Efficiency on two Rangeland Spices. MSc. Thesis. Faculty of Natural Resources, University of Tehran.

Souri, M., 2005. Investigation on Water Stress Effect on Seed Germination of tow Rangeland spices. MSc. Seminar. Faculty of Natural Resources, University of Tehran.

Zehtabian, G., 2003. Investigation on Water Stress Effect on Seed Germination of three Rangeland spices. Desert Scientific and Research Magazine.