Quarterly Report for SCRI Project (Objective 4):

Title: The impact of drought on the physiological behavior of pecans.

Introduction

For this portion of the research, our main objective was to study the effect of water deficit on the physiology of mature pecan trees. In late fall, we studied the physiology of five pecan trees in the Leyendecker orchard. Measurement started after an irrigation event ended.

Materials and methods

Between Nov. 15 and December 15, 2010, five trees at Leyendeker orchard were randomly sampled from the field and predawn (Ψ_{pd}) and midday leaf water potential (Ψ_{md}) were measured using pressure chamber (PMS instrument, Ore, USA). At Ψ_{pd} (3:00-5:00 am) two leaves from each tree (at the height two to three meters from the soil surface) were cut and their water potential measured. At midday (11:00 am -13:00 pm) two sunny leaves, height two to three meter from soil surface was bagged for one hour using aluminum foil bags. Then Ψ_{md} was measured as mentioned above.

We also determined stomatal conductance, transpiration, and chlorophyll fluorescence. Leaves also were selected for pressure-volume analyses and relative water contents. In later analyses, orchard soil moisture content from Time Domain Reflectometry (TDR) readings taken during the measurement period will be evaluated to determine the relationship between soil TDR readings and predawn leaf water potential.

Results and discussion

Transpiration rate decreased from 5.54 $mmolm^{-2}s^{-1}$ after five days of irrigation to 2.99 $mmolm^{-2}s^{-1}$ after twenty days of irrigation. Stomatal conductance also decreased from 403 $mmolm^{-2}s^{-1}$ after five days without irrigation, to 154.6 $mmolm^{-2}s^{-1}$ after twenty days without irrigation. This suggests that drought severely impacts gas exchange rates. On the other hand, drought stress had no effect on chlorophyll fluorescence (Chl-F) which averaged 0.74 (Table 1.). So, the efficiency of Photosystem II was not impacted.

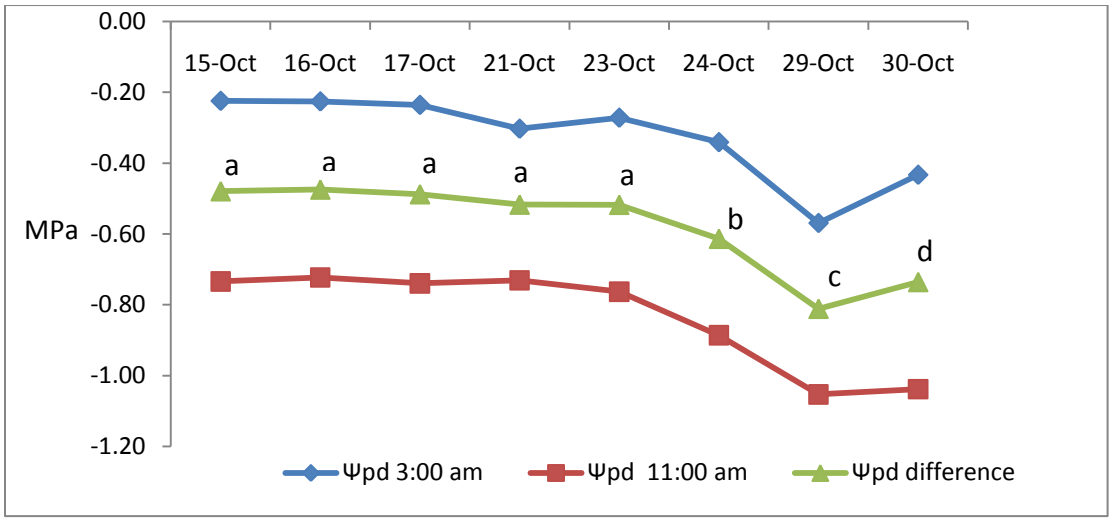
Table 1. Chlorophyll fluorescence, transpiration rate, and stomatal conductance

Date	Chl-F ($F_{v/m}$)	Transpiration ($mmolm^{-2}s^{-1}$)	Stomatal Cond. ($mmolm^{-2}s^{-1}$)
15-Oct	0.79 a*	0.5.54 bc	402.9 a
16-Oct	0.75 a	9.28 a	297.7 ab
17-Oct	0.74 a	6.49 b	272.2 abc
21-Oct	0.74 a	4.21 cd	218.4 bcd
23-Oct	0.73 a	4.23 cd	217.2 bcd
24-Oct	0.77 a	2.70 d	165.8 bcd
29-Oct	0.74 a	2.45 d	126.7 d
30-Oct	0.76 a	2.99 d	154.6 cd

* Means with the same letter are not significantly different.

