# Effect of the size of plastic mulch on the soil moisture and temperature regime and on the establishment and growth of *Acacia saligna* seedlings

Walter Zegada-Lizarazu and Pedro Berliner

*(Wyler Department of Dryland Agriculture, Blaustein Institutes for Desert Research, Ben Gurion University of the Negev, Israel)*

## Introduction

The establishment of forestry systems in dryland areas is difficult due to low precipitation and high evaporation rates. In such Mediterranean climates, seedlings are usually planted after the rainy season. During the early stages of their development, seedlings grow therefore on stored water. Minimizing unproductive water losses, such as evaporation from the soil surface, could increase the rate of survival and development during the early growth stages. Covering the soil surface close to the trunk with different sizes of polyethylene mulch may reduce evaporative losses and increase soil temperature at different levels and consequently plant establishment and growth may also be affected differently.

## Objectives

Determine the effects of covering different surface areas with polyethylene mulch on soil moisture and temperature and their interactions with the rooting patterns, canopy development and establishment of *Acacia saligna* tree seedlings on stored water.

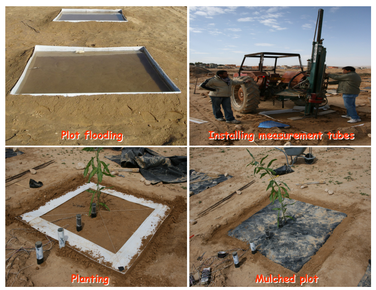
## Material and Methods

The treatments (Table 1) were replicated three times in a fully randomized block design. Plots were 1.8 x 1.8 m with a distance between trees of 4 m. Plots were flooded towards the end of the winter season. Trunk diameter, root development (Minirhizotron), soil water content to a depth of 1.65 m (Trime TDR), soil temperatures to a depth of 0.6 m (Thermocouples) and photosynthesis and transpiration (Li-Cor 6400) were measured routinely throughout the growing period. Distribution of measurement sites (0.15, 0.45, 0.75, 1.05 m from the center of the plot) is presented in Fig 1.

**Table 1: Mulch treatments (*)**

| Fraction of wetted surface (in %) covered with mulch | Dimensions of mulch (m x m) | Applied water volume ($m^3$) |
|---|---|---|
| 0 | - | 0.9 |
| 30 | 1.0 x 1.0 | 0.9 |
| 70 | 1.5 x 1.5 | 0.9 |
| 100 | 1.8 x 1.8 | 0.9 |

(*)The same treatments were applied to plots without tree seedlings



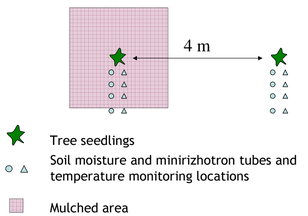
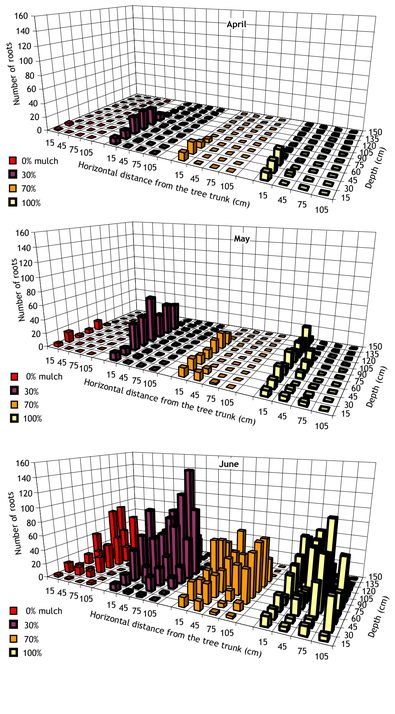



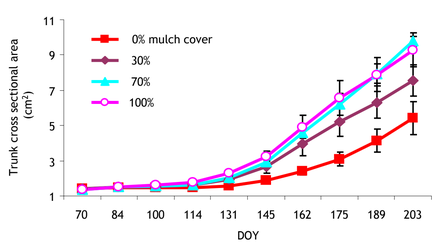

**Fig 1. Schematic description of plot layout**

## Results and Discussion

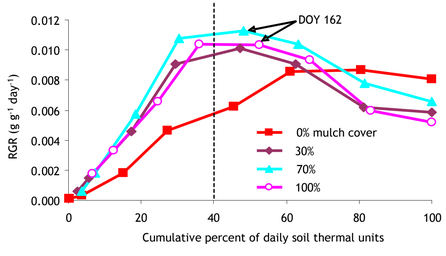
Average soil temperature in the upper 0.6 m was higher in the mulched plots. Temperatures close to the edged of the mulched area were lower than those close to the trunk for all depths. In plots with trees seedlings, consumptive water use was higher under mulch than under non-mulch treatments. The opposite trend was found in plots without tree seedling, but still considerable water losses were registered in the mulched treatments. During early grow stages, roots grew deeper in the 30% mulch treatment and more laterally in the 100% mulch cover and the lack of mulch produced the smallest root system. Bigger canopies were developed in the mulched than in the non-mulched treatments. Although no significant differences were found among the mulched treatments, the highest increments in stem diameter, RGR, photosynthetic and transpiration rates were found in the 100% and 70% mulch treatments. The treatments did not affect the instantaneous WUE. At later stages, growth rates and related physiological parameters tended to declined more sharply in the mulched than in the non-mulched treatment. These results indicate that polyethylene mulch modified soil moisture and soil temperature, which resulted in improved conditions for early tree development. At later stages, however, the lower soil moisture remaining and higher cumulated heat in the soil may have impaired tree development in the mulched treatments, especially when most of the plot area was covered by mulch.




**Root development as indicated by maximum vertical and horizontal spread**

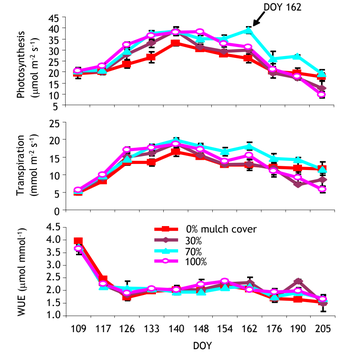



**Evolution of trunk cross sectional area from March to July**

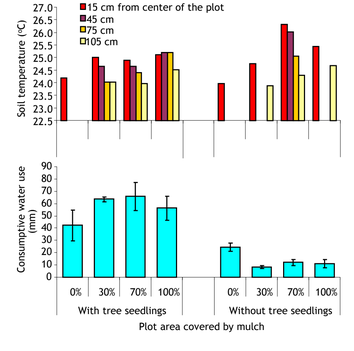



**Acacia seedlings development as a function of cumulative soil thermal time (March - July). Dotted line indicates when 40% of the total soil thermal units of the growing period were accumulated**

**Fig 2: Three month old saplings (L no mulch; R 100% mulch)**




**Midday photosynthetic and transpiration rates and instantaneous water use efficiency (WUE) throughout the growing period**




**Average soil temperature (top) and consumptive water use (bottom) from March to July**

## Conclusions

The different sizes of polyethylene mulch modified soil moisture distribution and affected the soil thermal regime in a similar way. At early stages seedlings performed better in the mulched treatments, with 70% mulch being the most effective. Towards the end of the growing period a more marked decline in plant development was observed in the mulched treatments. Considerable water losses were observed for the mulched plots in which no seedlings were planted.

**Acknowledgments:** This study was supported by the Jacob Blaustein Institutes for Desert Research - Jacob Blaustein Center for Scientific Cooperation.