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Araştırma

EFFECT OF DIFFERENT SALINITY (NaCl) CONCENTRATIONS ON THE FIRST DEVELOPMENT STAGES OF ROOT AND SHOOT ORGANS OF WHEAT

Burhan KARA*   Nimet KARA (UYSAL)

Suleyman Demirel University, Agriculture Faculty, Department of Field Crops, ISPARTA
***: e-mail: bkara@ziraat.sdu.edu.tr**

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ABSTRACT: The study was carried out with the aim to determinate the effects of different NaCl concentrations on germination, seedling growth and salt tolerance of some bread and durum wheat varieties. The experiment was arranged as randomized plots design with two factors and three replications. The research was conducted at the laboratory and Research Greenhouses of Suleyman Demirel University in 2008 year. The cultivars Gerek-79 and Altay-2000 (bread wheat), Kunduru-1149 and Kızıltan-91 (durum wheat) were used as experimental materials. Effects of NaCl concentrations (control and EC value: 3.5, 7.0, 10.5, 14.0 and 17.5 dS m^{-1}) on emergence rate, reduction percentage of emergence (RPE), seedling length, root length, dry weight of above-soil surface organs and root dry weight and salt tolerance index were observed. Germination vigor in petri dishes and characters of seedling growing in pots were noticed.
Emergence rate, reduction percentage of emergence (RPE), seedling length, root length, dry weight of above-soil surface organs and root dry weight and salt tolerance index decreased significantly depend on increasing salt concentrations. Response of wheat cultivars were significantly different regarding salt concentrations. Among the cultivars, while the highest salt tolerant index was observed in Altay-2000 cultivar, salt tolerant index of the other wheat cultivars were middle graduated tolerant.
Key Words: Wheat, salinity, emergence rate, cultivar

BUĞDAYIN KÖK VE TOPRAK ÜSTÜ ORGANLARININ İLK GELİŞMESİNE FARKLI TUZ (NaCl) KONSANTRASYONLARININ ETKİSİ

ÖZET: Çalışma, bazı ekmeklik ve makarnalık buğday çeşitlerinin çimlenme, fide gelişimi ve tuz tolerans indeksi üzerine farklı tuz konsantrasyonlarının etkisini belirlemek macıyla yürütülmüştür. Deneme tesadüf parselleri deneme deseninde iki faktörlü ve 3 tekerürülü olarak kurulmuştur. Araştırma 2008 yılında SDÜ Ziraat Fakültesi laboratuar ve seralarında yürütülmüştür. Gerek-79, Altay-2000 (ekmeklik buğday), Kunduru-1149 ve Kızıltan-91 (makarnalık buğday) çeşitleri deneme materyali olarak kullanılmıştır. Tuz konsantrasyonlarının (kontrol, EC değeri 3.5, 7.0, 10.5, 14.0 ve 17.5 dS/m) sürme oranı, çimlenme oranındaki azalma, fide boyu, kök uzunluğu, toprak üstü ve kök kuru ağırlığı ve tuz tolerans indeksi üzerine etkileri ele alınmıştır. Petri kaplarında çimlenme oranı; saksılarda ise fide gelişimi ile ilgili özellikler incelenmiştir.
Tüm çeşitlerde artan tuz içeriğine bağlı olarak çimlenme oranı, çimlenme oranındaki azalma, fide boyu, kök uzunluğu, toprak üstü ve kök kuru ağırlıklarında ve tuz tolerans indeksinde önemli ölçüde azalmalar tespit edilmiştir. Buğday çeşitlerinin tuz konsantrasyonlarına gösterdikleri tepkilerde farklı olmuştur. Çeşitler arasında tuz tolerans indeksi en yüksek Altay-2000 çeşidi olurken, diğer çeşitlerin tuz tolerans indeksi orta dereceli olarak değerlendirilebilir.
Anahtar Kelimeler: Buğday, tuzluluk, çıkış oranı, çeşit