Predawn leaf water potential Ψ_{pd} was lower (more positive) than the midday leaf water potential Ψ_{md} taken on equilibrated leaves. Both Ψpd and Ψ_{md} had the same pattern of response to water stress, but the difference in potential was constant at 0.5 MPa (Figure 1) .

Figure 1. Predawn leaf water potential at predawn and at midday between mid-Oct to Nov. first.



There was a positive relationship between Ψ_{pd} and Ψ_{md} (Figure 2).

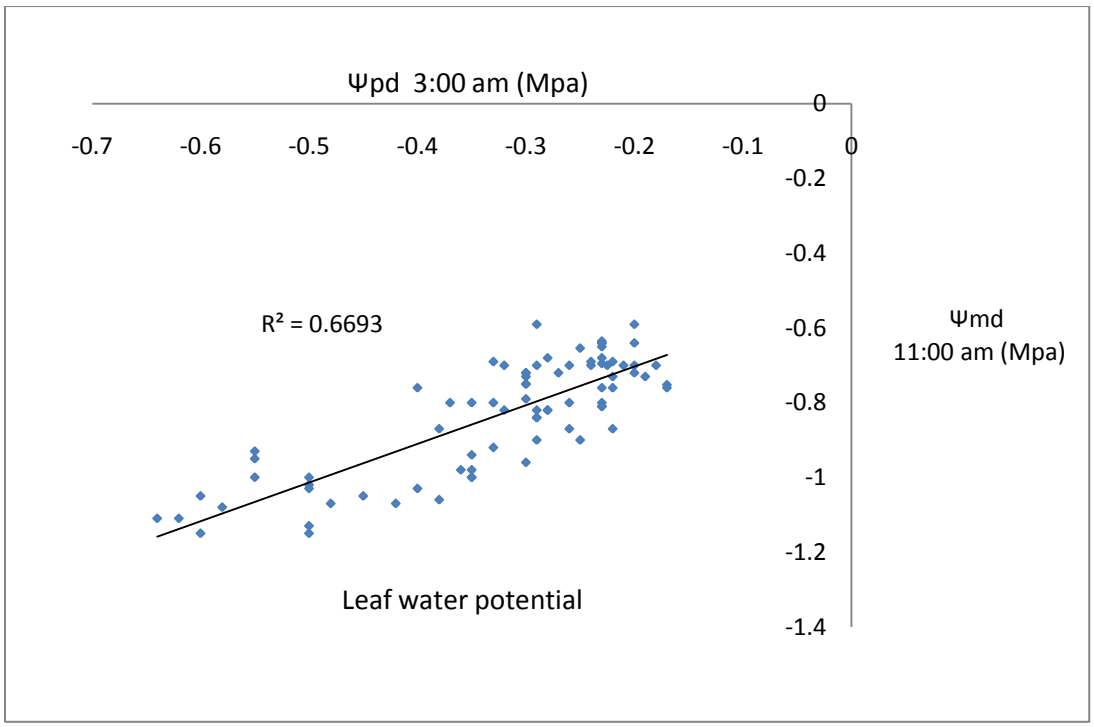


Figure 2. Relationship between predawn leaf water potential Ψ_{pd}, and midday leaf water potential Ψ_{md} taken on equilibrated leaves.

Pressure volume analysis revealed that the osmotic potential at full turgor was lower at the beginning of the experiment (Table 3). Relative water content remained relatively stable during the twenty days of drought treatment (Table 3). Again, suggesting that the impact of drought was relatively muted during the experimental period.

Table 3. Osmotic potential at full turgor and relative water content (%) of pecan trees.

Date	Osmotic potential at full turgor	Relative water content (RWC)
15-Oct	-1.70 a*	83.4 a
20-Oct	-2.5 b	84.2 a
29-Oct	-2.4 b	85.2 a

* Means with the same letter are not significantly different.