

# Ecophysiological and Root Responses to Precipitation Manipulations

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Future changes in climate are likely to strongly affect plant physiological and growth parameters, thus potentially influencing the nature (positive or negative) and intensity of plant-plant interactions. Mesquite and other shrubs have encroached into desert grasslands at the JRN over the past 150 years. Changes in precipitation (PPT) will likely influence future dynamics of this shifting vegetation. This project focuses on leaf physiology and belowground growth of honey mesquite (*Prosopis glandulosa*) and black grama (*Bouteloua eriopoda*) plants within the Sala *et al.* rainout shelters and sprinklers that experimentally manipulate PPT at the Jornada Basin LTER.

## Ecophysiology

Aboveground ecophysiological parameters were assessed with periodic field campaigns during the first and second growing seasons of the PPT manipulation experiment (2007 & 2008). Pre-dawn leaf water potential ( $\psi_{pd}$ ) was measured using Scholander-type pressure chambers. In mid-morning following the  $\psi_{pd}$  measurements, photosynthetic rates were measured with LiCor 6400 portable gas exchange systems on the -80%, 0, and +80% PPT treatments. Diurnal chlorophyll fluorescence response curves were measured in September 2008 using a fluorimeter (Opti-Science) on the -50%, 0, and +50% PPT plots.

Black grama  $\psi_{pd}$  was strongly influenced by PPT manipulation in 2007, but generally did not respond to treatments in 2008 (Fig. 1). Photosynthetic responses

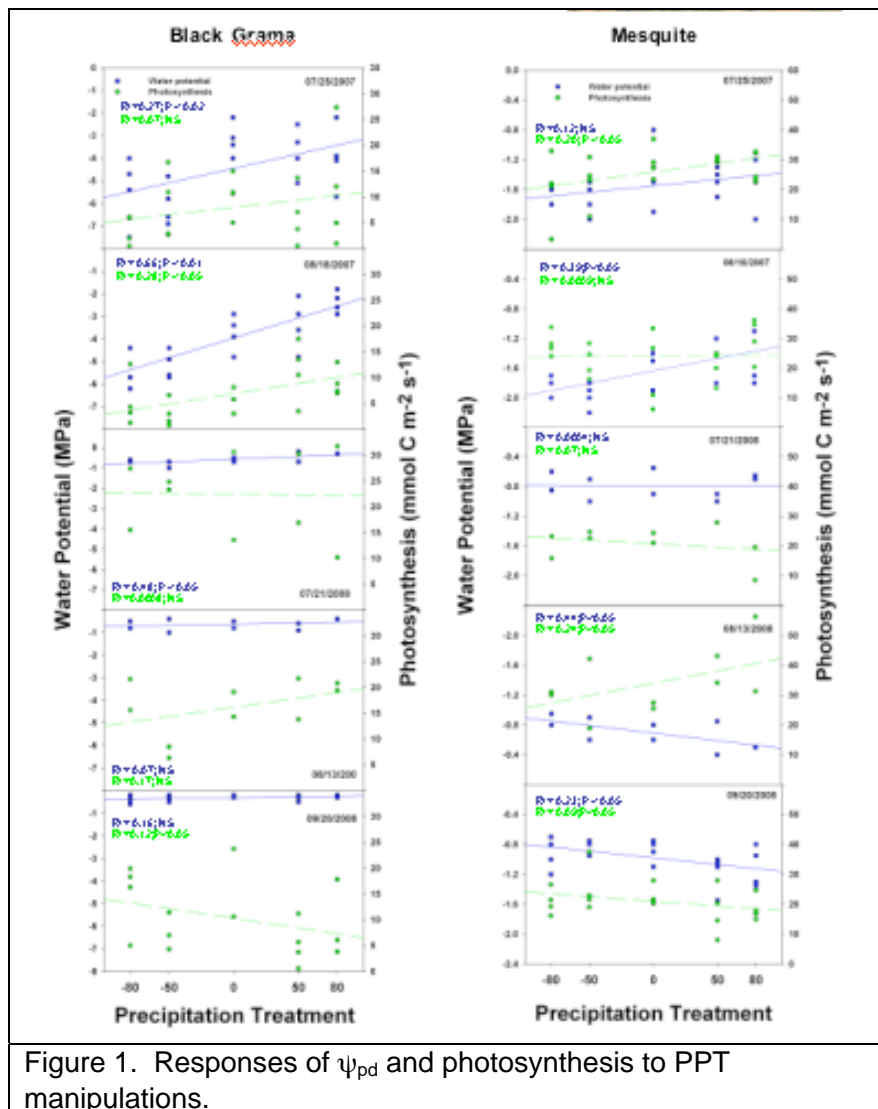


Figure 1. Responses of  $\psi_{pd}$  and photosynthesis to PPT manipulations.

