YIELD, QUALITY AND PROFITABILITY OF COTTON PRODUCED WITH SUBSURFACE DRIP VERSUS OVERHEAD SPRINKLER IRRIGATION SYSTEMS

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Abstract

New irrigation methods are being explored to find ways to save water without losing the benefits of irrigation. Subsurface drip can decrease evaporative water loss in cotton, but it remains to be seen how these savings compare to conventional overhead irrigation. Direct comparison of subsurface drip and overhead irrigation will provide information as to the plausibility of another form of irrigation. This experiment compared subsurface drip and low-pressure sprinkler irrigation in Georgia cotton. Treatments of overhead irrigation, two methods of subsurface drip, and dryland plots were studied. The overhead irrigation was watered when the soil water potential reached 40 centibars. One treatment of the subsurface drip was watered with the same amount of water as the overhead when it was watered. Another treatment of the SDI was fed with just enough water to keep the soil water potential below 40 centibars. The dryland received no irrigation. The cotton was machine picked and box picked to compare the quality and yield of each of the irrigation treatments. Drip treatments used less water than the overhead treatment and had similar yields.

Materials and Methods

The experiment was conducted at the Stripling Irrigation Research Park in Camilla, GA using Delta Pine 488BR at a density of three plants per foot. Plot layout consisted of a randomized block design with 4 irrigation treatments and 4 replicates. The plots were 60 ft long and 30 ft wide with 30 ft borders, and the middle two rows were used for data collection.

Treatments

1. Overhead Irrigation
2. Subsurface Drip Irrigation based on crop evapotranspiration (SSD based on ET)
3. Subsurface Drip Irrigation matching overhead irrigation rate (SSD matched)
4. Non-Irrigated

The overhead irrigated plots were watered by a linear sprinkler system. Both SSD treatments were watered by a drip irrigation system that consisted of 12” deep drip line in the center of every other row. The drip irrigation system was controlled by inputs from the Adcon telemetry units. When watermark reading triggered the irrigation, the automatic irrigation system watered the plots. The treatments were watered independently of each other.

Watermark sensors were installed in two replicates of each treatment. The sensors were placed between the center two rows of the plot. One set was placed in the row

center at the depths of 6", 24", and 36". Another set was placed 4" away from the cotton at depths of 8", 16", and 24". Irrigation was triggered in a treatment when any of the watermarks read above 40 cb. Adcon telemetry equipment was also installed in one replicate of the four treatments to continuously monitor soil water status.

The cotton picked from the plots was ginned and weighed at the University of Georgia Micro-gin, a state-of-the-art ginning facility in Tifton, Georgia. Quality samples were taken and sent to Cotton Incorporated for HVI analysis. Data Analysis of cotton growth and yield among all treatments was performed in SAS 8.0, using ANOVA at a confidence level of 0.05 and Tukey's pairwise test.

Results

The nodes above first square/white flower graph suggests that the dryland plots reached cutout more rapidly than the irrigated treatments, but also that the subsurface drip plots matured more quickly than the overhead irrigation (Figure 1). The overhead treatment had increasingly higher soil water readings in the later part of the year than either drip treatment, even though the water output was the same as SSD matched to the irrigation and more than for the SSD based on ET plots. This trend was especially evident at 24" readings, suggesting that water from the overhead irrigation did not penetrate the soil as far as that from either of the drip treatments. There are significant water use differences within the watering systems. The SSD based on ET used 27% less cumulative applied water than the overhead irrigated treatment. The decreased water use of the SSD based on ET treatment compared to the overhead irrigation for the 2004 experiment was approximately 46,000 gallons per acre. The lint yield from the SSD was comparable to that of the overhead irrigation treatment. Both the overhead irrigation and the subsurface drip were significantly higher than the non-irrigated. All of the irrigation systems had statistically the same yields. The 2004 results suggested that subsurface drip is more efficient than overhead irrigation and can give comparable yields with less water output.

