

Effect of Water Stress on Seed Germination of *Agropyron Elongatum*, *Agropyron Desertourm* & *Secale Montanum*

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Abstract

Physiological effect of six levels of water stress (0, -0.1, -0.03, -0.6, -0.9 and -1.2 MP) was studied on seed germination and plumule as well as radicle growth length in three species namely: *Agropyron elongatum*, *Agropyron desertourm* and *Secale montanum*. Polyethylene glycol (PEG) was used to provide appropriate water potentials. A total of 100 seeds in four replications (Petri dishes) were sown from each species. Experimental design was a factorial one of complete randomized design. Maximum germination rate was obtained at 0 MP. Germination rate and plumule and radicle growth declined with water potential level. The most resistance species to water stress are *Secale montanum*, *Agropyron elongatum* and *Agropyron desertorum* respectively.

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

1. Introduction

About 45 million square kilometers or one third of all land stands are classified in dry lands category. Arid and semi arid lands of Iran were estimated about 100 million hectares cover, about 64 percent of the area of the country (Javadi, M. 2003). In these regions, water is the main factor which controls the success of plants germination. 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). Rate and start of germination may be affected by inappropriate water potentials in arid and semi arid lands (Young *et al.* 1983). The

extent of damage to plant depends on water stress period, soil properties, environmental characteristics as well as plant specie.

As a matter of fact, the most sensitive life stage of a plant is germination period and successful passing of this stage seriously that affects plant stability and establishment. Many researches have been studying the germination of agricultural plant species while there are few studies on the germination of rangeland plant species as below:

Maginz (1960) studied water stress in *Lolium preenne* and concluded that percentage and rate of germination, tigella and radicle length would be decreased with reduction in water potential. Cluff and Roundy (1988) studied the germination responses of desert salt grass to temperature and osmotic potential and concluded that the decrease of osmotic potential from 0 to -2 MP would decrease the total germination from 60 to 9 percent. Sony and Park (1991) studied seed germination of *Astragalus* spp. and showed that

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reduction of water potential would decrease the germination rate and tigella length. Romo *et al.* (1991) investigated the influence of temperature and water stress on germination of plains rough fescue and stated that the increase of water potential would decrease the germination rate.

Qi and Redman, (1993) studied the seed germination and seedling survival of C3 and C4 grasses under water stress and pointed out that *Bouteloua gracilis* had the most germination rate. Javadi (2003) studied water stress in *Salsola* species and indicated that *salsola dendroides* was the most resistance species among the studied species. He also concluded that water potential reduction would decrease all the studied characteristics (Zehtabian, G. 2003).

Considering the lack of accurate knowledge about the resistance of range species to water stress, it is necessary to do more researches on this issue to have a better recognition of resistant species to water stress. Consequently, the results of the studies may be used in choosing suitable species for range management and range improvement in arid and semi-arid regions.

This study has been carried out to determine the water stress resistance of *Agropyron elongatum*, *Agropyron desertourm* and *Secale montanum* during the germination period. It is also aimed to nominate the most resistant species according to the germination factors in laboratory conditions. The mentioned species were selected due to their good forage production used by livestock in arid and semi-arid regions.

2. Materials and Methods

The test was performed in four replications and six treatments. In each Petri dish healthy seeds were cultivated. Before cultivation, the seeds were disinfected by vita wax solution for 2.5 minutes and were then washed with distilled

water. Petri dishes were also disinfected by a temperature of 100 ° C for two hours. For all treatments, 100 seeds were placed in Petri dishes (TP method). To study the water stress, different levels of PEG 6000 were added to Petri dishes equaling to 0, -0.1, -.03, -0.6, -0.9 and -1.2 Mega Pascal of dryness. In order to reduce the evaporation, Petri dishes were placed in plastic bags and then put in the germinator for 15 days. The percentage of germination and the average length of plumule and radicle were measured for all water stress treatments. To achieve this goal, the number of germinated seeds from each Petri dish was considered to measure three mentioned factors in fifteenth day.

3. Results

Comparing the replicates in each treatment for all the species, the 0 mega Pascal treatment benefited from the highest germination rate that was 69.25 % in *Secale montanum*, 56% in *Agropyron elongatum* and 45.75% in *Agropyron desertorum*. In total, germination rate decreases while water stress increases. The least germination rate was observed in -1.2 mega Pascal treatments in all three species. The highest radicle and plumule length was observed in 0 (Zero) mega Pascal treatment. Generally, the reduction of water potential caused reduction in radicle and plumule length. The least of these two parameters were observed in -1.2 mega Pascal treatment.

The results of statistical analysis show that the effects of treatments on germination, radicle length and plumule length were significant in the probability level of 1%. In addition the results of Duncan's Test show a significant difference of germination, radicle length and plumule length among three species within the probability level of 5% (Figures 1-6).

