Soil and leaf water relations of differentially moisture-stressed honey mesquite (*Prosopis glandulosa* Torr)*


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The objective of this study was to determine plant/soil water relations of honey mesquite (*Prosopis glandulosa* Torr.) following preconditioning to different levels of moisture stress. Moisture stress of 12 naturally occurring trees (mean height 3.2 m), located in north Texas, was manipulated through the use of drip irrigation and sub-canopy rain shelters. Pre-dawn leaf water potential and average daily stomatal conductance were greatest in irrigated trees and least in rain-sheltered trees on 27 June and 28 July 1986 after 1 and 2 months of stress preconditioning, respectively. Following a common irrigation of all trees (equivalent to 35-40 mm precipitation) on 28 June and 29 July, pre-dawn leaf water potential increased to similar levels in all trees within 1 day. Increase to maximum average daily stomatal conductance was delayed in moisture-stressed trees following the July watering, suggesting that moisture stress inhibited ability to respond to moisture availability. A positive relationship was found between soil moisture content and pre-dawn leaf water potential, and between soil moisture and average daily stomatal conductance. However, average daytime leaf water potential was unaffected by soil moisture content.

**Introduction**

Much of our knowledge of the water relations of honey mesquite (*Prosopis glandulosa* Torr.) has come from studies in the Sonoran Desert of southern California (Mooney *et al.*, 1977; Nilsen *et al.*, 1981, 1983, 1984; Jarrell & Virginia, 1990). In this arid environment, mesquite exist as deep-rooted phreatophytes (Phillips, 1963; Levitt, 1980; Sharifi *et al.*, 1982; Nilsen *et al.*, 1986). Comparatively little data are available concerning plant/soil water relations of mesquite in higher rainfall regions such as north central Texas, where annual precipitation is 8 to 10 times greater than the Sonoran Desert (Easter & Sosebee, 1975). On some semi-arid Texas sites, mesquite are dependent on shallow lateral roots for water—a rooting strategy associated with frequent rewetting of surface soil horizons (Heitschmidt *et al.*, 1988; Ansley *et al.*, 1990).

Studies have attempted to quantify mesquite/soil water relations in semi-arid environments over an entire growing season (Haas & Dodd, 1972; Thomas & Sosebee, 1978; Wan & Sosebee, 1990). However, seasonal changes in vapour pressure deficit interfered with an
accurate assessment of the influence of soil moisture on leaf water relations. No studies have reported the response of differentially moisture-stressed mesquite to moisture events, although Sala & Lauenroth (1982) noted the significance of small rainfall events on the physiological condition of semi-arid plants. Our goal in the present study was to quantify, under relatively constant ambient conditions, the relationships between soil moisture, leaf water potential, and stomatal activity of semi-arid mesquite. A second objective was to examine the response of differentially moisture-stressed mesquite to simulated rainfall events.

Materials and methods

Site description

The study was conducted on the W.T. Waggoner Estate located 30 km south of Vernon in the northern Rolling Plains ecological area of Texas (33°52'N, 99°17'W; elevation 368 m). Average annual precipitation is 665 mm, which occurs in a spring/fall bimodal pattern. Peak rainfall months are May (119 mm) and October (77 mm). The region supports primarily warm season grasses and forbs dominated by a moderate overstory (<30% canopy cover) of mesquite and the shrub lotebush (Ziziphus obtusifolia). Components of the understory include the C₄ grasses buffalograss (Buchloe dactyloides) and sideoats grama (Bouteloua curtipendula), and the C₃ grass Texas wintergrass (Stipa leucotricha). Soils of the study area are Udertic Paleustolls of the Deandale series and Typic Paleustalfs of the Kamay series. Both soils are clay loams developed from sandstone/shale parental material. Slopes are less than 3%.

