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Short communication

Application of different NaCl concentrations on seed germination of flax (linum usitatissimum l.) Cultivar

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(Manuscript received 11 October 2009; accepted for publication 30 October 2009)

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 flax. One flax (Linum usitatissimum L.) variety (Raulin) has been studied under four salinity treatments, including, 0, 50, 100 and 150 mM in the laboratory conditions. In the experiments, germination rate, plant fresh weight, hypocotyl and radicula length for all genotypes were decreased at the increase of salt dose. The evaluated flax variety was significantly different for germination speed and radicula length. Although the highest germination speed was recorded in 100 mM (100.0 %), 0 mM and 50 mM salt doses had the highest values for hypocotly and radicula length.*

Keywords: flax, germination, NaCl

Introduction

Throughout civilized history, environmental stress, due to highly concentrated ions of salt in soils has endured as one of the most serious factors limiting productivity of agricultural crops, especially those which are sensitive to soil salinity. Currently, elevated soil salinity affects agricultural production in a large proportion of the world's terrestrial areas (Zhang and Hodson, 2001). Among the common methods of cultivation in such regions tolerant cultivars are used, soil and water are reformed to meet the needs of crops and using transgenic plants (Puppala et al., 1999).

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 very 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). 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).

Linseed (Linum usitatissimum L.) is one of the most important oil crops for the extraction of oil and fibres. About 80 % of the linseed oil goes for industrial purpose and the remaining 20 % is used for edible purposes. However, little is known about the response of linseed to salt stres. It was, therefore, decided to evaluate the effect of different levels of salinity on linseed genotypes at different stages of plant growth to provide information on the significance of pro, CA and NR activities in response to salt stres and to determine the effect of salinity on growth, net photosynthetic rate and yield characteristics (Khan et al., 2007).

The aim of the research was to characterize the effect of salinity on seed germination of flax (Linum usitatissimum L.) cultivar (Raulin) and it has been studied under four salinity treatments, including, 0, 50, 100 and 150 mM in the laboratory conditions. In the experiments, germination rate, plant fresh weight, hypocotyl lenght and radicula lenght for all genotypes were decreased at the increase of the salt dose.

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Material and Methods

Flax cultivar was provided by the Department of Field Crops, Agriculture Faculty, Namik Kemal University, Tekirdag, Turkey. The flax cultivar (Raulin) seeds 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. Starting with the germinated seeds was 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.

Results and Discussion

The results of this study reveal that salinity concentration significantly affected germination speed and radicula length (Table 1). The differences between the means were compared by Duncan's

multiple range tests and are shown in Table 2.

The results show that the maximum germination speed of 100 mM (100.0 %) was observed in a salt dose. The lowest germination speed of 50 mM and 150 mM (93.75 %) were obtained in salt doses. The results show that the maximum radicula lenght of 50 mM (2.65 cm) and 0 mM (2.34cm) were observed in salt doses. The lowest radicula length 150 mM (0.82 cm) was obtained in a salt dose. Similar observations were reported by Maas and Hoffman, (1977) and Huggen (1987). Increasing salinity concentration in germination media often osmotic and specific toxicity, which may reduce or retard germination percentage (Waisel, 1972; Mohammed and Seeni, 1990 and Basalah, 1991).

Based on the results of correlation analysis on characterization, the relationships between characters of flax were identified. Radicula length and hypocotyls length were highly correlated. Hypocotyl length and germination rate were of the lowest correlation. It was found that between all characterizations positive correlated (Table 3).

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

Salt Dose	Germination speed (%)*		Germination rate (%)		Radicula length (cm)*		Hypocotyl length (cm)*		Plant fresh weight (gr)	
Variation D.F. Source	M.S.	F	M.S.	F	M.S.	F	M.S.	F	M.S.	F
Repeat 3	0.729	3.182^{ns}	0.333	0.857^{ns}	0.396	0.611^{ns}	0.139	0.185^{ns}	0.012	0.579^{ns}
Salt Doses 3	1.729	7.545**	0.167	0.429^{ns}	2.721	4.119**	2.330	2.353^{ns}	0.056	1.000^{ns}
Error 9	0.229		0.389		0.648		2.971		0.092	
Overall 15	0.629		0.333		1.012		5.440		0.123	

Table 2. Physical measurements of flax seeds during germination

Salt Dose	Germination speed (%)	Germination rate (%)	Radicula length (cm)	Hypocotyl length (cm)	Plant fresh weight (g)
0	98.75 ab**	100.0	2.34 a**	0.67	0.030
50	93.75 b	98.75	2.65 a	1.30	0.023
100	100 .0 a	97.50	1.520 ab	0.63	0.028
150	93.75 b	98.75	0.82 b	0.24	0.028
Means	96.56	98.75	1.83	0.71	0.027
LSD	1.100	-	1.287	-	-
CV	7.64	6.87	10.72	14.29	11.42

** Differences among the parameters are statistically significant at P<0,01 if they have no 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	-0.109	1.000			
Radicula length	0.139	-0.107	1.000		
Hypocotyl length	-0.270	-0.370	0.489	1.000	
Plant fresh weight	0.218	0.144	-0.210	-0.295	1.000

Conclusion

Results showed that flax germination speed and radicula length 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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