Acknowledgments

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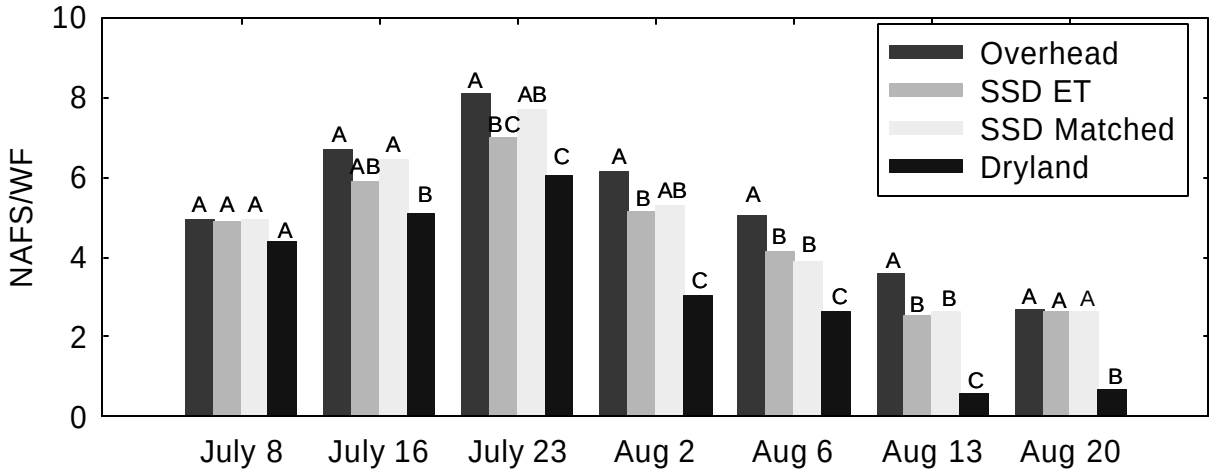

Figure 1. Nodes above first square or white flower for all treatments. Subsurface drip treatments showed greater maturity rates than the overhead treatment based on NAFS/WF data.

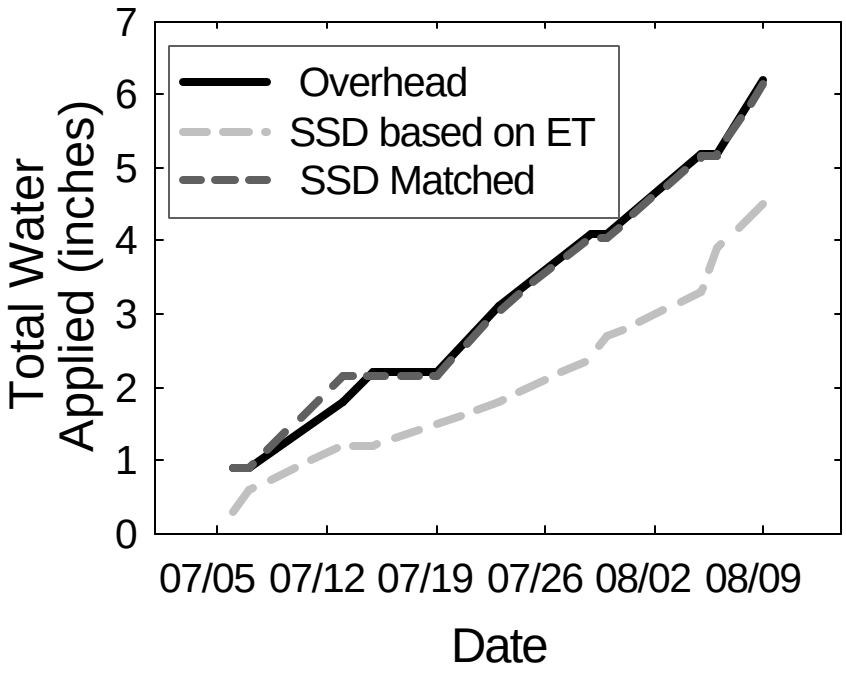

Figure 2. Total water used by the three irrigation treatments.

