

**Photosynthesis and Leaf Water Potential of Cotton
Under Trickle and Level Basin Irrigation**

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Summary

Deltapine 90 was grown under daily trickle, and weekly and bi-monthly level-basin irrigation treatments. The cotton in each treatment received equal amounts of irrigation water over the course of the growing season. The daily irrigated plants maintained more constant leaf water potential (WP) and net photosynthesis (Pn) than the level-basin irrigated plants. The level-basin irrigated plants experienced water stress-induced reductions in WP and Pn prior to irrigation.

Conservation of irrigation water is of critical importance for the arid Southwest. New technologies, such as trickle irrigation and new crop cultivars, are being developed to meet the need for greater conservation. The objective of this study was to compare the effect of daily-applied trickle irrigation and level basin irrigation systems on leaf water potential (WP) and net photosynthesis (Pn) of a short-staple cotton.

Deltapine 90 was planted on 11 April 1985, at the University of Arizona Maricopa Agricultural Center following a pre-plant irrigation. A plot consisted of 6-10 m rows, with 1.0 m bed spacing. The three irrigation treatments were as follows: (1) a single surface trickle irrigation line per two rows, irrigated daily; (2) level-basin irrigated weekly; and (3) level-basin irrigated every other week (bi-monthly).

Irrigations were scheduled such that all three treatments received approximately equal amounts of irrigation water during each two week irrigation cycle during the growing season. A neutron moisture probe was used to measure volumetric soil moisture content to a depth of 1.7 m the day of and two days after each level-basin irrigation.

Pn and WP were measured periodically between June 13 (day 164) and July 9 (day 190), the period of peak water use. Measurements were made the day before and the day following a level-basin irrigation whenever possible. Pn of single leaves near the top of the canopy was measured using a Li-Cor 6000 portable photosynthesis instrument.

The same leaves were then extracted at the petiole and placed into thermocouple psychrometer chambers and returned to the laboratory for measurement of WP. Three leaves were sampled in each plot. The plots were replicated three times in a randomized complete block experimental design.

Soil moisture content tended to decrease during the period of peak water use for all irrigation treatments, indicating that moisture lost to evapotranspiration was not being replaced through irrigation. The weekly and bi-monthly irrigation treatments, of course, showed sharp increases in soil moisture following irrigations, but the average rate of soil moisture depletion was similar for all irrigation treatments.

The daily irrigated plants maintained a uniform WP throughout the experiment in spite of a decrease in soil moisture content (Figure 1a). The weekly and bi-monthly irrigated plants, however, showed significant decreases in WP on days prior to an irrigation, days 176 and 190, for example. Immediately following irrigation, their WP returned to a level similar to the daily irrigated plants.

Pn measurements (Figure 1b) followed a trend similar to the WP results. The differences among the three irrigation treatments was greatest on days preceding a level-basin irrigation. Pn of the level-basin irrigated plants increased to a level similar to the daily irrigated plants immediately following irrigation. The stress-induced decline in the Pn was reflected in lower yields also. Average cotton lint yields of the daily, weekly, and bi-monthly irrigated plots were 1602, 1179, and 1260 kg per hectare, respectively (see also French et al. in this volume).

When cotton is irrigated with less than the optimum amount of water, it appears that a daily trickle irrigation regime results in less stress and greater productivity than less frequently applied level-basin irrigation.

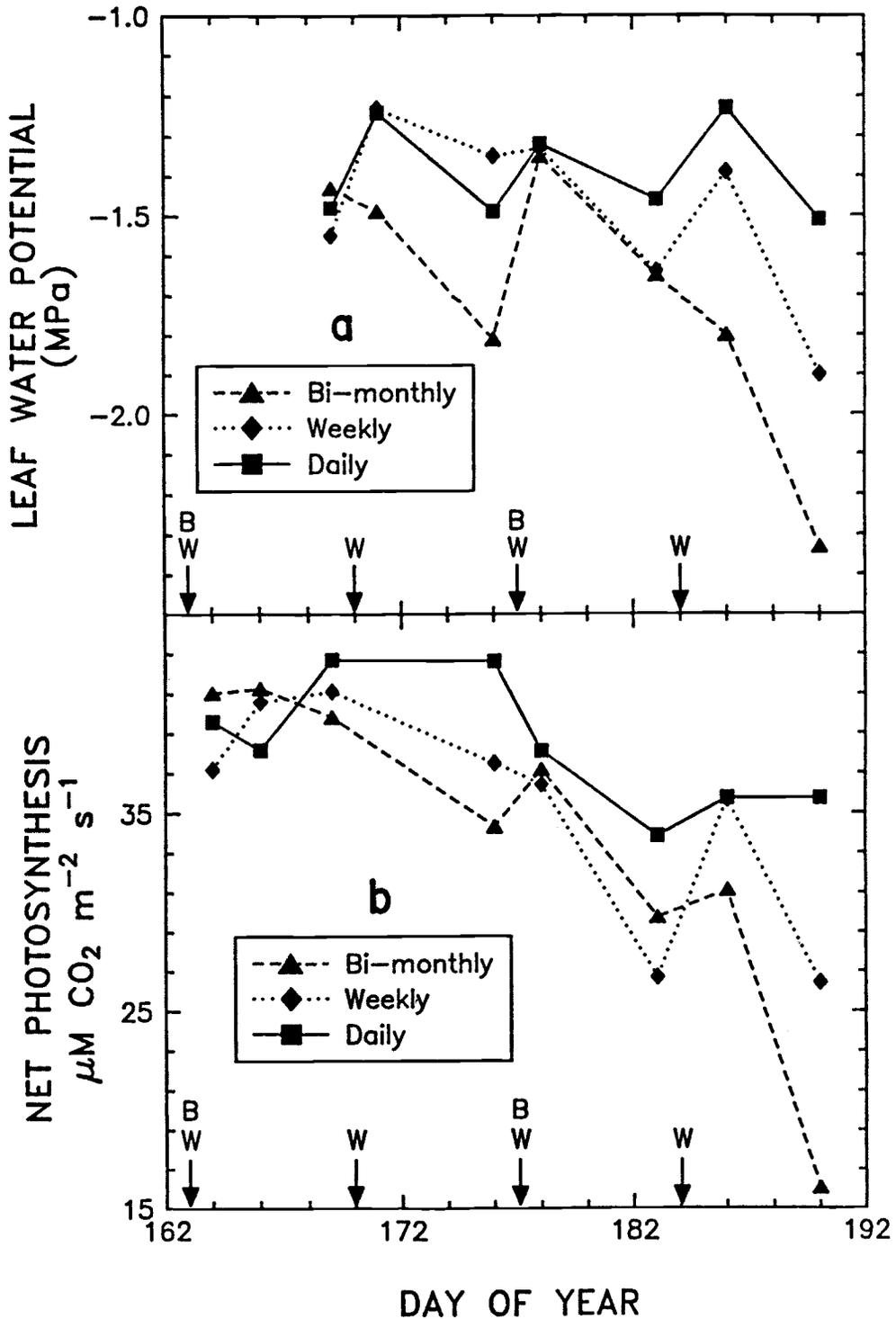


Figure 1. Leaf water potential (a) and net photosynthesis (b) of Deltapine 90 cotton grown under daily trickle, and weekly and bi-monthly level-basin irrigation. Arrows indicate days on which weekly (W) and bi-monthly (B) irrigations were applied.