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Short Communication

Seed germination of Southern Chihuahuan Desert plants in response to elevated temperatures

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ABSTRACT

High temperature is one of the main factors that prevent germination, through premature aging of the embryo. The high temperatures reached in the soil of arid environments can affect seed survival and plant establishment. In this study we tested whether seed exposure to high temperature (40 °C and 70 °C) affected germination of eight species common to the Southern Chihuahuan Desert, and used for fodder, firewood and timber, fiber, edible flowers, fruits and stems. The responses to heat varied between species. Two of the tested species were not affected by heat exposure; for two other species germination was higher, and for the remaining four, germination was lower. There was also a delay of germination after heat exposure. Seeds of three species germinated >1 d slower after exposure to high temperatures. These results could help establish management programs for these Chihuahuan desert species under a climate change scenario.

1. Introduction

One of the most critical stages of plants life cycle is the germination. Adequate conditions for germination in arid ecosystems are rare events in which the soil remains moist for adequate time periods (Nobel, 1998; Flores and Briones, 2001; De la Barrera and Nobel, 2003; Flores et al., 2004). Soil temperature can also affect seed viability mainly through the regulation of aging (Cancino et al., 1993; Núñez and Calvo, 2000; Culshaw et al., 2002; Danthu et al., 2003; Daws et al., 2007). However some seeds are not affected by high soil temperature (Al-Rawahy et al., 2003; Whitaker et al., 2004; Daws et al., 2007).

Exposure of seeds to high temperatures has often been explored as a pre-treatment to promote germination of desert plants. For instance, seeds of *Yucca whipplei* had lower germination after exposure to 110 °C and 130 °C (Keeley and Tufenkian, 1984). A combination of temperature and time of exposure resulted in a higher germination at 40 °C for 7 d and lower at 70 °C for 21 d for seeds of *Pachycereus pringlei* (Cancino et al., 1993). For *Mammillaria magnimamma* 90 °C for 4 and 12 h did not influence germination percentage (Ruedas et al., 2000), however seeds exposed for 12 h had a slower t_{50}. Seed germination of *Prosopis juliflora* and *P cineraria* were not affected by 6 h exposure to 90 °C (Al-Rawahy et al., 2003). Seeds of *Welwitschia mirabilis* from Namibia, were not influenced by exposure to 80 °C for 48 h (Whitaker et al., 2004). Daws et al. (2007) found seeds of species from Aizoaceae and Cactaceae to survive better than seeds of species of Crassulaceae after exposure to 103 °C for 17 m.

Global temperature increases under climate change would result in higher soil temperatures that might affect seeds in the soil seed bank (Ooi et al., 2009). In the Southern Chihuahuan Desert soil temperature can occasionally and for short periods reach 70 °C at the hottest times of the day (Nobel et al., 1986). It is possible that this extreme temperature could become more frequent in a global warming scenario. In this study we examined the effect that exposure to short-term high temperature for many days might have on the germination of useful species common to the Southern Chihuahuan Desert. We predicted lower germination percentage at a slower rate after exposure to higher temperatures.

2. Methods

The species studied included some used for fodder, firewood and timber, fiber, and edible flowers, fruits and stems: *Acacia schaffneri*, *Prosopis laevigata* (Fabaceae); *Yucca decipiens*, *Agave salmiana*, *Agave lechuguilla* (Agavaceae), *Isolatocereus dumortieri*, *Echinocactus platyacanthus*, *Ferocactus histrix* (the latter two specially protected; Cactaceae). Most of these species are common in reforestation

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