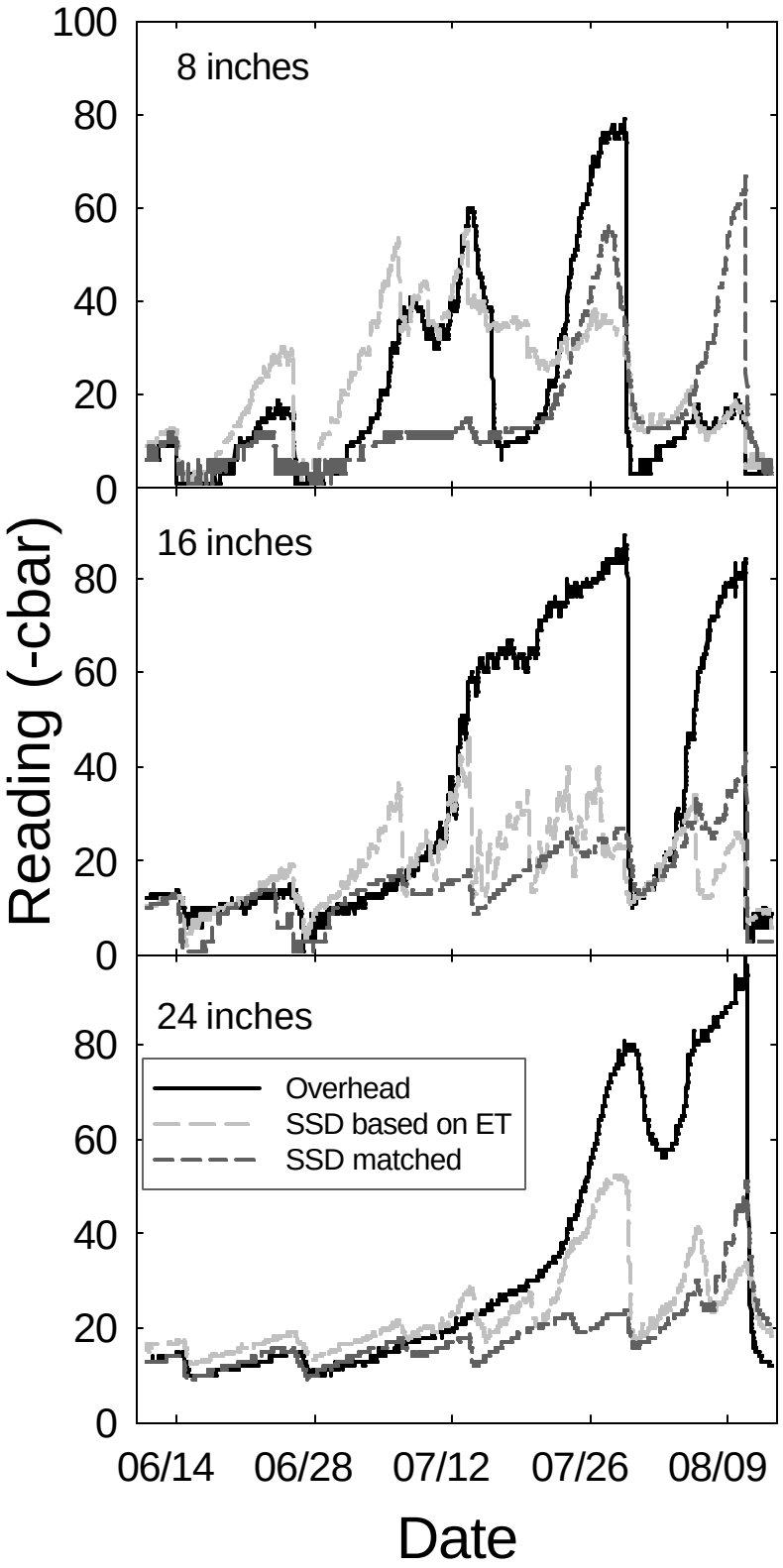

Figure 3. Watermark readings at 8, 16, and 24 inches for the three irrigation treatments.

