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Germination of Some Kuwait's Native Plants under Saline Conditions

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Abstract: The effects of high salinity on germination of *Haloxylon salicornicum* (Moq.) Bunge ex Bioss, *Zygophyllum qatarense* Hadidi and *Tamarix aucheriana* (Decne.) B.R. Baum seeds were determined by germinating them in NaCl solution of various concentrations (0-500 mM) under laboratory conditions. *Haloxylon salicornicum* seeds exhibited no dormancy as 84% of mature seeds germinated immediately after harvest. In *Zygophyllum qatarense*, a succulent perennial herb, seeds are small, black in color and are dispersed during November. Under laboratory conditions, 66% of these seeds germinated after 2 days. Similarly in *Tamarix aucheriana*, a large halophytic shrub with winged seeds that are dispersed by wind, fresh seeds germinated readily and the highest germination occurred within a day of sowing. In *Zygophyllum qatarense* and *Tamarix aucheriana* best germination was obtained in distilled water (control). Increase in NaCl concentration inhibited germination in all species. The degree of inhibition varied among the species. *Zygophyllum qatarense* seeds failed to germinate when NaCl concentration was above 300 mM, whereas some seeds of *Haloxylon salicornicum* and *Tamarix aucheriana* germinated even at 500 mM. In *Haloxylon salicornicum* and *Tamarix aucheriana*, the germination was above 80% at 0-75 mM NaCl concentrations and declined significantly above 400 mM. These results show that *Haloxylon salicornicum* and *Tamarix aucheriana* exhibited greater tolerance to high salinity than *Zygophyllum qatarense*.

Key words: *Haloxylon salicornicum* · *Zygophyllum qatarense* · *Tamarix aucheriana* · dormancy

INTRODUCTION

Zygophyllum qatarense Hadidi (Zygophyllaceae) is a drought tolerant succulent perennial herb that grows in the coastal saline flats and depressions. *Tamarix aucheriana* (Decne.) B.R. Baum (Tamariaceae) is a large halophytic shrub with scale like leaves and widely distributed along the coastlines of Kuwait. The seeds in this species are small, winged and dispersed by mainly by wind. It favors saline flats such as those found along the cost in Sulaibikhat/ Doha area (West of Kuwait city) [1]. *Haloxylon salicornicum* (Moq.) Bunge ex Bioss (Chenopodiaceae), a perennial herb is distributed in north eastern desert and southern coastal areas of Kuwait. The plant is an excellent sand binder and lizards love to live under its branches [1]. *Haloxylon* is considered as one of the most promising species for revegetation and sand dune fixation [2]. In Kuwait, *Zygophyllum qatarense* replaces *Haloxylon salicornicum* as the dominant shrub towards the coast under the influence of more saline conditions [3].

In this study the ability of seeds of the above three species to germinate in different dilutions of NaCl (0-500 mM) was determined in laboratory experiments. The sensitivity of plants to salinity may depend on their developmental stage. Several studies have been accomplished to elucidate the salinity adaptation mechanisms. One of the widely accepted methods for determination of plant tolerance to salt is through conducting germination tests i n salt solutions.

MATERIALS AND METHODS

Fresh seeds of *Zygophyllum qatarense* were collected from its native habitat in Mina Al Zour in October 2005. In *Haloxylon salicornicum* and *Tamarix aucheriana*, seeds collected from Subiya and Doha in December 2005 were used in for germination tests.

Climatic and soil conditions: Kuwait is a small arid country situated at the north-western corner of the Arabian Gulf. In Kuwait, summer is hot with mean

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maximum temperature of 44.7°C and the winter is cold with temperature around 8°C. The soil is mostly sandy in texture and is calcareous in nature [1]. The high salinity soil prevents the establishment of most of the plants, only few plants can thrive under high salinity condition.

Standard germination test: Germination tests were conducted at room temperature (around 25°C) using 9 cm diameter disposable petri dishes lined with whatmann filter paper. The filter paper was moistened with 5 ml of distilled water or NaCl solution (0-500 mM NaCl) prior to sowing. After sowing, petri dishes were covered and sealed with parafilm to avoid evaporation. Four replicates each with 25 seeds per treatment were maintained at laboratory conditions. In all there were ten treatments including the control. The germination was recorded daily until no seeds germinated continuously for three consecutive days. The seed was considered germinated when the radicle protruded to a length of at least 2 mm.

