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Evaluation of durum wheat genotypes at germination stage under salinity stress

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Introduction

Salinity is one of the most severe abiotic stress factors affecting plant growth and agricultural production worldwide. It affects almost 1 billion ha worldwide, globally representing about 7% of continental extent of the earth[1]. Agricultural crops exhibit a spectrum of responses under salt stress. Landraces, which have arisen through a combination of natural selection and the selection performed by farmers usually have a broader genetic base and can therefore provide valuable characteristics important for breeding, among which salt stress tolerance [2]. Information on the genotypic tolerance to salt stress during the germination process are lacking in Sicilian durum wheat landraces. Limited literature work is documented so far on these genotypes so knowing their behavior can help breeding programs in the selection of salt tolerant varieties to achieve optimum wheat growth under saline condition.

Research objectives

The aim of this work was to investigate for salt tolerance at germination and early growth stages several durum wheat genotypes: 11 landraces (Castiglione glabro, Ciciredda, Francesa, Perciasacchi, Russello, Russello Ibleo, Scorsonera, Cappelli, Timilia reste nere, Timilia reste bianche, Urria) 2 old varieties (Capeiti 8, Trinakria) and 7 modern cultivars (Ciclope, Duilio, K-26, Mongibello, Quadrato, Rusticano and Simeto).

Materials and methods

Laboratory experiments were conducted to evaluate the germination traits. Seeds were tested under 2 different concentrations of NaCl solution (50 mM and 100 mM) and the control (T) with distiller water. Experiments were laid out in a two-factorial design with three replications using a complete randomized design (CRD). Two-way ANOVA was performed, and means were compared with Duncan's Multiple Range test at 5% level of probability. Seven parameters were measured under laboratory conditions: germination, mean germination time, shoot length, root length, roots number, shoot dry matter and root dry matter.

Results

Genotype, concentration and their interaction showed significant differences in many of the parameters studied (table 1). Remarkable germination values, at 100 mM, were obtained by Timilia reste nere (98.67%), Ciclope (98.00%), Mongibello (96.67%) and Timilia reste bianche (96%): in particular, Timilia reste nere showed the highest value statistically different from the two modern varieties Duilio and Quadrato; Trinakria, Scorzonera, Russello and Russello Ibleo reported the lowest ones statistically different from all other genotypes.

Rusticano, Ciclope, Simeto and Mongibello are notable for the significantly shorter mean germination time (range from 2.15 to 2.20 days) compared to Cappelli, Francesa, Perciasacchi and Russello Ibleo (range from 2.43 to 2.68 days) (figure 1). In general, all the landraces have been reported for the better shoot length values than modern varieties; the top values are for Ciciredda, Scorsonera, Timilia reste nere and Timilia reste bianche with 7.95, 7.85, 7.76 and 7.69 cm respectively, values significantly higher than all modern varieties (figure 2). Raise of NaCl concentration determined an increase of the mean germination time and shoot dry matter; mean germination time passed from 2.31 days (control) to 2.38 days (50 mM) and 2.43 days (100 mM), while shoot dry matter varied from 8.92 (control) to 10.04 (100 mM). Increasing the concentration of NaCl in the solution determined a significantly reduction of shoot length, from 7.73 cm (control) to 5.67 cm (100 mM). Rusticano, with the highest value of root number (5.44), was statistically different from all other genotypes. The root number was higher at 50 mM (figure 3).

Table 1. Factorial analysis of variance

Source of Variation	Df	Germination (%)	MGT	Shoot length (cm)	Root length (cm)	Root number (n°)	Shoot dry matter (%)	Root dry matter (%)
Genotype	19	***	***	***	***	***	***	**
Concentration	2	**	**	***	***	***	***	n.s.
Genotype*Concentration	38	***	n.s.	n.s.	*	n.s.	n.s.	n.s.