Treatment installation

Twelve multistemmed trees were selected as experimental units from the overstory component of the study site on the basis of uniformity in canopy shape and basal stem number. Plant shapes were selected to follow that of a parabolic frustrum to facilitate construction of sub-canopy rain shelters. Trees were 3·0–3·5 m in height with canopies of 4–6 m diameter at the widest part. All woody vegetation including non-experimental mesquite occurring within 10 m of each experimental tree was removed by chain-sawing aerial portions and saturating remaining plant bases with diesel oil. Each experimental tree was containerised with a sheet metal and plastic vertical barrier to a depth of 2·5 m during January 1986 (Ansley et al., 1988). The containers were open at the bottom. Four 2·5 m long × 5 cm diameter aluminum access tubes were installed within each root container at 2 m laterally from the tree centre for soil moisture measurement. All 12 trees were equipped with a trickle irrigation system via underground polyvinyl chloride (PVC) tubing connected to a 23,000 l tank and electric pump powered by a 4·5 kW generator. Water from a municipally approved drinking system was supplied via water truck to the tank.

Root containerisation, irrigation and rain shelters were used to generate surplus and reduced soil moisture levels available to three groups of four mesquite trees. ‘Surplus’ trees received precipitation plus periodic trickle irrigation. Reduced soil moisture levels for ‘rainout’ trees were created by installing a sub-canopy rain shelter. Each shelter consisted of a plastic sheet stretched over a wood frame and suspended 1 m above the soil surface and beneath the canopy foliage (Jacoby et al., 1988). Trees exposed only to rainfall were selected as ‘control’ trees.

Rain shelters were imposed 29 May 1986, about 2 months following budbreak of mesquite. Trees were preconditioned through soil moisture manipulation for 1 month.
prior to a common watering of all trees on 28 June (Table 1). Post-irrigation measurements in this trial were terminated when a 26 mm rain occurred on 2 July. Trees were preconditioned for an additional month prior to a second common watering which began on 29 July. Rain on 3 August halted further sampling in the second trial. Between the first and second common irrigations, surplus trees received 133 mm more and rainout trees received 124 mm less water than control trees, a range of 257 mm.

**Response variables**

Stomatal conductance of lower leaflet surfaces was measured using a LICOR LI-1600 porometer (LICOR Inc, Lincoln, NE). All leaves that were measured were located on the perimeter of the canopy and fully exposed to the sun. Two leaves were measured per tree during each sample period which occurred at 2, 5, 8 and 11 h post-sunrise.

Leaf water potential was measured using a Scholander-type pressure bomb at pre-dawn (pre-dawn leaf $\Psi$), and during porometer sampling (daytime leaf $\Psi$). Two leaves were excised from the centre of each canopy at 1·5–2 m height and water potential determined as outlined by Turner (1981).

Photosynthetic photon flux density (400–700 nm) was determined using a LICOR LI-190S-1 Quantum Sensor at each point where conductance was measured. Two readings were taken, one with the sensor oriented vertically and a second with the sensor at leaf angle facing away from the basal centre of the tree. Values reported in this study represent

### Table 1. Water additions by irrigation and precipitation in three different soil moisture treatments during spring and summer 1986

<table>
<thead>
<tr>
<th>Date</th>
<th>Water type</th>
<th>Water amount (mm)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Surplus</td>
<td>Control</td>
<td>Rainout</td>
</tr>
<tr>
<td>19 May</td>
<td>p</td>
<td>28</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td>26 May</td>
<td>p</td>
<td>22·2</td>
<td>22·2</td>
<td>22·2</td>
</tr>
<tr>
<td>29 May</td>
<td>RS</td>
<td>6</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>31 May</td>
<td>p</td>
<td>6</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>04 June</td>
<td>p</td>
<td>45·0</td>
<td>45·0</td>
<td></td>
</tr>
<tr>
<td>10 June</td>
<td>s</td>
<td>26·5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16–17 June</td>
<td>p</td>
<td>31·9</td>
<td>31·9</td>
<td></td>
</tr>
<tr>
<td>19 June</td>
<td>s</td>
<td>45·9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23 June</td>
<td>p</td>
<td>5·0</td>
<td>5·0</td>
<td></td>
</tr>
<tr>
<td>28 June</td>
<td>c</td>
<td>38·2</td>
<td>38·2</td>
<td>38·2</td>
</tr>
<tr>
<td>01–03 July</td>
<td>p</td>
<td>19·8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 July</td>
<td>p</td>
<td>6·2</td>
<td>6·2</td>
<td></td>
</tr>
<tr>
<td>15 July</td>
<td>s</td>
<td>31·7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21 July</td>
<td>p</td>
<td>11·2</td>
<td>11·2</td>
<td></td>
</tr>
<tr>
<td>22 July</td>
<td>s</td>
<td>29·1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29 July</td>
<td>c</td>
<td>34·5</td>
<td>34·5</td>
<td>34·5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>160·3</td>
<td>87·9</td>
<td></td>
</tr>
<tr>
<td>Total (29 May–27 June)</td>
<td></td>
<td>98·0</td>
<td>37·2</td>
<td>0</td>
</tr>
<tr>
<td>Total (29 June–28 July)</td>
<td></td>
<td>296·5</td>
<td>163·3</td>
<td>38·2</td>
</tr>
</tbody>
</table>

