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Short communications

Effect of NaCl on Seed Germination of Sunflower (*Helianthus annuus L.*) Cultivar

C. Pasa , S. Yaver

Namik Kemal University, Agricultural Faculty, Field Crops Department 59030, Tekirdag, Turkey

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Abstract. *This investigation was conducted at the Field Crops Department, Agriculture Faculty, Namik Kemal University Tekirdag, Turkey. The present research has studied the effects of NaCl of different concentrations on some characteristics of germination of sunflower. One sunflower (Helianthus annuus L.) variety (Sanay) has been studied under four salinity treatments, including, 0, 50, 100 and 150 mM in the laboratory conditions. In the experiments, germination speed, germination rate and plant fresh weight for all genotypes were decreased at the increase of salt dose. Evaluated sunflower variety was significantly different for germination speed, germination rate, radicula length and plant fresh weight. Although the highest germination rate was recorded at 0 mM (95.0 %), 0 mM salt doses had the highest values for germination speed (88.3 %) and plant fresh weight (0.470 g).*

Keywords: Sunflower, germination, NaCl

Introduction

Salt affected soils occupy wide regions scattered all over the world (about 954 millions of hectares) (Szaboles, 1989). About 23 % of the world's cultivated land is saline and 37 % is sodic (Khan and Duke, 2001). The resistance to alkali stress of sunflowers (*Helianthus annuus* L.) is stronger than that of other crops. Some sunflower varieties are able to grow on alkalinized soil; however, there are very few reports about sunflower resistance to salt stress or alkali stress (Lui and Baird, 2003). In different plant species it was found that salinity stress caused accumulation of soluble sugars, free proline and soluble proteins in germinating seed and leaf growth is most inhibited under drought and salinity (Zidan and Elewa, 1995; Zdunek and Lips, 2001). It has been generally recorded that salinity adversely affects seedling growth and some relevant metabolic processes of glycophytic plants (Shaddad and Zidan, 1989; Hampson and Simpson, 1990; Zidan and Al-Zahrani, 1994). However, the direction and magnitude of these changes varied according to the level and duration of salinization treatment as well as the plant species used. Carbohydrates are accumulated in plant tissues under saline stress and these substances are suspected of contributing to osmotic adjustment (Munns and Termmat, 1986; Delaumey and Verma, 1993).

One of the most sensitive phases of a plant's life to salinity is that of seed germination. Absence of germination in salinity soil is often due to the high concentration of salt in the soil where the seeds are sown. The reason is that the salt solution moves upward, following the evaporation at soil level (Bernstein, 1974). The salt disturbs both germination and plant growth (Fowler, 1991). The research has shown that in response to soil salinity, seedlings growth, leaves area, root biomass and shoot biomass have all been reduced (Redmann et al., 1994).

The aim of the research was to characterize the effect of salinity on seed germination of sunflower (*Helianthus annuus* L.). The cultivar (Sanay) has been studied under four salinity treatments, including, 0, 50, 100 and 150 mM in laboratory conditions. In the experiments germination speed, germination rate and plant fresh weight for all genotypes decreased with an increase of the salt dose.

Materials and Methods

Sunflower cultivar was provided by the Department of Field Crops, Agriculture Faculty, Namik Kemal University, Tekirdag, Turkey. The seeds of the sunflower cultivar (Sanay) were sown on top filter paper in sterilized petri dishes (7cm diameter) and wetted with solution of different salinity concentrations (0, 50, 100 and 150 mM), in addition to the control, i.e. distilled water. The experiments were performed with four replicates of each. Germinated seeds were taken out at 24 h intervals up to 12 days, root and shoot were separated from the seeds. Germination rate, plant fresh weight, hypocotyl and radicula lengths were evaluated using ten seedlings.

The experimental data were analyzed by ANOVA and the differences were compared by Least Significant Difference (LSD) test ($p<0.05$, $p<0.01$). For all investigated parameters, analysis of variance was performed using the MSTAT-C computer software program.

* e-mail: cpasa@nku.edu.