1. INTRODUCTION

Salinity is a general term used to describe the presence of elevated levels of different salts such as sodium chloride, calcium sulfates and bicarbonates in soil and water. According to the General Directorate of Rural Services, around 5.48 % of cultivable lands in Turkey have both salinity and sodicity problems (Anonymous 1, 2006). In Turkey, the soil salinity problem is becoming an important constraint on crop production particularly in arid and semi-arid regions (Eker *et al*. 2006). Salinity is one of the major abiotic stresses limiting agricultural production in many area (Lutts *et al*., 1996). Salinity negatively affects plant growth when enough salts accumulate in the root zone. Salinity stress retards plant growth (Lutts *et al*., 1996; Alan, 1999) by influencing at plant metabolism such as transpiration, CO_2 assimilation in light, respiration, cell growth and division, hormonal balance, nitrogen metabolism, enzyme level, water availability, ion uptake (Hsiao, 1973), and osmotic adjustment (McNeil *et al*., 1999). Salinity induces numerous disorders in during germination (Khan and Ungar, 1997). Excess salts in the root zone is hinder to plant root growing due to withdrawing water from surrounding soil.

In generally, EC values between 0 and 0.8 dS/m are acceptable for general crop growth. Soil salinity class and general crop responses for each class: soil EC value 0-0.98 dS m^{-1} is non saline and almost negligible effects, 0.98-1.71 dS m^{-1} is very slightly saline and yields of very sensitive crops are restricted, 1.71-3.16 dS m^{-1} is slightly saline and yields of most crops are restricted, 3.16-6.07 dS m^{-1} is moderately saline and only tolerant crops yield satisfactorily, and > 6.07 dS m^{-1} is strongly saline and only very tolerant crops yield satisfactorily (Anonymous 2, 1999).

Germination is an important stage in the life cycle of crop plants particularly in saline soils as it determines the degree of crop establishment. Many researchers have reported that several plants are sensitive to high salinity during germination and the seedling stage. Salt stress affects many physiological aspects of plant growth. Shoot growth was reduced by salinity due to inhibitory effect of salt on cell division and enlargement in growing point (Maghsoudi and Maghsoudi, 2008; Saboora and Kiarostami, 2006). Salinity have toxic effect on seed germination, and excessive salt is hinder water uptake of seed during germination. Cereals are sensitive to elevated salinity at the germination and early seedling phase of development (Ghoulam and Fares, 2001). Therefore, this study was conducted to determine the effect of NaCl on the germination, seedling growth and salt tolerance of some bread and durum wheat varieties.

2. MATERIALS AND METHOD

2.1. Materials

The experiment was conducted in the laboratory and greenhouse of the Department of Field Crops, Faculty of Agriculture, University of Suleyman Demirel. In adaptation studies conducted in the region Gerek-79 and Altay-2000 (bread wheats), Kunduru-1149 and Kızıltan-91 (durum wheats) cultivars that had higher yield were used as experimental materials.

2.2. Method

2. 2.1. Laboratory study

The experiment was arranged as randomized plots design with two factors and three replications. Salinity levels with electrical conductivity of the solution at 25 ^{0}C were adjusted to control and EC values 3.5, 7.0, 10.5, 14.0 and 17.5 dS m^{-1} (deciSiemens m^{-1}) using different NaCl concentrations. Distilled water used as a control. Three replicates of 20 seeds were germinated on 2 sheets of Whatman No.1 filter paper in petri dishes (9 cm diameter) with 10 ml each of the respective test solution and the fitler paper was altered at every 2 days to prevent accumulation of salt (Rehman *et al*., 1996, Atak *et al*., 2006). In order to prevent evaporation, the edges of the petri dishes were tightly sealed with Parafilm. The seeds were allowed to germinate at 25 ^{0}C in the dark for 8 days (Anonymous 3, 1996). A seed was considered to have germinated when the emerging radicle elongated to 1 mm (Atak *et al*., 2006). Germinated seeds were recorded every day at the same time. Mean germination time was calculated to assess the rate of germination (Ellis and Roberts, 1980). The reduction percentage of emergence (RPE) was calculated according to the following formula (Madidi *et al*., 2004);

$$RPE = (1 - Nx / Nc) \times 100$$

"Nx" is the number of emerged seedlings under salt treatments and "Nc" is the number of emerged seedlings under control.

