Evaluation of a Low-Pressure, Linear Move Irrigation System for Cotton

D.D. Fangmeier, Agricultural Engineer; S.H. Husman, Research Assistant

Summary

A modified, low-pressure, linear move sprinkler irrigation system was used to irrigate upland cotton at the Marana Agricultural Center, University of Arizona in 1984. Furrow drop lines and low-pressure spray booms were used for water delivery for comparison purposes. Irrigations were scheduled according to a Crop Water Stress Index (CWSI) in conjunction with a neutron probe for soil moisture deficit determinations. The yield with furrow drop lines was 2.45 bales/acre while the spray drop booms yielded 2.55 bales/acre. The furrow drop lines received 21.47 inches of applied irrigations. Spray booms received 21.74 inches. Seasonal rainfall was 8.60 inches.

*****

A linear move sprinkler system operating at low pressures was used to irrigate DPL-55 cotton at the Marana Agricultural Center. One span of the system was equipped with furrow drop lines for every other furrow and another span had 40 foot spray booms each with 5 spray heads spaced for optimum application uniformity. Planting date was April 23.

Irrigation scheduling was facilitated using the Crop Water Stress Index (CWSI). Canopy temperature measurements were made with a hand held infrared thermometer. Vapor pressure deficit was determined using an aspirated psychrometer. The CWSI is based on the fact that a well-watered plant will transpire at a maximum potential rate, thereby cooling the plant. As soil moisture is depleted from the plant root zone, transpiration will be reduced below the potential rate and the plant temperature will increase causing the stomates to close, reducing photosynthesis and therefore growth and yield. A significant correlation exists between the foliage minus the air temperature (ΔT) and air vapor pressure deficit (VPD). Using this relationship between ΔT and VPD a linear index or CWSI baseline between 0 and 1 can be established for a particular plant species. Zero (0) indicates a well-watered, fully transpiring plant while 1 indicates cessation of transpiration or severe water stress. The cotton was irrigated when the index value reached 0.1 on the average indicating very little stress was even incurred. Depths of irrigation were determined with a neutron probe to evaluate the soil moisture deficit. Irrigations were applied 2 to 3 times per week similar to the frequency of drip irrigation systems.

A soil sample prior to planting indicated a P deficiency and adequate soil N, therefore 92 lbs. P_2O_5 and 36 lbs. N per acre were applied pre-plant. Petiole samples were taken on a weekly basis and never indicated a need for additional N, therefore, no additional fertilizer applications were made during the growing season.

The yields and water applications are given in Table 1. The total water applications including pre-plant irrigation were less than 22 inches. Yields averaged 2.5 bales/acre.

The linear move system has the ability to apply water at an amount and frequency to meet crop needs. The system is a cost effective alternative

irrigation method. Yields can be increased by approximately 25% while reducing water applications by an estimated 30%. The CWSI is a promising method of irrigation scheduling since yield reducing stress can easily be detected before visual signs are apparent.

Table 1. Irrigation Method, Water Applied, Lint Yield in Field E-2, Marana Agricultural Center, 1984

IRRIGATION METHOD	WATER APPLIED INCHES	RAINFALL	FIRST PICK BALES/ACRE	SECOND PICK BALES/ACRE	TOTAL BALES/ACRE
Furrow Drops	21.47	8.60	2.15	.30	2.45
Sprays	21.74	8.60	2.23	.32	2.55