*** significantly different at p< 0.001; ** significantly different at p< 0.01; * significantly different at p< 0.05; n.s. not significantly different

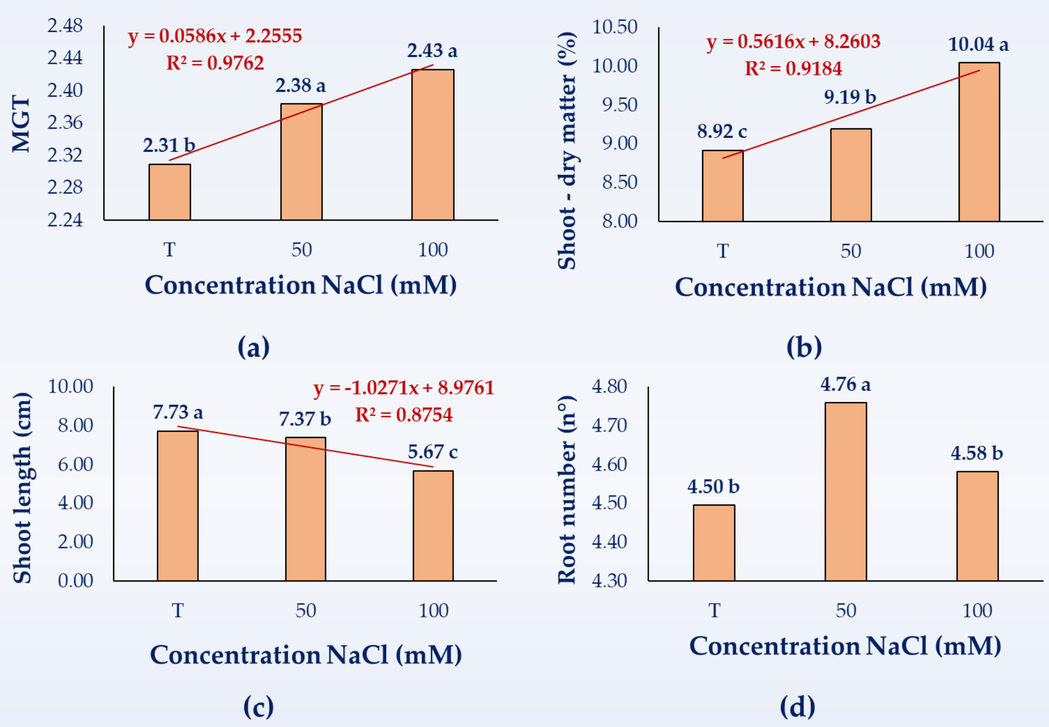

Figure 3. Influence of concentration on: MGT (a), shoot dry matter (b), shoot length (c) and root number (d). Mean followed by the same letter are not statistically different with Duncan's Multiple Range test at 5% of probability level.