2. 2.2. Greenhouse study

Seeds were surface sterilised in 30 % mercuric chloride for 2 min, once rinsed with sterile water and germinated in plastic pots with non drainage bags. Plastic pots that 2000 g volume were filled with a mixture of 1600 g powdered soil, sand and farmyard manure in proportion of 1:1:1. The plastic pots were treated with saline solutions of various electrical conductivity levels i.e. 3.5, 7.0, 10.5, 14.0 and 17.5 dS m^{-1} and control. The soils were supplemented with these salt solutions before sowing in order to obtain the required salinity level. The desired salinity levels were maintained throughout the growing period of the crop by fortification with saline solutions at regular weekly intervals. The electrical conductivities of different salinity levels were adjusted on direct conductivity meter readings. The control sets were irrigated with tap water (EC value 0.4 dS m^{-1}) only. Eight seeds in each plastic pot were sown at the depth of 4 cm and were placed in greenhouse at temperature of 25 ± 2 ^{o}C and dark conditions. Five plants of uniform size were maintained in each pot. The experiments were carried out for four weeks. Plants were sampled and analysed for the following parameters: Seedling length, root length, dry weight of above-soil surface organs and root dry weight.

The shoot and root dry weights of plants were taken after drying the samples in an electric oven for 48 h at 70 ^{0}C (Bray, 1963). The evaluation of the root and shoot dry weight salt stress index [(total dry weight of salt stressed seedling/total dry weight of control seedlings) x 100] was calculated as described by Sopha *et al*. (1991).

Statistical analysis were conducted separately for bread and durum wheat cultivars. Analysis of variance (ANOVA) was conducted with SAS (1998) statistics package program and differences among means were compared with LSD test.

3. RESULTS

According to results of variance analysis, emergence rate, reduction percentage of emergence, seedling length, root length, dry weight of above-soil surface organs and root dry weight and salt tolerance index were significantly influenced by different NaCl concetrations in both bread wheats and durum wheats. Similarly, cultivar x NaCl concentration interactions in both bread and durum wheats were significant for all investigated parameters. The emergence rate, seedling length, root length, dry weight of above-soil surface organs and root dry weight and salt tolerance index of breads and durum wheats were significantly decreased depend on increasing of NaCl concentrations. The reduction percentage of emergence (RPE) of bread and durum wheats increased depend on increasing of NaCl concentration (Table 1 and 2).

The highest emergence rate was observed from control applications (96.0 and 95.7 %), while the lowest emergence rate was obtained from 17.5 dSm^{-1} NaCl appplication (38.5 and 43.8 %). Among the bread wheats the highest emergence rate was observed from control level with Gerek-79 cultivars (96.3 %), and the lowest emergence rate was obtained from

Gerek-79 cultivars at the 17.5 dSm^{-1} NaCl (36.0 %). Among the durum wheat the highest emergence rate was observed from control level with Kızıltan-91 cultivars (96.0 %), and the lowest emergence rate was obtained from Kızıltan-91cultivar at the 17.5 dSm^{-1} NaCl concentrations (40.7 %) (Table 1).

The lowest RPE was observed from control application (3.5 and 7.0 % respectively), and the highest RPE was obtained from 17.5 dSm^{-1} NaCl appplication (60.0 and 58.2 % respectively) in both bread and durum wheat cultivars. Among the bread wheats the lowest RPE was observed from control x Gerek-79 cultivars interaction (1.4 %), and the highest RPE was obtained from Gerek-79 x 17.5 dSm^{-1} NaCl interactions (62.8 %). Among the durum wheats the lowest RPE was observed from control x Kunduru-1149 cultivars interaction (6.6 %), and the highest RPE was obtained from Kunduru-1149 x 17.5 dSm^{-1} NaCl interactions (58.6 %) (Table 2).

17.5 dSm^{-1} NaCl concentration wasn't taken into consideration, because sufficient plant sample for analysis in 17.5 dSm^{-1} NaCl concentration wasn't obtained.

In the both bread and durum wheats the highest seedling and root length, dry weight of above-soil surface organs and root dry weight were determined from control applications (bread wheat: 26.4 cm, 17.9 cm, 1.32 g and 0.43 g respectively, durum wheat: 27.0 cm, 20.2 cm, 1.40 g and 0.41 g respectively), and lowest seedling and root length, dry weight of above-soil surface organs and root dry weight were obtained from 14.0 dSm^{-1} NaCl appplications (bread wheat: 17.5 cm, 15.7 cm, 0.32 g and 0.09 g respectively, durum wheat: 18.2 cm, 15.1 cm, 0.28 g and 0.09 g respectively) (Table 3).

