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Effect of salt stress on seed germination of barley (*Hordeum vulgare* L.) cultivars

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Abstract
The effects of five concentrations of Sodium chloride Nacl (0mM, 50mM,100mM,150mM, and 200mM) on seed germination of four Libyan cultivars of Barley; Local Barley, California Marriott, Acasd 176 and Acsad 1164 were tested. Regardless of salt concentration, the variation in seed germination among the cultivars was clear. The tested barley cultivars showed wide range of adaptation to salinity in terms of seed germination. Only at the high salt concentration (200 mM), the germination rate was significantly reduced for some cultivars. In general, the other salt concentrations did not inhibit seed germination significantly. However, the long term effect of using saline water on the vegetative and reproductive growth of barley and on the soil salinization need more research.

Keywords: Sodium, salinization, California, Nacl

Introduction

Cereals are the main dietary food for North African populations (Riba *et al.*, 2010) [6]. Barley is the most important small-grain cereal crop in the world with an annual production of about 700 million tones (Anonymous, 2010) [1], it is also used as an important crop to feed animals (Katerji *et al.*, 2006). Salt stress is one of the major environmental factors that decrease plant growth and production (Ashraf *et al.*, 2015) [2]. Yield of barley was considerably reduced under severe conditions of salt and drought stresses (Katerji *et al.*, 2006). Exposing barley plants to 100 mM NaCl and 0.1mM Ca^+ reduced root thickening and root hairs density (Shabala *et al* 2003). The differences in salt tolerance range among plant species are very well documented (Torech and Thompson 1993) [7]. Barley is considered as a drought and salinity tolerant plant (Ceccarelli *et al.*, 1987; Belaid & Morris, 1991) [4, 3]. Salt tolerance is particularly important in North Africa and other semi-arid regions where large areas are subjected to potential Salinization. Salt stress affects plant growth throughout its life cycle from germination to maturation (Munns *et al.*, 2006) [5]. It inhibits the plant ability to take up water or through ion-excess effect (Munns *et al.*, 2006) [5]. In this research paper the effect of different salt concentrations on seed germination of some widely cultivated cultivars in Libya was investigated.

Materials and Methods

The effects of five concentrations of Sodium chloride Nacl (0mM, 50mM, 100mM, 150mM, and 200mM) on seed germination of four Libyan cultivars of Barely; Local Barley (Local B), California Marriott (Cali. M), Acasd 176 and Acsad 1164 were tested. Three replicates were used for each treatment. So, the number of petri dishes involved were 5 concentrations X 4 cultivars X 3 replicates = 60 petri dishes. Each lot of seeds was placed in sterilized Petri dish containing filter paper and received the designed concentration of Nacl. The petri dishes were then left at room temperature until the end of the experiment. The appearance of radical is considered as a sign of seed germination. Germinated seeds were counted and removed daily from petri dishes.

For statistical analysis and graphs, Minitab 19, Anova test, general linear model and excel software were used.

Results and Discussion

Fig.1 shows that seed germination started earlier in Cali. M & Acsad 176 and reached up to 60% and 57% respectively after 24 hours of treatment. At the same time, germination rates were 3% and nil for Acsad1164 and Local B cultivars respectively. The graph also reveals that one day after treatment; the concentration of 200 mM reduced seed germination in Cali. M noticeably but had no effect on Acsad 176. Germination rate for Cali. M was higher at salt concentration of 50 mM and lower at 200 mM as compared to the other salt concentrations which was true throughout the experiment.

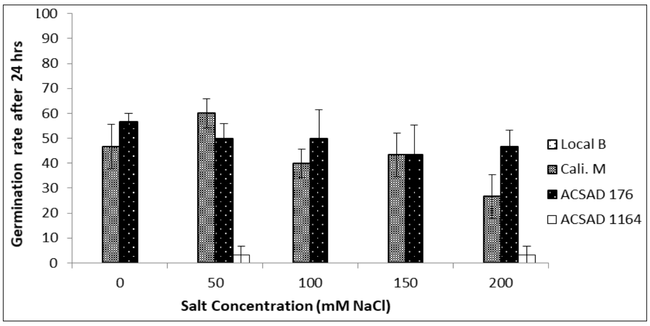

Fig 1: The effect of different salt concentrations of NaCl on seed germination of four barley cultivars after 24 hours of treatment. The data are expressed as percentage ±SE.

As shown in fig. 2, germination rate in Local B cultivar was recovered after 48 hours of treatment, 90%-100% of seeds of this cultivar germinated after 48 hours except for the salt concentration of 200 mM where only 70% of its seeds germinated. During the second day, seed germination of

Acsad 1164 was less than Local B especially at the higher salt concentration. With one exception, graph 2 reveals that the germination rate at the salt concentration of 200mM was lower than its counterparts at any other salt concentration for any cultivar.