*p, precipitation; s, irrigation of surplus trees only; c, common irrigation of all trees. RS, rain shelter installation.*
an average of the two readings. Vapour pressure deficit was determined using a hygrothermograph which was calibrated periodically with a sling psychrometer.

Volumetric soil moisture ($\theta$) was measured at 30 cm increments to a depth of 210 cm using the neutron attenuation method (Greacen, 1981). Measurements were made on each day that leaf parameters were measured. Soil moisture measurements were calibrated to field samples following bulk density determination. Soil water retention curves were determined at each depth for each soil series using a pressure plate apparatus (Richards, 1965), and soil matric potential (soil $\Psi_m$) was calculated based on retention curve equations.

**Statistical analysis**

Because of a slight variation in soils across the study site, a randomized complete block design was established with four blocks (soils), three treatments (surplus, control, rainout), and four replicates (individual trees) to assess significant differences in $\theta$, soil $\Psi_m$, conductance and leaf $\Psi$ between treatments. A repeated-measures analysis of variance was used to determine differences between treatments on a particular day, and differences between dates within a treatment (Steel & Torrie, 1980). Prior to analysis, leaf variables were averaged over all sample periods within each day.

Data from all dates (pre- and post-common irrigation) were used to examine relationships between soil and plant variables. Plant variables were averaged over all sample periods within a treatment and date. Soil variables were averaged over certain depths within a treatment and date, as designated in the figures. Linear and curvilinear regression techniques were used to determine each relationship.

**Results**

**Ambient conditions**

Photosynthetic radiation followed similar diurnal curves on all sample days, except during the 2 h post-sunrise sample period on 29 June when a slight haze blocked the sun (Fig. 1). Vapour pressure deficit followed similar diurnal patterns on all sample days, but generally was greater during the July irrigation trial than during June. Peak vapour pressure deficit occurred on each day during mid-afternoon.

![Figure 1. Diurnal photosynthetic photon flux density (PPFD) near sampled leaves, and vapour pressure deficit on each sample date. PPFD was averaged over all 12 trees. ●, 27 June; ○, 29 June; ▲, 28 July; △, 30 July; ▼, 01 August.](image-url)
Volumetric soil moisture ($\theta$) and soil matric potential (soil $\Psi_m$) were greatest beneath surplus trees and least beneath rainout trees on 27 June and 28 July 1986, following month-long intervals of stress preconditioning (Fig. 2). Differences in $\theta$ and soil $\Psi_m$ between surplus and rainout trees were greatest at $30 + 60$ cm depth on both dates. Soil $\Psi_m$ was maintained near or greater than $-0.5$ MPa at most depths beneath surplus trees, but was near or below agronomic wilting point ($-1.5$ MPa) at all depths beneath rainout trees. Soil moisture beneath control trees was between that of surplus and rainout trees at most depths.

Pre-dawn leaf $\Psi$ was significantly different between the three moisture treatments on 27

Figure 2. Volumetric soil water content ($\theta$) and soil matric potential (soil $\Psi_m$) at different soil depths beneath mesquite trees exposed to three moisture treatments during spring and summer 1986. Vertical bars indicate ±1 standard error of the mean ($n = 4$). c, common irrigation of all trees. ●, Surplus; ○, control; △, rainout.
June and 28 July, following month-long preconditioning prior to each of two common irrigation events (Fig. 3). Rainout trees had the lowest pre-dawn leaf $\Psi$ on both dates. Effects of increasing environmental stress from 27 June to 28 July were evident by a decline in pre-dawn leaf $\Psi$ in all treatments. The lowest pre-dawn leaf $\Psi$ recorded during the study was $-2.09$ MPa which occurred in rainout trees on 28 July.

