POTENTIAL FOR NATIVE PLANT COMMUNITY RECOVERY FOLLOWING FIRE IN THE MOJAVE DESERT

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Joshua tree fruit

Joshua tree inflorescence

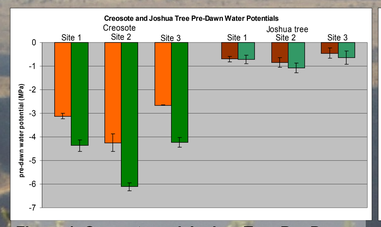

Figure 1. Creosote and Joshua Tree Pre-Dawn Water Potentials in August 2009. orange = creosote in burned, green = creosote in unburned, brown = Joshua tree in burned, teal = Joshua tree in unburned. error bars = +/- standard error

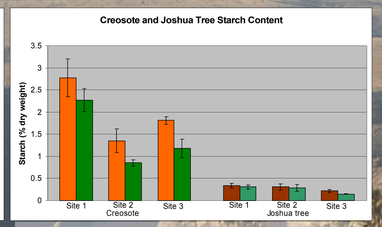

Figure 2. Creosote and Joshua Tree % Starch Content in Leaves. orange = creosote in burned, green = creosote in unburned, brown = Joshua tree in burned, teal = Joshua tree in unburned. error bars = +/- standard error

Abstract

Variation in the timing and magnitude of precipitation patterns at varying temporal scales along with plant invasions are hypothesized to be driving a plant invasion/fire cycle that is increasing the extent and intensity of fires in the Mojave Desert. Pockets of native plants within the burned areas that survived the fire may be important seed sources for regenerating the native vegetation. The objectives of this study were to assess the physiology and reproductive potential of surviving vegetation in burned areas. Six paired transects along burn boundaries from the 2005 fire were set up in the Beaver Dam Wash (southwestern Utah) in March of 2008. Surviving creosote in the burned transects demonstrated better water relations and higher leaf carbohydrate concentrations than creosote in the unburned transects. Joshua tree showed no differences in water relations or leaf carbohydrate status. Flower production in Joshua trees did not differ along burned and unburned transect but fruit production was considerably lower in burned transects. The data suggest that reductions in competition and nutrients pulses stemming from the fire stimulated physiology in surviving creosote in the burn zone. However, pollination failure may reduce viable seed production.

Introduction

Imperative to the post-fire recovery of the Mojave Desert is the physiological and reproductive fitness of neighboring and inclusive surviving and regenerating vegetation. Limited water dictates the regular spacing of plant across the arid landscape as plants of the same and differing species compete for this resource (Wallace et al. 2000). Reduction in intra- and interspecies competition as a result of fire will have several positive effects on the surviving and regenerating vegetation. Plants in disturbed areas should have improved water relations after the removal of neighboring plants. Better water relations will allow for longer periods of photosynthesis and increased energy production. Increased photosynthesis may be manifest in non-structural carbohydrates and seed production. The reduction in competition also increases the distance to pollination sources. Yucca species have coevolved with the yucca moth for which they solely depend as a pollinator. Pellmyr et al. (1997) indicated that there is a selection force for female yucca moths to cross-pollinate the host plant for their larvae. This increases the likelihood of fruit retention in which the larvae are nurtured and results in viable offspring for both moth and tree. The pressure for pollinators to cross-pollinate flowers may result in reduced fruit production of isolated plants.

Study Site

The study was conducted near BYU's Lytle Ranch Preserve (N37.14, W114.02) in Southwest Utah near the Arizona and Nevada state boarders. Much of the area was burned in 2005 (see Fig. 1). Vegetated areas are dominated by Creosote (*Larrea tridentata),* Blackbrush (*Coleogyne ramosissima),* and the iconic Joshua tree (*Yucca brevifolia*).

Methods

Joshua trees were randomly selection along transects and flowers and fruits were counted.

Starch was extracted from desiccated leaves via a hot water extraction and analyzed with a modified Megazyme© Total Starch extraction kit.

Pre-dawn water potential was measured after midnight and before sunrise using PMS Instrument Co.© pressure bomb and compressed nitrogen.

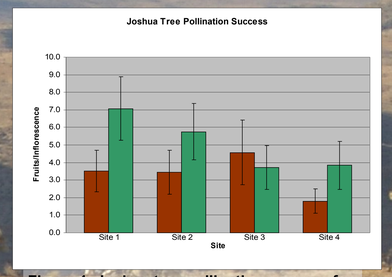

Figure 1. Joshua tree pollination success for Spring 2008 in number of fruits produced per inflorescence. Brown bars = burned zones, green bars = unburned zones

Results and Discussion

Pre-dawn water potentials (see Figure 1) and Starch content (see Figure 2) indicated that creosote bushes in burned zones had significantly better water relations and energy reserves than in the unburned zones while the Joshua trees showed no difference between the zones. The different response between the two species likely deals with their water management strategies. Creosote depends on an extensive root structure to supply moisture to the leaves (Schwinning 2009) and Joshua tree stores water within its semi-succulent leaves (Smith et al. 1983). Fruit and flowing counts for spring 2008 generally indicated that fruit production of individual Joshua trees in burned zones is reduced by pollination success as the number of flowers produced did not significantly differ (see Figure 3). Deviance from this trend in site 3 may have been due to an adequate distance to a pollination source. These finding suggest that seed production is limited by reduced pollination success even though physiological fitness is improved in some Mojave Desert plants.

References

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