Results and Discussion

The results of this study reveal that salinity concentration significantly affected germination speed, hypocotyl length and plant fresh weight (Table 1). The differences between the means were compared by Duncan's multiple range tests and are shown in Table 2. The maximum germination speed of 0 mM (88.3 %) was observed in salt dose. The lowest germination speed of 150 mM (83.75 %) and 100 mM (71.7 %) were obtained in salt doses. The results show that the maximum germination rate of 0 mM (95.0 %) was observed in salt dose. The lowest germination speed of 150 mM (83.3 %), 50 mM (83.3 %) and 100 mM (80.0 %) were obtained in salt doses. The results show that the highest radicula length of 150 mM (2.56 cm) was observed in salt doses. The minimum radicula length 50 mM (1.91 cm), 100 mM (1.85 cm) and 0 mM (1.64 cm) were obtained in salt doses. The results show that the highest plant fresh weight 0 mM (0.470 g) and 100 mM (0.453 g) were obtained in salt doses. The minimum plant fresh weight 150 mM (0.410 g) was observed in salt doses. The increasing salinity concentration in germination media often has osmotic and specific toxicity, which may reduce or retard the germination percentage (Waisel, 1972, Mohammed and Sen,1990; Basalah, 1991).

Table 1. Source of variance, degrees of freedom (D.F.), mean squares (M.S.) and probability (F) of studied factors for seed germination speed, germin ation rate, radicula and hypocotyls length, plant fresh weight.

Salt Dose		Germination speed (%)		Germination rate (%)		Radicula length (cm)		Hypocotyl length (cm)		Plant fresh weight (g)	
Variation Source	D.F.	M.S.	F	M.S.	F	M.S.	F	M.S.	F	M.S.	F
Repeat	2	100.000	0.873^{ns}	39.583	0.671^{ns}	0.255	0.413^{ns}	0.017	1.583^{ns}	0.002	2.208^{ns}
Salt Doses	3	179.861	3.938^{*}	129.861	10.20^{**}	0.473	5.766^{*}	4.948	1.048^{ns}	0.004	13.340^{**}
Error	6	127.778		59.028		0.618		0.093		0.003	
Overall	11	136.932		74.811		0.512		1.049		0.001	

ns: not significant, *: Significant at 0.05 % level of probability, **: Significant at 0.01 % level of probability

Table 2. Physical measurements of sunflower seeds during germination

Salt Dose	Germination speed(%)	Germination rate (%)	Radicula length (cm)	Hypocotyl length (cm)	Plant fresh weight (g)
0	88.333 a^{*}	95.00 a^{**}	1.640 b^{*}	1.360	0.470 a^{**}
50	81.667 ab	83.33 b	1.907 b	1.213	0.437 ab
100	71.667 b	80.00 b	1.853 b	1.660	0.453 a
150	73.333 b	83.33 b	2.560 a	1.673	0.410 b
Means	78.750	85.42	1.990	1.477	0.443
LSD	6.846	6.782	0.423	-	0.037
CV	7.13	8.246	11.329	9.347	12.314

*Differences among the parameters are statistically significant at P<0,05 if have not equal letter
**Differences among the parameters are statistically significant at P<0,01 if have not equal letter

Table 3. Correlation analysis of characterization

Salt Dose	Germination speed	Germination rate	Radicula length	Hypocotyl length	Plant fresh weight
Germination speed	1.000				
Germination rate	0.881^{**}	1.000			
Radicula length	0.031	0.023	1.000		
Hypocotyl length	0.213	-0.111	0.560	1.000	
Plant fresh weight	0.265	0.379	-0.589	-0.116^{**}	1.000

Through correlation analysis of all characteristics (Table 3), it can be seen that the degree of correlation between radicula length and other characterizations were not high, but it was high between the following other characteristics: germination rate and germination speed (r=0.881**), radicula length and hypocotyl length (r=0.560); plant fresh weight and radicula length (r=-0.589); plant fresh weight and hypocotyls length (r= -0.116).

Conclusion

Results showed those sunflower germination speed and germination rates were depressed when we increased NaCl concentration. Although further investigations are needed to ascertain the present result, some conclusions may be drawn from these findings.

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