typically mirrored those of  $\psi_{pd}$ . This interannual difference may be the result of greater summer

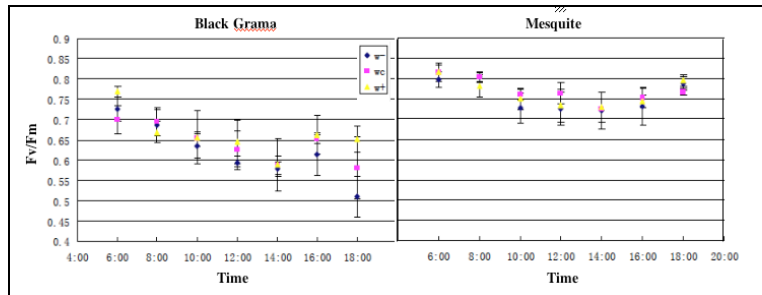


Figure 2. Diurnal patterns of maximum quantum yield ( $F_v/F_m$ ) for black grama and mesquite.

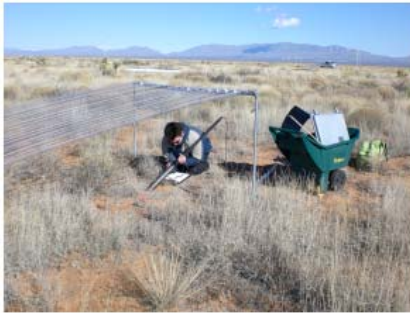
PPT in 2008. In contrast to black grama, mesquite response to PPT treatments were generally less pronounced (Fig. 1), suggesting that greater rooting depths, and perhaps lateral roots extending beyond the plot perimeters, effectively buffer water stress.

Black grama exhibited strong diurnal declines in maximum quantum yield (Fig. 2). This was most pronounced

in the PPT reduction treatment, suggesting a diurnal water stress response. Mesquite did not exhibit this strong diurnal pattern, providing more evidence for limited water stress in mesquite.

### Root Area

Minirhizotron tubes were used for assessing root responses to PPT and N manipulation. Tubes ( $n=54$ ) were installed across a factorial combination of three PPT treatments (-80%, control, +80%) and two N treatments (control, +N).



Tubes were installed at a  $45^\circ$  angle to a vertical depth of 32 cm. Minirhizotron root images were collected at the end of the second growing season of the experiment (2008). Images ( $10 \times 13\text{mm}$ ) were obtained along the length of each tube ( $n=22$  images/tube) during each imaging session. Images were analyzed in RooTracker 2.0. Data presented here are from September 2008 images.



There were no significant treatment effects on root area (Fig. 3;  $P>0.05$ ). While not significantly different, the greatest root area was found in the 80% water addition plots and the least in the 80% water reduction plots. While again not significant, there was slightly less root area in N addition plots than in N control plots. Additional analyses from other sampling dates are underway; and may yield insight clarify response patterns and root elongation/turnover

rates.

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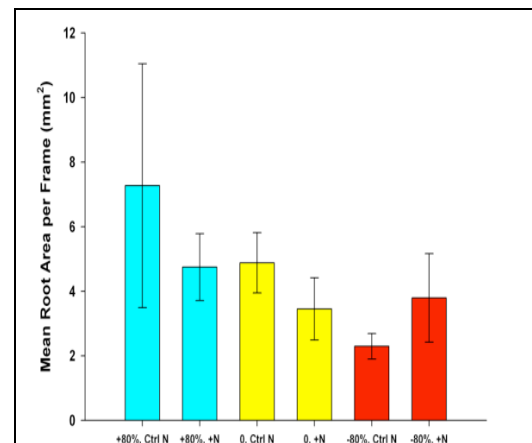


Figure 3. Root area response to PPT and nitrogen treatments.