EFFECT OF DIFFERENT LEVEL OF SALINITY ON SEED GERMINATION OF WHEAT (*TRITICUM AESTIVUM* L.) CULTIVARS

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The aim of this study was to evaluate the effect of different levels of salinity on seed germination of wheat cultivars. The experiment plan was done as a completely randomized design with four replications. Seeds of four wheat (Zagros, Sardari, Chamran and Taro) cultivars were obtained. Salinity treatments measuring 0.00, -2.460, -4.920, -9.830 and -14.745 bars were achieved by adding NaCl in deionized water. Data obtained from this study showed that there was a decrease in water uptake and germination of all cultivars. Increase salt concentration also affected the early seedling growth. Among the cultivars under investigation Sardari cultivar appeared to be more sensitive at germination stage. In conclusion we could demonstrate that there were differences between different levels of salinity and seed germination of wheat (*Triticum aestivum* L.) cultivars.

Keywords: wheat, germination, seed, salinity.

INTRODUCTION

Salinity is a widespread problem around the world. Seed germination and seedling growth of wheat (*Triticum aestivum* L.), like other crops, are negatively affected by salinity stress (Hampson and Simpson, 1990). Poor germination and decreased seedling growth result in poor crop establishment. Poor crop establishment in turn causes decreased crop competitiveness with weeds; lower shading of the soil surface and subsequently higher loss of soil water through evaporation and hence, lower crop water availability (Condon *et al*., 1993).

Wheat is a major staple food crop for more than one third of the world population and is the main staple food of Asia (Mer *et al*., 2000). It is grown both as spring and winter crop. Winter crop is more extensively grown than spring one. The possible cause of varietal difference most likely evolves ion transport properties and cellular compartementation (Ashraf, 1999). It is rated as moderately salt tolerant,

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but salinity reduces germination and delays emergence in this species and stands tend to be irregular with depressed crop yield. Schachtmann and Munns (1992) reported that sodium exclusion was a general characteristic of salt tolerance in wheat lines, whereas, salt tolerant display much higher shoot sodium level than sensitive lines. Few studies have been carried out on the relative salt tolerance of various cultivars of agricultural crops of Iran (Shirazi *et al*., 2001). The screening of salt tolerant lines or cultivars has been attempted by many researchers on various species at seedling growth stage (Kayani, 1987). The relation of various seedling growth parameters to seed yield and yield component under saline conditions are important for the development of salt tolerant cultivar for production under saline. The aim of this study was to evaluate the effect of salinity on seed germination of wheat (*Triticum aestivum* L.) cultivars.

MATERIAL AND METHODS

The experiment plan was done as a completely randomized design with four replications. Seeds of four wheat (Zagros, Sardari, Chamran, and Taro) cultivars were obtained. The seeds were surface sterilized by dipping the seeds in 1 percentage mercuric chloride solution for two minutes and rinsed thoroughly with sterilized distilled water. There were five salinity treatments having osmotic potential 0.00, -2.460, -4.920, -9.830 and -14.745 bars. The treatment having osmotic potential 0.00 bars served as control. These treatments were prepared by dissolving separately calculated amounts of NaCl in deionized water. All the experiments were conducted in 10 cm Petri plate on filter paper beds in growth chambers. The total of 25 seeds were sown in 10 cm diameter Petri plate on filter paper beds, irrigated with 5 ml solution of respective treatment and incubated at 30 °C. Each treatment was replicated thrice. The filter paper beds were irrigated daily with 5 ml solution of the respective treatment. The filter beds were changed after 4 days in order to avoid salt accumulation. The emergence of radical or plumule from seed was taken as an index of germination. The germination percent was recorded daily up to 10 days. Recovery test was applied on those seeds which did not germinate in the scheduled time. Non-germinated seeds were washed with distilled water and sown in Petri plates on Whatmann's No.1 filter paper in an incubator at 24–26 °C for one week. Also, five mL distilled water was added to each Petri plate daily. Data analysis was performed by using the general linear model procedure and the comparison of means was made through Duncan's (1995) multiple range tests by using SAS 8.2 software SAS, 2001.