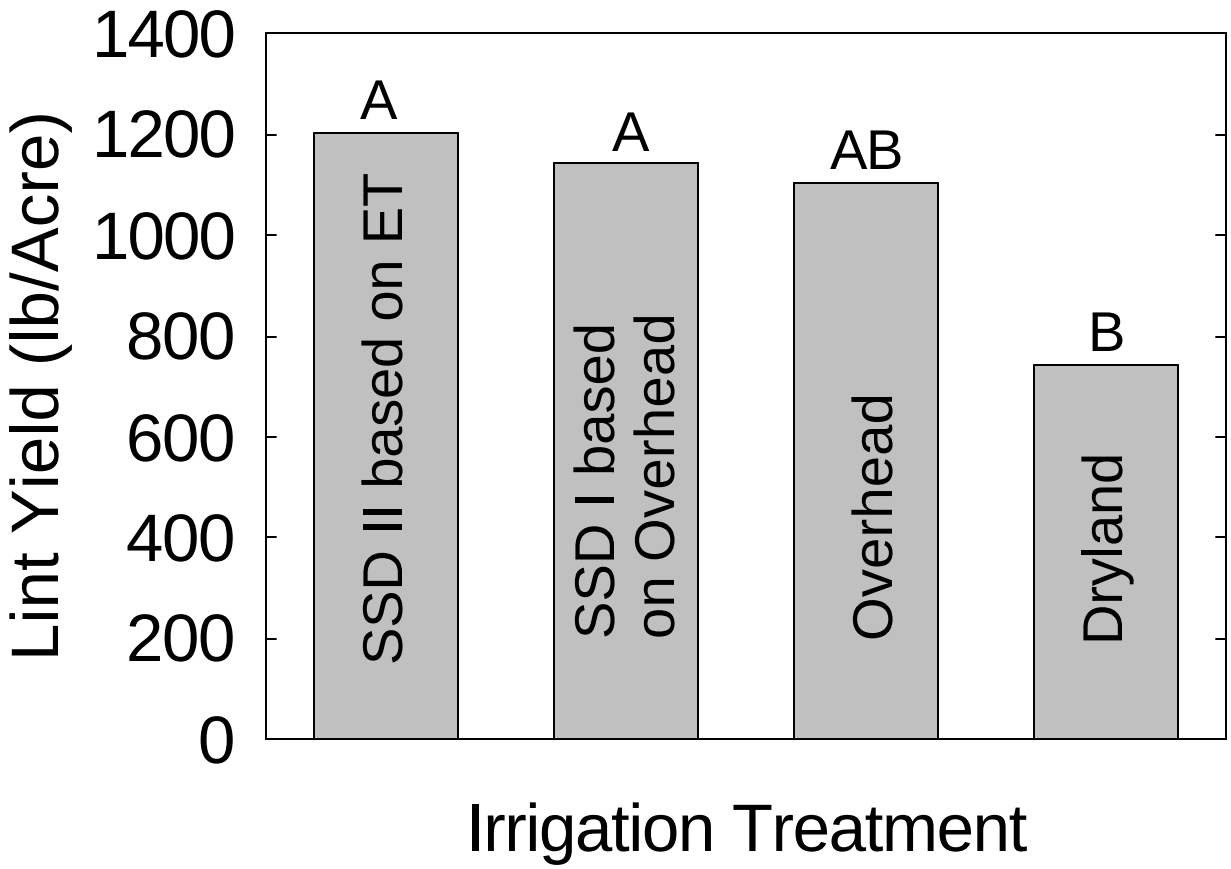

Figure 4. Final yield of the three irrigation treatments and the dryland treatment. Letters were assigned based on Tukey's pairwise tests.