Following sunrise, daytime leaf $\Psi$ decreased in all treatments to below $-2.5$ MPa, but increased after 2 h post-sunrise on both pre-irrigation dates [Fig. 4(a),(c)]. Differences in
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Table 2. Average daily stomatal conductance (mmol m\(^{-2}\) s\(^{-1}\)) of trees in each soil moisture treatment

<table>
<thead>
<tr>
<th>Date</th>
<th>Treatment</th>
<th>Surplus</th>
<th>Control</th>
<th>Rainout</th>
</tr>
</thead>
<tbody>
<tr>
<td>27 June</td>
<td></td>
<td>106-8 a; y</td>
<td>73-7 b; y</td>
<td>66-8 b; z</td>
</tr>
<tr>
<td>29 June</td>
<td></td>
<td>148-5 a; w</td>
<td>140-7 ab; w</td>
<td>127-3 b; x</td>
</tr>
<tr>
<td>28 July</td>
<td></td>
<td>74-7 a; z</td>
<td>54-6 b; z</td>
<td>53-8 b; z</td>
</tr>
<tr>
<td>30 July</td>
<td></td>
<td>130-6 a; wx</td>
<td>88-3 b; xy</td>
<td>84-1 b; y</td>
</tr>
<tr>
<td>01 Aug</td>
<td></td>
<td>126-3 a; x</td>
<td>101-5 b; x</td>
<td>90-1 b; y</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>117-4 a</td>
<td>91-8 b</td>
<td>84-4 b</td>
</tr>
</tbody>
</table>

Means followed by different letters (a–c) indicate a significant difference between treatments within a date. Means followed by different letters (w–z) indicate a significant difference within a treatment (p ≤ 0.05; n = 4).

daytime leaf Ψ between treatments were not apparent on any date before or after common irrigation. Stomatal conductance declined each day from maximum levels at 2 h post-sunrise [Fig. 4(f)–(j)]. Seasonally, conductance declined from 27 June to 28 July in all treatments [Fig. 4(f), (h)]. Surplus trees had greater conductance than other trees on both dates, although there was less difference between treatments on 28 July than on 27 June.

Response to common irrigation

Following common irrigation on 28 June and 29 July, differences in θ and soil Ψ\(_m\) between treatments were reduced but not eliminated (Fig. 2). Equalization of soil variables between treatments was most apparent at 30 + 60 cm depth. Differences in pre-dawn leaf Ψ between treatments were eliminated within 1 day following each irrigation, although in the July trial pre-dawn leaf Ψ continued to increase in stressed trees (control and rainout) from 1 to 3 days post-irrigation (Fig. 3). Stomatal conductance increased in all trees within 1 day following each irrigation [Fig. 4(g),(i)]. Following the 29 July irrigation, maximum levels of average daily conductance occurred within 1 day in surplus trees but did not occur until 3 days post-irrigation in control or rainout trees (Table 2). In both irrigation trials absolute average daily conductance was greatest in surplus trees before and after irrigation (Table 2), but percentage increase in average daily conductance, as well as in pre-dawn leaf Ψ, from pre-irrigation levels was eventually greatest in either control or rainout trees (Table 3).

Table 3. Per cent increase in pre-dawn leaf water potential and average daily stomatal conductance from pre-irrigation levels following 34–40 mm irrigation on two dates

<table>
<thead>
<tr>
<th>Date of common irrigation</th>
<th>Days post-irrigation</th>
<th>Pre-dawn water potential</th>
<th>Average daily conductance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Surplus</td>
<td>Control</td>
</tr>
<tr>
<td>28 June</td>
<td>1</td>
<td>8-9 c</td>
<td>23-5 b</td>
</tr>
<tr>
<td>29 July</td>
<td>1</td>
<td>27-0 b</td>
<td>31-2 ab</td>
</tr>
<tr>
<td>29 July</td>
<td>3</td>
<td>15-3 c</td>
<td>36-5 b</td>
</tr>
</tbody>
</table>

Means within a row and variable followed by similar letters are not significantly different (p ≤ 0.05; n = 4).
Figure 5. Relation between volumetric soil moisture or soil matric potential at different soil depths when plotted against pre-dawn leaf water potential [(a)-(f)] and average daytime leaf water potential [(g)-(h)]. Lines are fitted from regression equations and the coefficients of determination \( r^2 \) are indicated. ●, Surplus trees; ○, control trees; △, rainout trees. Each point represents mean of four trees on a particular date. Dates used: 27 June, 29 June, 28 July, 30 July and 1 August.