Statistical analysis: Germination data were analyzed using one way ANOVA and the significant means were separated using Duncan Multiple Range Test at 0.05% confidence level [4].

RESULTS AND DISCUSSION

In *Haloxylon salicornicum*, germination occurred within one day and the highest germination occurred (86%) in 50 mM NaCl solution (Table 1). The germination was reduced to 62, 52 and 23%, respectively in 300, 400 and 500 mM NaCl concentrations. At 100, 150 and 200 mM Nacl concentration more than 70% seeds were germinated (Table 1). The germination was decreased with increase in salinity.

In *Zygophyllum qatarense*, seed germination was delayed by as many as five days when NaCl concentration was increased to 300 mM and no seed germinated at 400 and 500 mM NaCl concentrations. In contrast, the greatest number of seeds germinated (66%) in distilled water. Germination was reduced from 66 to 15%, even when NaCl concentration was increased slightly (0 to 25 mM).

Seeds of *Tamarix aucheriana* germinated equally well in distilled water and in 25, 50 or 75 mM NaCl treatment (Table 3). However, it was reduced to 36% in 500 mM NaCl treatment.

The findings of the present study clearly showed that the increasing NaCl concentration has negative impact on seed germination of native desert species, although the nature and the degree of impact varied with species. The freshly collected seeds of *Haloxylon salicornicum* and *Tamarix aucheriana* showed similar almost identical response to NaCl concentrations in the germinating solution. While increasing NaCl concentrations did not

Table 1: Effect of salinity on germination of *Haloxylon salicornicum*

Nacl concentration (mM)	Germination %
0	83.0d
25	84.0d
50	86.0d
75	84.0d
100	78.0d
150	75.0cd
200	73.0cd
300	62.0bc
400	52.0b
500	23.0a

Table 2: Effect of salinity on germination of *Zygophyllum qatarense*

Nacl concentration (mM)	Germination %	Days to Initiate germination
0 (Control)	66.0d	2
25	15.0c	2
50	13.0bc	2
75	7.0a-c	3
100	5.0ab	3
150	4.0ab	3
200	2.0a	5
300	1.0a	7
400	0.0a	-
500	0.0a	-

Table 3: Germination of *Tamarix aucheriana* seeds in various NaCl treatments

Nacl concentration (mM)	Germination %
0	87.0d
25	86.0cd
50	83.0cd
75	83.0cd
100	78.0cd
150	75.0cd
200	74.0cd
300	71.0c
400	51.0b
500	36.0a

* The treatment values followed by the same letter are not statistically different at p = 0.05 or 5% level of confidence

affect speed of germination, the total germination was reduced after the threshold was surpassed. In *Haloxylon salicornicum* seed germination was slightly better in 25, 50 and 75 NaCl concentrations compared to that in the control (80%). Brown and Al-Mazrooei [5] also reported slight improvement in germination in *Haloxylon salicornicum* at low salt concentrations. Low levels of NaCl and other osmoticants have also been shown by other researchers to stimulate germination in several arid land species [6-9].

In *Zygophyllum qatarense* increase in concentration of NaCl adversely affected both the speed of germination and the total germination percentage. Similar effects have also been reported by other investigators [10-12]. In *Eucalyptus*, Vandermoezel and Bell [13] demonstrated a decrease in germination percentage with increasing salinity. From these results it is clear that *Haloxylon salicornicum* and *Tamarix aucheriana* seeds have the ability to withstand higher salinity compared to *Zygophyllum qatarense*. As Ayer [14] stated, high evapotranspiration and salt build up at the soil surface coupled with greater inherent sensitivity of seeds to salt are responsible for most crop emergence failures in saline soils of the coastal as well as the arid and semi-arid regions of the tropics. Salt tolerant species can, therefore, have better opportunity to germinate, establish and colonize in the desert environment than sensitive ones.

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