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Investigate the effect of drought and salinity on germination of native wheat cultivars in Ardabil

Nasim Naderi* and Ali Aghaei

Department of Agronomy and Plant Breeding, Ardabil branch, Islamic Azad University, Ardabil, Iran

Corresponding author Email : Nasim naderi

ABSTRACT: Considering that salinity and drought stress are the most important environmental stresses. In this study, the physiological effects of these stresses were studied in levels 0, -3, -6 and -9 bar with sodium chloride (NaCl) and polyethylene glycol (PEG) on germination and seedling growth of wheat cultivars (Cross Sabalan and Gascogne). Germination percent, germination rate, length ratio of root to shoot (R / S) and seedling fresh weight measured in this experiment. The aim of this study was to investigate genetic differences in wheat varieties under salinity and drought stress and also determining the sensitivity of the germination components and its seedling growth. Results indicated that there was significant difference between wheat different genotypes in terms of the sensitivity to salinity and drought stress, wheat germination was not affected by drought, but the germination percent of Cross Sabalan and Gascogne decreased respectively to 69 and 33 percent under salinity stress. The maximum germination rate was observed on the wheat's Gascogne seeds under stress. Drought stress had a significant effect on the ratio R / S, but there was no significant effect of salinity on this character. The greatest increase was devoted to "Cross Sabalan" in the drought conditions. Gascogne had the highest seedling fresh weight in different levels of salinity and drought.

***Keywords*:** Polyethylene glycol, Sodium chloride (NaCl), germination, wheat.

INTRODUCTION

Germination has decisive role in the appropriate establishment and final performance of plant (Almasouri, M. et al, 2001). To start the metabolic activity of seed germination is necessary a certain amount of water to be absorbed by them which vary depending on the chemical composition and permeability of the seeds membrane (Misra, N., and U.N. Dwivedi. 1995). There is significant water for any potential that cannot be done germination (Delachiava, M.E.A.,and S.Z.De-Pinho. 2003). Moreover, the sensitivity to drought stress is different during the stages of germination and root withdrawal (De,R., and R.K.Kar. 1995). Seed germination percentage and germination rate reduce under drought conditions and therefore can be reduced seedling growth. Salinity is known as the most important factor of seedbed in arid and semi-arid regions that will affect plant establishment; sufficient rainfall does not exist for leaching salts from the root zone in these areas, and mostly salt concentration in the soil increase due to the high evaporation rate (Almasouri, M et al 2001 and Pesarrakli, M. 1999). Salinity not only reduces the water's free potential through the toxic effects of ions such as Na^+ and Cl^- , also affect seeds germination (Kafi, M and M. Goldani. 2001). Since there are differences between species and even different varieties in terms of susceptibility to salt and drought stress, the aim of this study is to investigate the effects of salinity and drought stress on germination of wheat genotype.

MATERIALS AND METHODS

The study was performed on seed cultivars "Cross Sabalan" and "Gascogne" of wheat. Before starting the experiment, first the seeds were disinfected with solution of sodium hypochlorite 3% for 2 min and seeds germination of cultivars was performed using 30 seeds in Petri dish 9 cm and four levels of osmotic potential caused by NaCl (salinity stress) or PEG (osmotic drought stress) with potentials 0, -3, -6 and -9 bar and germinated seeds were counted on a daily basis. Root length, shoot length, length ratio of root to shoot (R / S) and seedling fresh weight were measured using 5 samples at the end of the last day.

To calculate the percentage and rate of seed germination was used the following formula:

Germination percentage = S/T × 100
Germination rate = N1/D1+N2/D2+…+Ni/Di

Which S is the number of seeds germinated, T is total number of seeds and Ni is the number of seeds germinated on day Di. After studying the data collected from each plant were separately analyzed according to factorial experiments 2+4 with three replications and in a completely randomized design using MSTAT-C statistical software.

RESULTS AND DISCUSSION

The results of ANOVA showed that the effect of drought and salinity was significant on the wheat germination percentage (Table 1). Drought and salinity stress reduced significantly seed germination percentage, but reduction was higher in salinity (data has not been shown). Seeds germination percentage in wheat cultivars were not significantly reduced under drought conditions, but germination percentage was significant under salinity conditions (data has not been shown).