*Leaf/soil water relationships*

Pre-dawn leaf \( \Psi \) decreased with decreasing \( \theta \) and soil \( \Psi_m \) at 30+60 cm soil depths [Fig. 5(a),(b)]. Pre-dawn leaf \( \Psi \) was relatively insensitive to changes in \( \theta \) until \( \theta \) decreased to 22%, below which response was very steep [Fig. 5(a)]. Conversely, pre-dawn leaf \( \Psi \) was sensitive to changes across the entire range of measured soil \( \Psi_m \) [Fig. 5(b)]. Separation of response by treatment was not well expressed in the relation between pre-dawn leaf \( \Psi \) and \( \theta \) or soil \( \Psi_m \) at 30+60 cm depth. Below 60 cm depth there was no clear relationship between pre-dawn leaf \( \Psi \) and \( \theta \) or soil \( \Psi_m \), other than points within each treatment were clustered vertically [Fig. 5(c)-(f)]. Treatment clusters were separated laterally due to
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Figure 6. Average daily stomatal conductance when plotted against (a) soil moisture, (b) soil matric potential (soil variables were averaged over 30 and 60 cm depths), (c) pre-dawn leaf water potential, and (d) average daytime leaf water potential. Lines are fitted from regression equations and r's are indicated. ●, Surplus trees; ○, control trees; ▲, rainout trees. Dates used were the same as in Fig. 5.

Discussion

Leaf/soil water relations

Nocturnal rehydration of mesquite leaves (i.e., pre-dawn leaf Ψ) was a function of soil moisture content. The curvilinear relationship expressed between volumetric soil moisture (θ) at 30+60 cm depth and pre-dawn leaf Ψ in mesquite [Fig. 5(a)] was similar to that reported for Acacia drepanolobium in Kenya by Hesla et al. (1985), in that pre-dawn leaf Ψ was only slightly influenced by a decline in θ until a threshold was reached, below which pre-dawn leaf Ψ was strongly influenced.

The positive linear relationship found between θ and average daily stomatal conductance supports the hypothesis that mesquite uses more water if more is available (Biscoe, 1972; Moseley, 1983). Soil moisture levels were apparently not high enough to produce a characteristic levelling of conductance at high θ, as described for other woody species.
(Schulze, 1986; Rosenthal et al., 1987). Our results in general agree with Easter & Sosebee (1975) and Thomas & Sosebee (1978), who found greater transpiration in irrigated than non-irrigated, field-grown mesquite trees. However, Wendt et al. (1968), in a glasshouse study, found little difference in transpiration of mesquite seedlings under a wide range of soil water potentials. Apparent conflicts in the literature such as this may relate to plant age and/or field vs. glasshouse conditions.

The relationships of average daily stomatal conductance to each of the two soil variables, $\theta$ and soil $\Psi_m$, in terms of linearity vs. curvilinearity, were opposite to those of pre-dawn leaf $\Psi$ [Figs 5(a),(b), 6(a),(b)]. This suggests that the relationship between the two leaf variables, pre-dawn leaf $\Psi$ and average daily conductance, was curvilinear instead of linear, and this is what was found [Fig. 6(c)]. Our results agree with findings for other woody species which indicated that conductance decreased with decreasing pre-dawn leaf $\Psi$ (Running, 1976; Hinkley et al., 1978; Pereira et al., 1987). The relationship between these variables suggests that water loss through stomata during a particular day was primarily a function of nocturnal tissue rehydration.

Nilsen et al. (1983) reported that pre-dawn leaf $\Psi$ in Sonoran Desert mesquite remained near $-2.5$ MPa throughout the growing season. Using Nilsen's data, we calculated average daily conductance of Sonoran mesquite during a mid-July day to be near 140 mmol m$^{-2}$ s$^{-1}$. While this conductance value is higher than expected, based on the relationship between pre-dawn $\Psi$ and conductance developed from our study in Fig. 6(c), this difference is explained by the unique conditions which were conducive to phreatophytic behaviour of mesquite at Nilsen's study site (Jarrell & Virginia, 1990).