Among the bread wheats the highest seedling length, dry weight of above-soil surface organs and root dry weight were obtained from control x Gerek-79 cultivar interactions (28.9 cm, 1.46 g and 0.49 g respectively), the highest root length was obtained from control x Altay-2000 cultivar interaction (18.5 cm), and the lowest seedling length, dry weight of above-soil surface organs and root dry weight were obtained from 14.0 dSm^{-1} x Altay-2000 cultivar interactions (17.1 cm, 0.28 g and 0.09 g respectively), the lowest root length was obtained from 14.0 dSm^{-1} x Gerek-79 cultivar interaction (15.2 cm) (Table 3).

Table 1. The effect of different NaCl concentrations on emergence rate (%) of bread and durum wheat cultivars

Bread wheat Varieties	NaCl concentrations (dSm^{-1}) Control	3.5	7.0	10.5	14.0	17.5	Mean
Gerek-79	96.3 a	93.7 ab	65.3 e	57.0 f	47.0 g	36.0 i	65.9 b
Altay-2000	95.7 a	89.7 c	78.3 d	56.3 f	49.3 h	41.0 ı	68.4 a
Mean	96.0 a	91.7 b	71.8 c	56.7 d	48.2 e	38.5 f	
$LSD_{Variety:1.379**}$							
NaCl concentration:1.534**						CV:1.9	
Variety x NaCl concentration: 2.169**							

Durum wheat Varieties	NaCl concentrations (dSm^{-1}) Control	3.5	7.0	10.5	14.0	17.5	Mean
Kunduru-1149	95.3 a	90.0 a	73.0 c	70.0 c	62.7 d	47.0 e	73.0
Kızıltan-91	96.0 a	88.0 ab	84.3 b	61.7 d	53.0 e	40.7 f	70.6
Mean	95.7 a	89.0 b	78.7 c	65.8 d	57.8 e	43.8 f	
$LSD_{NaCl\ concentration:\ 4.786**}$						CV: 5.53	
Variety x NaCl concentration: 6.769**							

**: significant at 0.01 probability levels

Table 2. The effect of different NaCl concentrations on reduction percentage of emergence (%) of bread and durum wheat cultivars

Bread wheat Varieties	NaCl concentrations (dSm^{-1}) 3.5	7.0	10.5	14.0	17.5	Mean
Gerek-79	1.4 h	31.5 e	40.2 d	50.9 c	62.8 a	37.4 a
Altay-2000	5.6 g	17.7 f	40.9 d	48.2 c	57.2 b	33.9 b
Mean	3.5 a	24.6 b	40.6 c	49.6 d	60.0 e	
$LSD_{Variety:1.69**}$						
NaCl concentration:1.755**					CV: 4.02	
VarietyxNaCl concentration: 2.482**						

Durum wheat Varieties	NaCl concentrations (dSm^{-1}) 3.5	7.0	10.5	14.0	17.5	Mean
Kunduru-1149	6.6 g	24.4 e	27.5 d	35.2 c	58.6 a	30.5
Kızıltan-91	7.4 g	11.3 f	35.4 c	44.6 b	57.7 a	31.3
Mean	7.0 a	17.8 b	31.5 c	39.5 d	58.2 e	
$LSD_{NaCl\ concentration:1.989**}$					CV: 5.26	
Variety x NaCl concentration: 2.813**						

**: significant at 0.01 probability levels

Table 3. The effect of different NaCl concentrations on seedling length (cm), root length (cm), dry weight of above-soil surface organs (g) and root dry weight (g) of bread and durum wheat cultivars

Seedling length (cm)

Bread wheat Varieties	Control	3.5	7.0	10.5	14.0	Mean
	NaCl concentrations (dSm^{-1})					
Gerek-79	28.9 a	23.9 b	19.6 bc	20.5 b	17.8 c	22.2 a
Altay-2000	23.8 b	20.4 b	18.7 bc	18.6 bc	17.1 c	19.7 b
Mean	26.4 a	22.2 b	19.2 c	19.6 bc	17.5 c	

$LSD_{Variety:1.390*}$ CV:6.54
NaCl concentration:2.633**
Variety x NaCl concentration:3.723**

Durum wheat Varieties	Control	3.5	7.0	10.5	14.0	Mean
	NaCl concentrations (dSm^{-1})					
Kunduru-1149	23.7 b	18.8 b	19.8 b	18.4 b	17.9 bc	20.8
Kızıltan-91	30.3 a	17.2 bc	17.8 bc	20.0 b	18.3 bc	19.8
Mean	27.0 a	18.0 b	18.8 b	19.2 b	18.2 b	