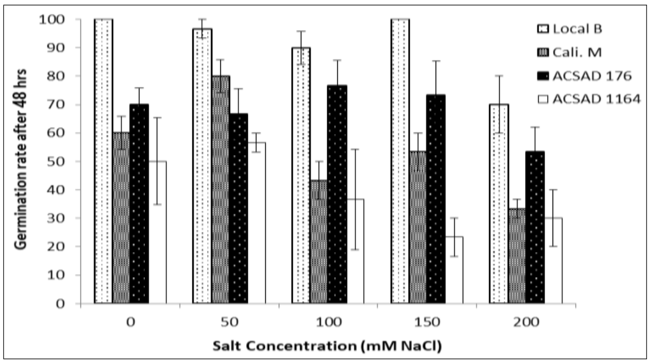

Fig 2: The effect of different salt concentrations of NaCl on seed germination of four barley cultivars after 48 hours of treatment. The data are expressed as percentage ±SE.

Fig.3 illustrates that after 3 days of treatment the salt concentration of 200mM reduced seed germination in all the wheat cultivars tested in this experiment. The graph also shows that, regardless to the salt concentration, Local B cultivar gave the highest germination rates while Acsad1164 gave the lowest three ones as compared with the other cultivars.

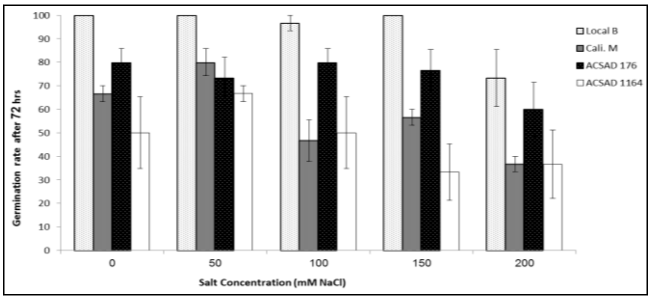

Fig 3: The effect of different salt concentrations of NaCl on seed germination of four barley cultivars after 72 hours of treatment. The data are expressed as percentage ±SE.

Graphs 4 and 5 suggests that, as compared to the control, the germination rates after 4-5 days of treatment were; significanly less at salt concentrations of 100mM and 200 mM for Calif. M, significantly less at 200 mM for Local B, but not significantly different for Acsad 176 and Acsad 1164.

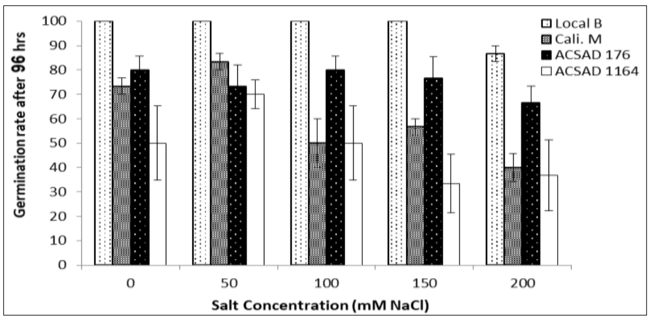

Fig 4: The effect of different salt concentrations of NaCl on seed germination of four barley cultivars after 96 hours of treatment. The data are expressed as percentage ±SE. hours of treatment.

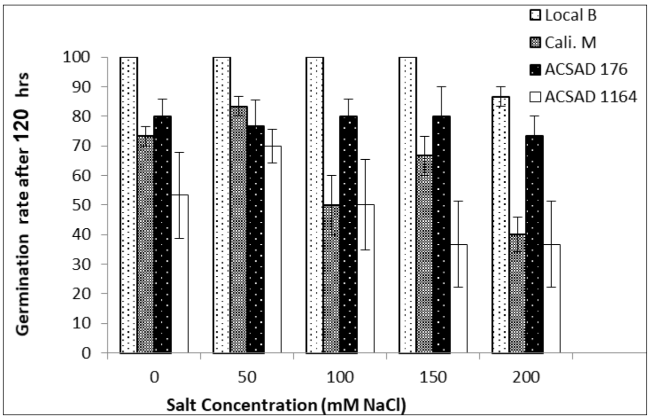

Fig 5: The effect of different salt concentrations of NaCl on seed germination of four barley cultivars after 120 hours of treatment. The data are expressed as percentage ±SE.

In general, the tested barley cultivars showed good adaptation to wide range of salinity in terms of seed germination, salt germination inhibtion was significant only at 200 nM concentration which was clear only on two cultivars. Except for the 200mM treatment, variations among cultivars in seed germination were more pronounced than variations among the tested salt concentrations. The effect of salt concentration on the vegetative and reproductive growth of barley is byound the purpose of this experiment but Fig. 6 may suggest negative corrrelation between salt concentration and the early vegetative growth. More investigations about the effect of the long time use of saline water on the vegetative and reproductive growth of these cultivars and on the soil salinization are needed.

A)

B)

C)

D)

0mM 50mM 100mM 150mM 200mM

Fig 6: patterns of early vegetative growth stage 120 hours after germination at 5 different salt concentrations of NaCl treatments. (A-Acsad176, B-Acsad 1164, C- California. M and D-Local Barley).

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