Mesquite and grass response to prescribed burning depends on fire intensity

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INTRODUCTION

Woody plant encroachment is a well-documented consequence of fire suppression in rangeland ecosystems. This phenomenon has contributed to large-scale transitions of grasslands to shrublands, which are often less productive for livestock and game animals and tend to decrease biodiversity across all levels. In Texas, juniper (*Juniperus spp.*) and honey mesquite (*Prosopis glandulosa*) are two of the most widely established encroachers.

Mesquite is of particular concern due to its widespread presence and its ability to resprout following disturbances that fail to kill the root. Although mesquite is native to Texas, it now covers millions of acres of Texas rangelands that were once open grasslands.

Although encroachment is often recognized as a result of fire suppression combined with decades of over-grazing, the reintroduction of fire has frequently failed to reverse the trend. This is in part due to the resprouting capability mesquite shares with many woody plants. In many cases, fire alone has been associated with an increase in number of stems and no reduction in stand density. Thus, land managers who wish to reduce mesquite density are left using costly mechanical or chemical control methods, which may cause unintended mortality of desirable perennial grasses.

Recent work has suggested that extreme fire may contribute to mortality of mesquite and other resprouting woody encroachers, especially if the fire occurs during a period of drought stress. However, little is known about the physiological response of mesquite to extreme fire. Furthermore, land managers concerned with increasing herbaceous forage may avoid using fire during drought for fear of negative impacts to desirable perennial grasses.

LOCATION

This study was conducted in the Edwards Plateau region of central Texas. The site is characterized by shallow, rocky soils and presently dominated by shortgrasses, primarily common curly-mesquite and Texas wintergrass. Ashe juniper, redberry juniper, live oak, and honey mesquite are common encroaching species across the site.

TREATMENTS

Firebreaks were installed around 72 mature mesquite shrubs to create 32 foot x 32 foot plots centered around individual shrubs.

Plots were randomly assigned one of three treatments: no fire, low-intensity fire, or high-intensity fire. To create consistent fuel loading, hay was distributed evenly across all burn plots prior to ignition (Figure 1). Cut and dried juniper was also added to plots assigned high-intensity fire treatments (Figure 2).

Root collars of half of the mesquite plants were dug out to expose the entirety of the stems, and half were left unexposed. Soil heating was recorded using thermochrons placed at depths of 2, 4, and 6 inches in each burned plot.

Plots were burned individually between July 31 and August 6, 2018 under conditions defined as extreme. Air temperatures at ignition ranged from 90° – 105° F

Figure 1. Hay was added to low-intensity treatments to provide a continuous fuelbed.

Figure 2. High intensity treatments included cut and dried junipers placed around mequite shrubs in addition to hay.

and relative humidity ranged from 20 – 29% with light winds. Stem and grass exposure to heat during and after passage of flames was measured using visible and infrared imagery.

Nine months post-fire (April 2019), plots were observed to determine if individual mesquite plants resprouted. For each plant that resprouted, the number of resprouts on each stem was counted.

RESULTS

Mesquite shrub resprouting was 46 times greater in the low-intensity fire treatment as compared to the high intensity treatment (Figure 3). Additionally, shrubs in low-intensity treatments had 30 times more resprouts per plant than high-intensity treatments.

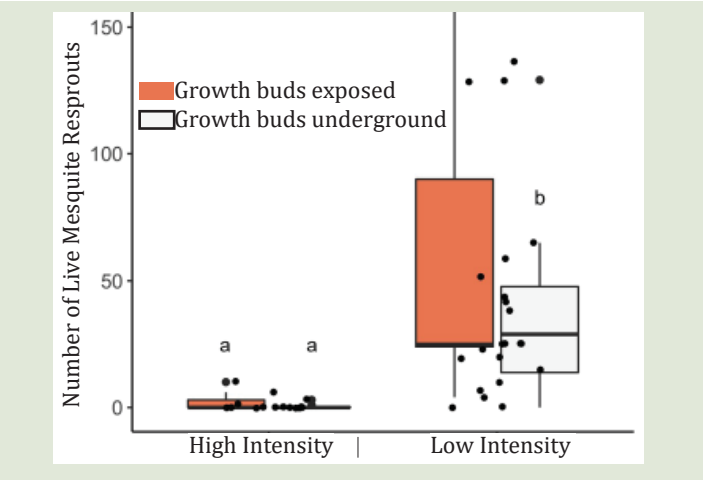

Figure 3. Probability of mesquite resprouting related to fire intensity and growing bud exposure to fire (unpublished data).

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[1]Hiers, QA. 2019. Belowground bud bank dynamics of grasses following extreme fire and drought. MS-thesis, Texas A&M University.

Three weeks post-fire, 100% of Texas wintergrass buds (average bud depth 0.75 inches) had resprouted in both high- and low-intensity treatments. In contrast, 75% of common curly-mesquite buds, which are at shallower depths, (average bud depth 0.20 inches) failed to re-sprout in the high-intensity treatments (Figure 4).

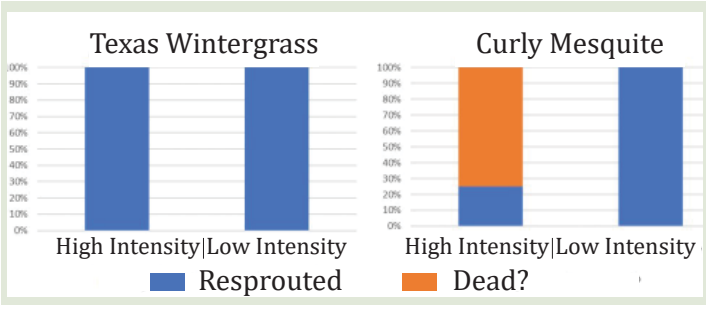

Figure 4. Belowground bud response of Texas wintergrass and common curly-mesquite three weeks postfire.[1]

High-intensity fires resulted in significantly higher below-ground soil temperatures when compared to low-intensity fires and buds of common curly-mesquite experienced higher temperatures in high-intensity fires than did Texas wintergrass.

MANAGEMENT IMPLICATIONS

This study suggests that extreme fires can decrease resprouting of mature honey mesquite. Although our results are from a single extreme fire event, we suspect that exposure to multiple fires may further increase the mortality rate of mesquites, especially when fires occur under drought conditions.

The high-intensity fires in our experiment had mixed effects on dominant desirable perennial grasses in the semi-arid environment of the Edwards Plateau region of central Texas. Grazing management may need to be adjusted after extreme fires depending on the grass composition of the pasture.