$LSD_{NaCl\ concentration:\ 6.425*}$ CV:5.89
Variety x NaCl concentration: 5.086 *

Root length (cm)

Bread wheat Varieties	Control	3.5	7.0	10.5	14.0	Mean
	NaCl concentrations (dSm^{-1})					
Gerek-79	17.4 a	16.0 a	16.9 a	17.2 a	15.2 ab	16.8
Altay-2000	18.5 a	16.7 a	15.8 a	16.8 a	16.2 a	16.5
Mean	17.9 a	16.3 ab	16.4 ab	16.9 ab	15.7 b	

$LSD_{NaCl\ concentration:\ 1.183*}$ CV: 5.52
Variety x NaCl concentration: 2.087*

Durum wheat Varieties	Control	3.5	7.0	10.5	14.0	Mean
	NaCl concentrations (dSm^{-1})					
Kunduru-1149	20.6 a	18.1 ab	16.9 abc	17.6 ab	15.0 bc	17.6
Kızıltan-91	19.7 a	16.5 abc	16.2 bc	17.0 ab	15.2 bc	16.9
Mean	20.2 a	17.3 b	16.5 bc	17.3 b	15.1 c	

$LSD_{NaCl\ concentration:\ 1.524**}$ CV: 6.69
Variety x NaCl concentration: 2.156*

Dry weight of above-soil surface organs (g)

Bread wheat Varieties	Control	3.5	7.0	10.5	14.0	Mean
	NaCl concentrations (dSm^{-1})					
Gerek-79	1.46 a	1.17 c	0.81 d	0.59 c	0.35 e	0.87
Altay-2000	1.19 b	1.03 c	0.94 d	0.56 c	0.28 f	0.80
Means	1.32 a	1.10 b	0.88 c	0.57 d	0.32 e	

$LSD_{NaCl\ concentration:\ 0.159**}$ CV: 5.41
Variety x NaCl concentration: 0.224**

Durum wheat Varieties	Control	3.5	7.0	10.5	14.0	Mean
	NaCl concentrations (dSm^{-1})					
Kunduru-1149	1.32 b	1.03 b	0.81 c	0.59 d	0.27 e	0.80
Kızıltan-91	1.48 a	1.04 b	0.83 c	0.60 d	0.30 e	0.85
Mean	1.40 a	1.03 b	0.82 c	0.59 d	0.28 e	

$LSD_{NaCl\ concentration:\ 0.128**}$ CV: 6.16
Variety x NaCl concentration: 0.181**

Root dry weight (g)

Bread wheat Varieties	Control	3.5	7.0	10.5	14.0	Mean
	NaCl concentrations (dSm^{-1})					
Gerek-79	0.49 a	0.32 b	0.23 d	0.17 d	0.10 de	0.26 a
Altay-2000	0.37 b	0.29 bc	0.19 d	0.14 de	0.09 ef	0.21 b
Mean	0.43 a	0.30 b	0.21 c	0.15 c	0.09 d	

$LSD_{Variety:0.037*}$ CV:5.29
NaCl concentration: 0.053**
Variety x NaCl concentration: 0.076**

Durum wheat Varieties	Control	3.5	7.0	10.5	14.0	Mean
	NaCl concentrations (dSm^{-1})					
Kunduru-1149	0.41 a	0.22 c	0.17 d	0.13 d	0.09 de	0.21 b
Kızıltan-91	0.42 a	0.28 b	0.31 b	0.16 d	0.10 de	0.25 a
Mean	0.41 a	0.25 b	0.24 b	0.14 c	0.09 d	

$LSD_{Variety:\ 0.035*}$ CV: 4.97
NaCl concentration: 0.033**
Variety x NaCl concentration:0.047**

*, **: significant at 0.05 and 0.01 probability levels, respectively

Table 4. The effect of different NaCl concentrations on salt tolerance index (%) of bread and durum wheat cultivars