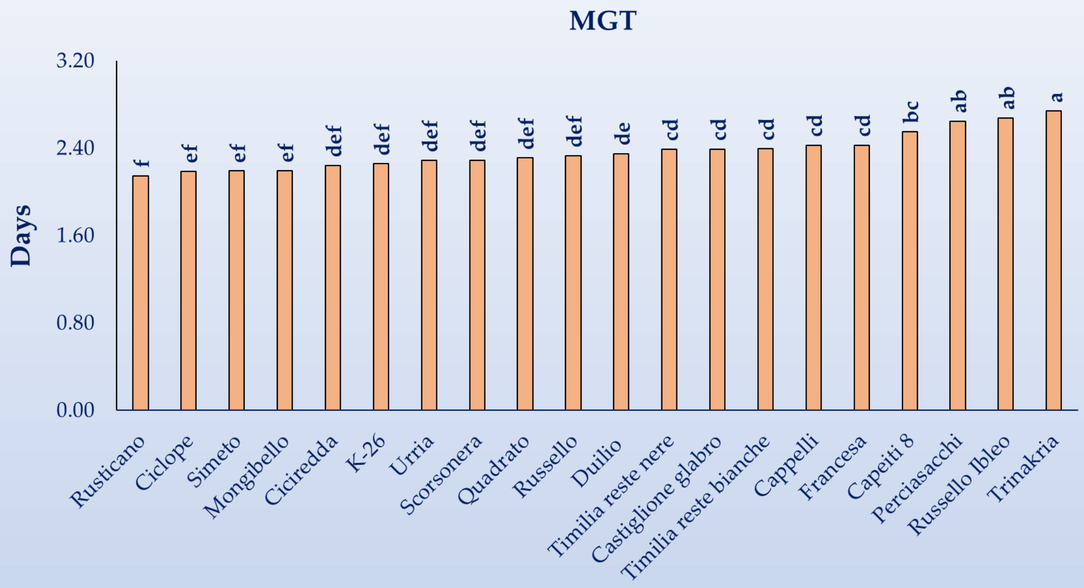

Figure 1. Effect of different durum wheat genotypes on mean germination time (MGT)

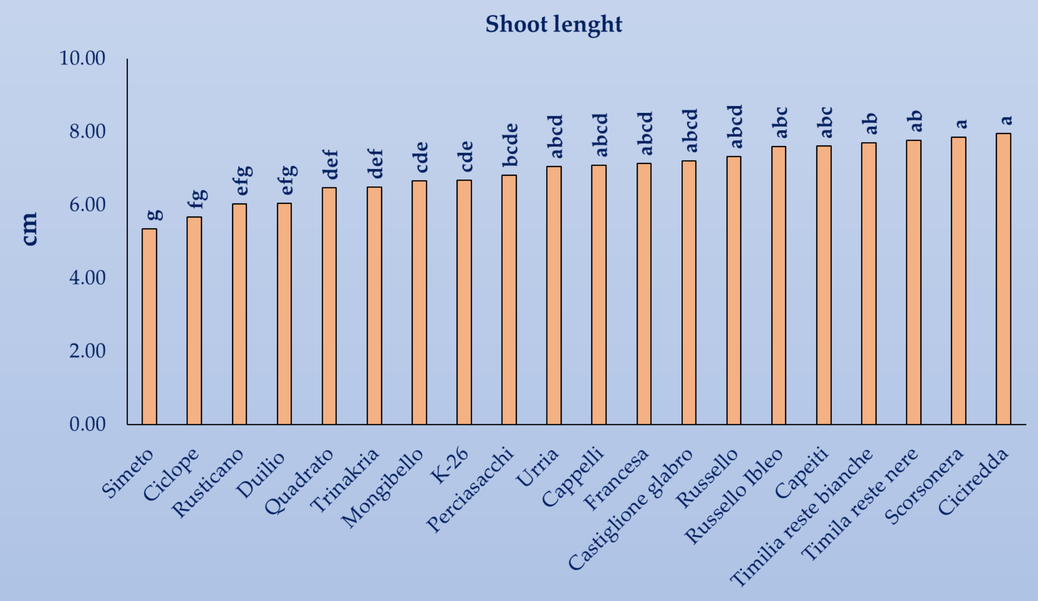

Figure 2. Effect of different durum wheat genotypes on shoot lenght (cm)

Conclusion

Our results confirm that durum wheat seeds tend to consume longer time when exposed to salt stress [3]. Increasing NaCl concentrations determined a raise in mean germination time and shoot dry matter and a reduction of shoot length of the seedlings. Among the genotypes, all the landraces showed the best performance in shoot length. The root number value significantly higher at 50 mM is probably due to a stimulating action of the solution to be investigated with further studies. On the other hand, the increase to the maximum concentration resulted in a statistically significant reduction of this parameter. In conclusion, landraces are interesting genetic materials to be investigated and used in breeding programs for the selection of varieties better tolerant to salt stress. To confirm our results and extend the study at the following growing stages, further study is needed.

References

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