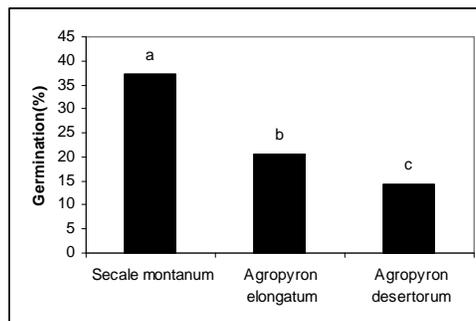


Fig. 1. Duncan's test of Germination (P< 0.01)

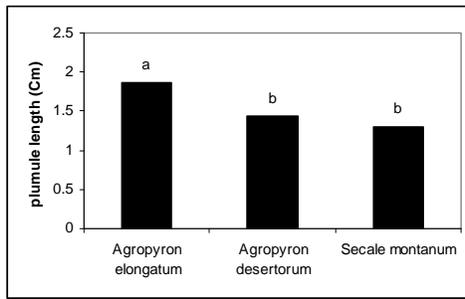


Fig. 2. Duncan's test of Plumule ($P < 0.05$)

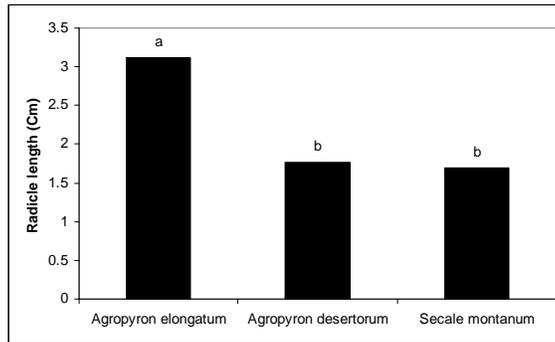


Fig. 3. Duncan's test of Radicle ($P < 0.05$)

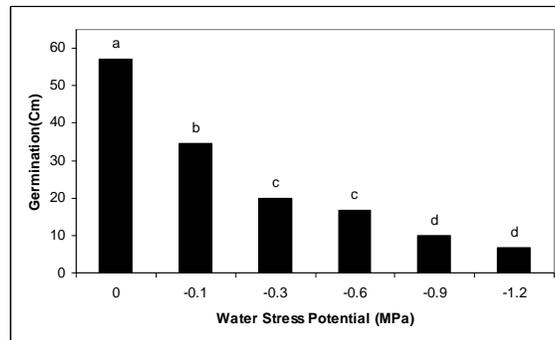


Fig. 4. Duncan's test of germination under water stress potentials ($P < 0.05$)

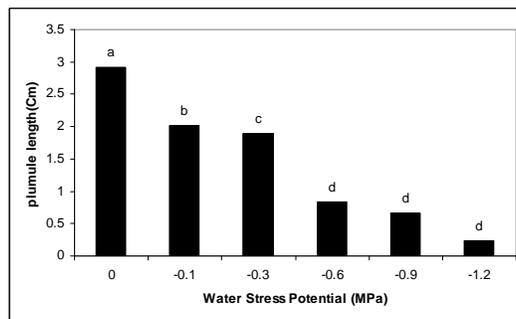


Fig. 5. Duncan's test of Plumule length under water stress potentials ($P < 0.05$)

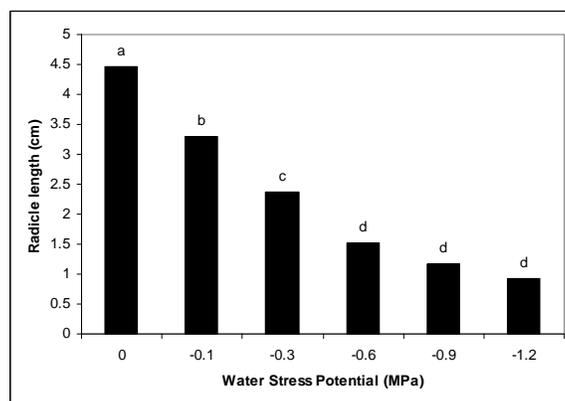


Fig. 6. Duncan's test of radicle length under water stress potentials ($P < 0.05$)

4. Conclusion

The results of this research indicated that germination rate, radicle and plumule length decreased with reduction of water potential and *Secale montanum* had the most percentage of germination.

Doescher *et al.* (1985) studied the effect of water stress on the germination of Idaho fescue and founded as water stress decreased and temperature increased, both germination amount and rate for the 4 collections declined. Kouchaki and Zarifketabi (1997) proved the direct negative relationship between water stress rate and the percentage of germination, radicle and plumule length. Javadi (2003) studied three species of *Salsola* and concluded that germination rate, radicle and plumule length decreased with the increase of water stress rate. Finch *et al.* (2001) studied the effect of water stress on the germination of *Daucus carota* and concluded that the maximum germination rate was observed in 0 MP and with the increase of water stress, germination rate, and radicle and plumule length decreased.

Present study showed similar result to other researches, like decreasing water potential, decreases germination; Plumule and radical length. Increasing PEG solution Concentration and decreasing seed water absorption, restricted natural activities of seedling. Water stress research showed different results, some plants show high resistance during germination stage, on the other hand some of them show high resistance during growth stage. So high resistance in germination stage does not express high resistance during growth stage. On the other hand, we carried out our research under Laboratory

condition and its result can be applied in laboratory condition. Knowledge of drought-resistance mechanisms and selection of resistant species would improve management strategies. For this reason, we propose to scientists to carry out water stress studies in laboratory and field condition and select resistant species and accetions for rangeland improvement and development.

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