Bread wheat Varieties	NaCl concentrations (dSm^{-1}) 3.5	7.0	10.5	14.0	Mean
Gerek-79	77.9 a	54.7 c	39.3 cd	23.6 e	48.8
Altay-2000	85.1 a	72.5 b	44.8 c	24.4 e	56.7
Mean	81.5 a	63.6 b	42.1 c	24.0 d	
$LSD_{NaCl\ concentration:8.481**}$				CV:5.77	
$_{VarietyxNaCl\ concentration:11.994**}$					
Durum wheat Varieties	**NaCl concentrations (dSm^{-1}) 3.5**	**7.0**	**10.5**	**14.0**	**Mean**
Kunduru-1149	73.7 a	57.1 b	41.6 c	21.6 d	48.5
Kızıltan-91	70.4 a	60.9 b	40.8 c	20.7 d	48.2
Mean	72.1 a	59.0 b	41.2 c	21.2 d	
$LSD_{NaCl\ concentration:\ 6.032**}$				CV:9.91	
$_{Variety\ x\ NaCl\ concentration:\ 8.531**}$					

**: significant at 0.01 probability levels

Among the durum wheats the highest seedling length, dry weight of above-soil surface organs and root dry weight were obtained from control x Kızıltan-91 cultivar interactions (30.3 cm, 1.48 g and 0.42 g respectively), the highest root length was obtained from control x Kunduru-1149 cultivar interaction (20.6 cm), and the lowest seedling length, root length dry weight of above-soil surface organs and root dry weight were obtained from 14.0 dSm^{-1} x Kunduru-1149 cultivar interactions (17.1 cm, 15.0 g, 0.27 g and 0.09 g respectively) (Table 3).

The highest salt tolerance index was determined from 3.5 dSm^{-1} NaCl application (81.5 and 72.1 % respectively), and the lowest salt tolerance index was obtained from 14.0 dSm^{-1} NaCl appplication (24.0 and 21.2 % respectively) in both wheat and durum wheat varieties. Among the bread wheats the highest salt tolerance index was observed from 3.5 dSm^{-1} x Altay 2000 cultivar interction (85.1 %), and the lowest salt tolerance index was obtained from Altay-2000 x 14.0 dSm^{-1} NaCl interaction (24.4 %). Among the durum wheats the highest salt tolerance index was observed from 3.5 dSm^{-1} x Kunduru-1149 cultivars interaction (73.7 %), and the lowest salt tolerance index was obtained from Kızıltan-91 x 14.0 dSm^{-1} NaCl interaction (20.7 %) (Table 4).

4. DISCUSSION

The study showed that traits in the germination and early growth period of the investigated wheat varieties were significantly influenced by NaCl concentrations. In generally, nearly all plants are sensitive to high salinity during germination and first development stage. Therefore, the germination and early seedling stage of plant species are important endurance to salinity (Ghoulam and Fares, 2001). Especially, wheat is very sensitive to high salinity during the first development stage (Bayraklı, 1998). In our study, for the both bread and durum wheat varieties, NaCl caused a significant reduction for all of the considered growth parameters. The reduction was greater at higher NaCl concentrations. Increasing NaCl levels decreased germination percentage, and result in reduction percentage of emergence (Figure 1 and 2). Our findings agree with those of Van Hoorn (1991) and Atak *et al*. (2006), who determined that increase in salt concentration delayed germination time in several crops. Mohammed and Sen (1990) have suggested that germination is inhibited in saline because of osmotic stress or specific ion toxicity. Commonly, higher sodium content disrupts the nutrient balance and osmotic regulation, thereby causing specific ion toxicity (Alan, 1999). This means that Na^+ accumulation has a toxic effect on germination time, but does not completely inhibit germination (Van Hoorn, 1991; Begum *et al*., 1992). In addition, water uptake in barley and wheat (Pesserakli *et al*., 1991) plants is significantly reduced under salt stress conditions. Shoot and root length decreased by increasing levels of NaCl (Figure 3). These results are similar to those reported by Gupta and Srivastava (1989) and Atak *et al*. (2006), who found that the shoot and root length were decreased with increasing NaCl in wheat and Triticale. The responses of bread and durum wheat varieties to NaCl concentration were different. It is likely that the resulted from of salt stres tolerance between the bread and durum wheat varieties during the early growth stage (Bağcı *et al*., 2007). Our findings agree with those of Güneş *et al*. (1997), Munns *et al*., (2000) and Bağcı *et al*. (2007), who observed that there were differences among varieties regards soil salinity tolerance. The results obtained from shoot and root dry weight showed that wheat shoots and roots were inhibited severely by salinity levels, however, roots more were inhibited than the shoots. Kang *et al*. (2005) explained that Na is rapidly transported from the roots to the shoots of salt-sensitive cultivars. In earlier studies, Hussain and Rehman (1997) found that the roots of seedling were more sensitive than the shoots. Basically, dry weights decreased as shoot and root length declined after salinity levels increased. Increased NaCl levels decreased to salt tolerance index of bread and durum wheats.

