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Effects of salinity, temperature and light on germination of invasive *Prosopis juliflora* (Sw.) D.C.

A. El-Keblawy*[,1], A. Al-Rawai

Department of Biology, Faculty of Science, UAE University, P.O. Box 17551, Al-Ain, UAE

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Abstract

Effects of salinity, temperature, light and their interactions on the rate and final percentage of germination were evaluated for the invasive shrub *Prosopis juliflora*, grown under arid environmental conditions of the United Arab Emirates (UAE). Seeds that were not treated with NaCl germinated well in a wide range of temperatures and in both full light and complete dark. Seed germination decreased significantly with the increase in both NaCl concentration and temperature. Optimal germination percentage occurred at 25 °C. The inhibitory effect of high salinity on final germination percentage was greater at 40 °C than at 15 and 25 °C. Germination was completely inhibited in 400 mM NaCl at 40 °C and in 600 mM NaCl at 25 °C. However, germination rate was significantly greater at 40 °C than at 15 and 25 °C in lower salinities and the reverse was true at higher salinities. Germination in light was significantly greater than in the dark at lower salinity levels and high temperature.

Keywords: Germination percentage; Germination rate; Invasive species; Light; *Prosopis juliflora*; Salinity; Mesquite; Temperature

*Corresponding author.
E-mail address: a.keblawy@uaeu.ac.ae (A. El-Keblawy).
[1]Permanent address: Department of Biology, Faculty of Education in Al-Arish, Suez Canal University, Egypt.

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1. Introduction

Species of *Prosopis* have attracted attention because of their great ability to survive in very inhospitable environments, and their capacity to provide fuel, timber, fodder and edible pods. The most common species, *Prosopis juliflora* (Sw.) D.C. (mesquite), native to Central and South America, was introduced to several deserts in tropical and subtropical regions, including the Arab Gulf, for greening of landscapes and for sand and desertification control (Ghazanfar, 1996; Western, 1989). In the UAE, it has escaped forested areas and invaded both natural and managed habitats, including farms, and has been associated with habitat degradation and land abandonment. Mesquite is highly aggressive and coppices well, so that it often crowds out native vegetation (Tiwari, 1999; El–Keblawy, 2002). However, *P. juliflora* shows great potential for use as a multipurpose tree in different parts of the world, in comparison to several native and exotic species (Shukla, et al., 1990; Jhala, 1997; Tewari et al., 2001; Deans et al., 2003).

Germination is a crucial stage in the life cycle of plants. Tolerance to salinity during germination is critical for the establishment of plants growing in saline soil of arid regions (Ungar, 1995). In these regions, germination occurs during rainy seasons when soil salinity levels are usually reduced (El-Keblawy, 2004). Optimal germination in seeds of halophytes often occurs under fresh-water conditions and germination of most species is reduced and delayed with salinity increase, so the response may vary greatly depending on species. Whereas several perennial halophytes could germinate in 860 mM NaCl or more (e.g., *Salicornia pacifica*, Khan and Weber, 1986; *Cressa cretica*, Khan, 1991), other halophytes showed little germination above 125 mM NaCl (e.g., *Zygophyllum simplex*, Khan and Ungar, 1996).

Temperature and salinity can interact in determining salinity tolerance during germination. Although higher salinity decrease germination, the detrimental effect of salinity is generally less severe at optimum temperature. The detrimental effect of salinity was found to be severe at higher temperatures in some species, including *Sagittaria latifolia* (Delesalle and Blum, 1994), *Atriplex semibaccata* (De Villiers et al., 1994), *Polygonum aviculare* (Khan and Ungar, 1998), *Atriplex cordobensis* (Aiazzi et al., 2002), and *Sarcobatus vermiculatus* (Khan et al., 2002); but at lower temperatures for other species, including *Allenrolfea occidentalis* (Gul and Weber, 1999), *Salicornia rubra* (Khan et al., 2000), *Aeluropus lagopoides* (Gulzar and Khan, 2001), and *Halopyrum mucronatum* (Khan and Ungar, 2001). In another group of species, the detrimental effect of salinity was severe at both higher and lower temperatures (including *Zygophyllum simplex* (Khan and Ungar, 1997a), *Ducrosia anethifolia* (Al-Yemeni and Basahy, 1999), *Urochondra setulosa* (Gulzar et al., 2001), *Sporobolus ioclados* (Khan and Gulzar, 2003)). Finally, salinity tolerance did not depend on temperature in some other species, such as *Arthrocnemum indicum* (Khan and Gul, 1998). Salinity-temperature interaction may have significant ecological implications in terms of time of germination under field conditions (Ungar, 1995); it has been attributed to both osmotic and toxic effects (Khan and Rizvi, 1994; Khan and Ungar, 1997b, 1998).