Table 1. The ANOVA results of the effects of drought and salinity stress on germination and early growth of wheat

Sidling fresh weight		R/S		Germination rate		Germination percentage		SOV
drought	Salinity	drought	Salinity	drought	Salinity	drought	Salinity	
*	**	**	**	**	*	**	**	Cultivar (A)
**	**	**	**	**	**	ns	**	Osmotic potential (B)
ns	ns	*	ns	ns	ns	ns	**	A.B

*and ** respectively significant at the five and one percent, and ns no significant effect

The greatest decrease of the germination percentage occurred in Cross Sabalan under salinity stress which germination bar of seeds decreased 68.8 percent with increasing the level of zero to -9 bars. According to above results, it seems that salinity have greater effect on seed germination of cultivars. These results are inconsistent with results of Ashraf and Abushakera (Ashraf,C.M., and S.Abu-Shakra. 1978) and Okcu et al (Okcu,G., M.D.Kaya, and M.Atak. 2005). The researchers found that drought stress due to PEG had the greater inhibitory effect on seeds germination percentage than salinity stress. Also, the effect of salinity on seed germination of wheat was significant (Table 1).

Table 2. The interaction between varieties (wheat) in the solution osmotic potential in relation to the traits tested

Osmotic potential	Germination percentage				R/S			
	cultivar				cultivar			
	163		153		163		153	
	Salinity	drought	Salinity	drought	Salinity	drought	Salinity	drought
zero	88.9 ab	88.9 ns	94.4 a	94.4 ns	1.9 ns	1.9 bcd	1.7 ns	1.7 cd
-3	68.9 c	86.7 ns	91.1 ab	94.4 ns	1.5 ns	1.7 cd	1.1 ns	1.5 cd
-6	42.2 d	83.3 ns	76.7 bc	95.6 ns	1.9 ns	3.1ab	1.4 ns	2.5 abc
-9	27.8 d	84.4 ns	63.3 c	95.6 ns	1.7 ns	3.3 a	1.3 ns	1.1 d

The higher effects of drought stress on decreasing of the seed germination rate have also been reported than salinity stress in similar potential at previous studies (Ashraf,C.M., and S. Abu-Shakra. 1978, Okcu, G., M.D.Kaya, and M.Atak. 2005). Different responses of cultivars to salinity and drought in germination stage have been demonstrated by other researchers (Okcu,G., M.D.Kaya, and M.Atak. 2005, Pesarrakli,M. 1999). Components of germination can be reduced due to deceleration, the initial uptake of water and the negative effects of low osmotic potential and toxicity of ions Na^{+} and Cl^{-} on biochemical processes of anabolic and catabolic stages of germination (Kafi,M and M.Goldani.2001 and De,R., and R.K.Kar. 1995 and Misra,N., and U.N.Dwivedi. 1995 and Neto, N.B.M et al 2004). In wheat cultivars in both salinity and drought stress the root to shoot ratio increased with increasing osmotic potential (data has not been shown). The greatest increase of R/S was observed in the Cross Sabalan seeds under drought stress. Increasing the amount of R/S showed shoot growth reducing than root. In other words, shoot growth was more sensitive to stress. These results are similar to those reported in other cultivars of wheat in Turk et al (Pesarrakli,M. 1999). Salinity and drought stress decreased significantly the fresh weight of wheat seedlings (Tables 1 and 2), but the greatest reduction was observed in the above figures in drought conditions that these results are consistent with the findings of previous studies (Okcu,G., M.D.Kaya, and M.Atak. 2005). Growth reduction of seedlings components (root and shoot) in salinity and drought stress conditions have been reported in other studies on wheat (Pesarrakli,M. 1999), green gram (De,R., and R.K.Kar. 1995) and pea (Okcu,G., M.D.Kaya, and M.Atak. 2005). In these experiments, the rate of decrease varies depending on the cultivar. However, crop tolerance to salinity during after germination depends on the seedling's ability to store toxic ions of Na^+ and Cl^- in their vacuoles, so that the cell metabolism is not affected (Wahid,A.E.Rasul, and A.R.Rao. 1997).

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