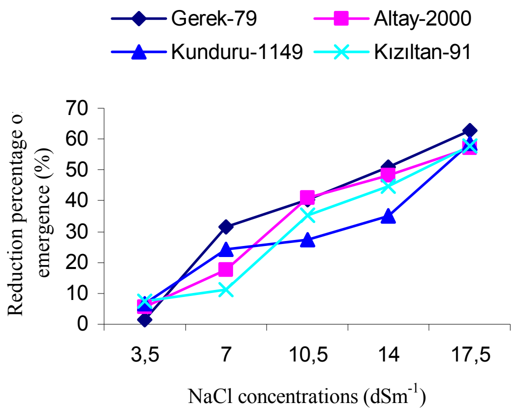

Figure1. Effect of different NaCl concentrations on reduction percentage of emergence

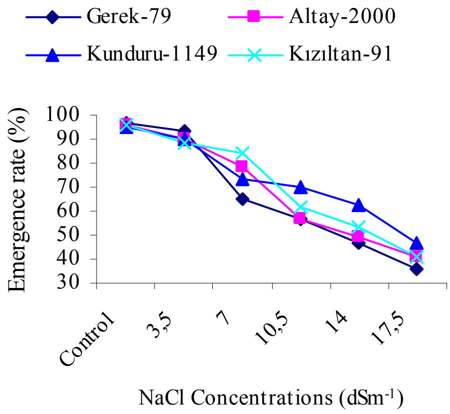

Figure 2. Effect of different NaCl concentrations on emergence rate

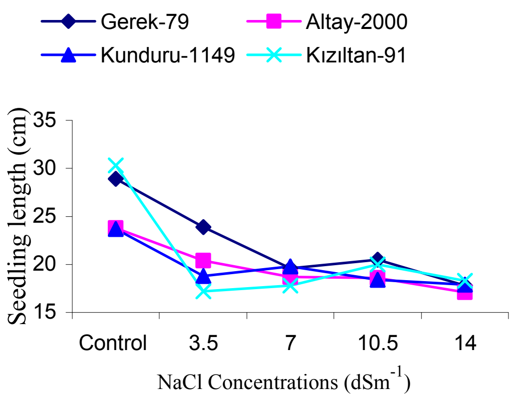

Figure 3. Effect of different NaCl concentrations on seedling length

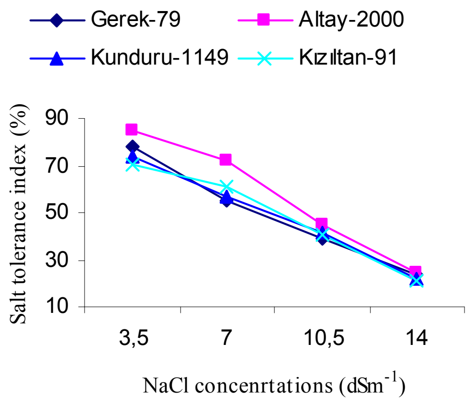

Figure 4. Effect of different NaCl concentrations on salt tolerance index

This decreases were drastically reduced at 3.5≤ dS m^{-1} NaCl concentrations (Figure 4). Our findings agree with those of Bağcı *et al.* (2007), who observed that salt tolerance index were decreased in whole varieties depend on increasing NaCl concentration. In compared to bread and durum wheat varieties, significanf differences weren't appear in all considered parameters.

5. CONCLUSION

The assessment of the effect of salinity on the first development stages of root and shoot organs in bread and durum wheat varieties allow us to conclude that all of the considered parameters were affected by salinity with a varietal difference. In conclusion, in the emergence and seedling and root length, dry weight of above-soil surface organs and root dry weight and salt tolerance index were drastically decreased and RPE was increased depending on increasing NaCl level, and there were significant differences among the varieties for salt tolerance; Altay-2000 cultivar was more resistant to high salt concentrations than the other varieties.

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