In contrast to the clear relationship between pre-dawn leaf $\Psi$ and average daily conductance, we found no relationship between average daytime leaf $\Psi$ and average daily conductance. Our findings are similar to those reported for black walnut (Juglans nigra), soybean (Glycine max), and cotton (Gossypium hirsutum), in which a wide range of conductance occurred within a narrow range of daytime leaf $\Psi$ (Brown et al., 1976; Davies & Kozlowski, 1977; Turner et al., 1978; Schultz & Hall, 1982). These results suggest that adjustments to a baseline level of leaf $\Psi$ were necessary prior to stomatal function on each day. Nilsen et al. (1981) found that midday leaf $\Psi$ of mesquite in the Sonoran Desert of California was commonly lower than $-4$ MPa from June through November, but that stomatal activity remained uncoupled from midday leaf $\Psi$ until $-4.8$ MPa was reached. We were unable to lower midday leaf $\Psi$ below $-3.2$ MPa, even after water was eliminated from rainout trees for 2 months.

While there was no relation between average daily values of conductance and leaf $\Psi$, the curves shown in Fig. 4 suggest a diurnal relationship between these two variables. The decline in conductance following a diurnal peak at 2 h post-sunrise and concomitant increase in leaf $\Psi$ indicate that stomatal closure in the afternoon stimulated tissue rehydration, which increased leaf $\Psi$. This finding disagrees with studies on some woody species which indicated that conductance declined with decreasing daytime leaf $\Psi$ (Davies & Kozlowski, 1977; Szarek & Woodhouse, 1977; Schulze & Kuppers, 1979). In general, however, our findings concur with those of Nilsen et al. (1981) and others who concluded that stomatal closure was more related to soil water status than to daytime leaf $\Psi$ (Schulze & Hall 1982; Schulze, 1986; Davies et al., 1987; Davies et al., 1990).

**Influence of stress on response to watering**

Responses of differentially moisture-stressed mesquite to common irrigations were evaluated according to rapidity and magnitude of response. We were unable to ascertain duration of response because of rains on 2 July and 3 August which terminated each post-irrigation trial before plant responses in any treatment had returned to pre-irrigation levels.

Rapidity of response was evaluated only during the July trial in which observations were
made 1 and 3 days after irrigation. The results suggest that moisture stress exhibited by rainout and control trees delayed rapidity of response, as measured by increases in pre-dawn leaf $\Psi$ and average daily conductance following irrigation. Mean pre-dawn leaf $\Psi$ in control and rainout trees 1 day prior to the 29 July irrigation were the lowest recorded during the study ($-1.70$ and $-2.01$ MPa, respectively). Apparently a threshold level of stress was necessary before responses to moisture availability were affected.

Magnitude of response was interpreted in two ways: (1) absolute, or (2) relative (i.e. percentage increase from pre-irrigation levels). While absolute pre-dawn leaf $\Psi$ was not different between treatments following either the June or July irrigation, we did find that absolute average daily conductance was greatest in surplus trees following each irrigation. These results agree with Ludlow et al. (1980) and Kaufmann (1981) who indicated that stress history had a significant effect on stomatal behaviour, even though leaf water potential recovered quickly after rewatering. Our study indicated that long-term pre-conditioning with elevated soil moisture enhanced absolute magnitude of response to a simulated rainfall.

When viewed as a percentage increase from pre-existing levels, relative magnitude of response to irrigation was greater in more stressed trees and least in surplus trees. This suggests that greater physiological adjustments were required by more stressed individuals when responding to moisture events. Responses of non-stressed (i.e. surplus) trees may have been near maximum potential prior to irrigation which would limit magnitude of post-irrigation responses.

Conclusions

In summary, stomatal conductance and pre-dawn leaf $\Psi$ of mesquite were positively related to soil moisture. This was in contrast to daytime leaf $\Psi$ which was not well related to soil moisture. Because pre-dawn $\Psi$ was closely related to both soil moisture and conductance, pre-dawn leaf $\Psi$ was determined to be the best single indicator of overall moisture stress in mesquite. Pre-dawn leaf $\Psi$ below $-1.6$ MPa appeared to retard the response of mesquite to simulated rainfall.

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References