RESULT AND DISCUSSION

Table 1

Recovery of experimental wheat cultivars at germination stage

Osmotic potential (Bars)	Zagros	Chamran	Taro	Sardari
-2.460	-*	-	-	-
-4.920	-	-	-	2
-9.830	11	-	-	28
-14.745	15	-	40	38

*Number of non-germinated seeds sown in each treatment

At higher osmotic potentials -9.830 and -14.745 bars the water uptake decreased as compared with control. The reduction in water uptake at -14.742 bars with respect to control was 51.09, 36.55, 42.82, and 35.35 percentage in (Zagros, Chamran, Taro and Sardari) respectively. The cultivars can be arranged in the following order on the basis of water uptake. The initiation of germination of cv. raskoh was delayed up to one day by all levels of salinity while of Sardari beyond -4.920 bars osmotic potential. The increase in salinity up to -14.745 bars osmotic potential had no effect on germination of Sardari seed. The maximum decrease in germination was observed in Sardari 76.67 percentage. The cultivars had the following order on basis of germination at -14.745 osmotic potential. The increase in NaCl concentrations decreased the shoot and root length and biomass of all the wheat cultivars. All cultivars responded in same manner to salinity stress. However, the intensity of stress varied with the cultivars. It had been observed that those cultivars responded poorly at germination stage showed better response at seedling stage. The reduction in shoot growth was greater than root growth. The reduction in biomass production was also greater in cultivar having higher germination rates.

Table 2

Effects of salinity on salt tolerance index of wheat cultivars
at germination and seedling growth stage

Osmotic potential (Bars)	Zagros		Chamran		Taro		Sardari	
	Germination	Growth	Germination	Growth	Germination	Growth	Germination	Growth
-2.460	100	83.16	100	76.15	100	83.25	100	83.07
-4.920	98.3	65.23	100	63.42	100	66.19	96.6	72.62
-9.830	81.66	30.22	100	41.21	100	52.27	53.33	53.42
-14.745	58.33	11.56	100	10.24	33.33	15.18	23.33	32.18

Result of effects of salinity on salt tolerance index of wheat cultivars at germination and seedling growth stage are shown in Table 2. Data regarding salt tolerance of different cultivars under investigation show that cultivar Chamran is most tolerant at germination stage while cultivar Sardrai at seedling growth stage.

Our results are in line with the findings of Kollar (1982) and Rahman (1988) that germination was directly related to the amount of water absorbed and delay in germination to the salt concentration of the medium. Decrease and delay in germination in saline medium has also been reported by Rahman (1988) and Mirza (1986).

After application of seeds which did not germinated probably their embryo was damaged due to the presence of NaCl ions. Physiologically absolute ratio of K/Na in the tissue is important. It has been suggested that ion ratios are important in determining relative toxicities of various ions and can provide insight into ion antagonisms (Cramer, 1994). The increase in salinity shortens this ratio (Wilson *et al*., 2000) and probably caused injury to embryo. Greater recovery at lower osmotic potentials has been reported by Kayani and Rahman (1988) that they suggested that this might be due to low concentration of ions. The salt tolerance of plants varies with the type of salt and osmotic potential of the medium.

Water availability is one of the main environmental factors limiting photosynthesis and growth (Khan, 1984). Salinity affects the seedling growth of plants (Tezara *et al*., 2003 and Rahman *et al*., 1988) by slow or less mobilization of reserve foods (Meiri and Poljakoff-Mayber, 1970) suspending the cell division, enlargement (Kayani *et al*., 1990) and injuring hypocotyls (Meiri, 1970).

Among the varieties tested Sardari cultivar appeared to be more sensitive at germination stage than others. Although Sardari cultivar had comparatively low germination at higher salinity levels, performed quiet satisfactorily at seedling stage. Ayers and Hayward (1984) reported that there may not be a positive correlation between salt tolerance at germination stage and during later phases of growth as observed in the present studies. Many plants are most sensitive to ion stress during germination or young seedling growth (Francois, 1994; Catalan *et al*., 1994 Rogers *et al*., 1995 and Carvaja *et al*., 1998). Mahmood and Malik (1986) observed greater salt tolerance at growth than at germination stage. It is clear from the results that behavior of cultivars varies both at germination and seedling growth stages. This shows that species or varieties can never be selected simply on the basis of higher germination percentage. According to Mass and *et al*. (1990) the ability of seed to geminate and emerge in saline soil depends not only upon the concentration of salts, but also upon various other biological factors *i.e.* viability of seed, seed age, dormancy, seed coat permeability, internal inhibitors and genetic makeup. Yet, George *et al*. (1964) have the opinion that greater tolerance to salinity during germination is associated with lower respiration rates and greater reserve of respiratory substances.

CONCLUSION

In conclusion we could demonstrate that salinity treatments measuring 0.00, -2.460, -4.920, -9.830 and -14.745 bars were achieved by adding NaCl in deionized water. There was a decrease in water uptake and germination of all cultivars. Increase salt concentration also affected the early seedling growth. Among the cultivars under investigation Sardari cultivar appeared to be more sensitive at germination stage. However, it performed quite satisfactorily at seedling stage.

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