DEFICIT IRRIGATION OF COTTON FOR OPTIMUM RETURN ON INVESTMENT

Brian G. Leib
University of Tennessee - Biosystems Engineering & Soil Science
Knoxville, TN
C. Owen Gwathmey
West Tennessee Research and Education Center
Jackson, TN
Christopher L. Main
University of Tennessee
Jackson, TN

Abstract

The goal of this research was to determine the level of deficit irrigation that provides the highest economic return for cotton. In 2006 and 2007, drip tape was used to create nine deficit irrigation treatments compared to a dryland control in a RCB Design. Irrigation was initiated at square, bloom, and post-bloom by opening manual valves on the drip lines while irrigation levels were created by different drip tapes that supplied 1.5, 1.0, and 0.5 inches per week. Irrigation amounts were reduced if rainfall supplied the required water. Delta Pine 143 was used on a Memphis soil at the West Tennessee Research and Education Center, Jackson, TN.

During the growing season, soil water tension, NDVI, and nodes above white flower and cracked bowl were monitored. At harvest, seed cotton was weighed, fiber samples were collected, plant height was measured, and bowl location was mapped. After harvest, gin out was determined and cotton samples were classed.

In 2006, a five week drought period started three weeks prior to bloom. The highest gross return (see table 1) occurred in plots that received from 2.5 to 4.5 inches of irrigation (1850 lbs of lint per acre at $0.53 per lb). Based on a 200 acre center pivot, these optimum irrigation amounts would have produced an additional $30,000 in cotton value as compared to the dryland treatment (1550 lbs of lint per acre at $0.54 per lb). The treatment that received the highest irrigation, 8 inches, produced only $2,000 in additional cotton value (1725 lbs of lint per acre at $0.495 per lb), a return insufficient to pay for pumping costs let alone the capital cost of a center pivot.

Table 1. 2006 yield and price results.

Treatment	Lint (lbs/ac)	Price ($/lbs)	Gross Return	Irrigation (in)
Square - 1.5"/week	1728.6 [c]	0.494	$853	7.9
Square - 1.0"/week	1773.1 [bc]	0.519	$919	5.2
Square - 0.5"/week	1867.4 [a]	0.534	$996	2.6
Bloom - 1.5"/week	1865 [a]	0.530	$989	4.3
Bloom - 1.0"/week	1819 [ab]	0.517	$941	2.8
Bloom - 0.5"/week	1776.2 [bc]	0.522	$927	1.4
Post Bloom - 1.5"/week	1725.9 [c]	0.523	$903	1.5
Post Bloom - 1.0"/week	1693.1 [c]	0.524	$887	1.0
Post Bloom - 0.5"/week	1730.1 [c]	0.518	$895	0.5
Dryland	1565.9 [d]	0.539	$844	0.0

In 2007, drought stress was more severe than in 2006 and occurred at completely opposite growth stages. There were several weeks of dry weather at the start of “match head square” and seven weeks of drought starting 2 weeks after first bloom. The highest yield occurred when 1.5” per week was applied starting at bloom and 2 weeks after bloom (1850 lbs of lint/acre) and thus accumulating 7.7” to 6.7” of irrigation, respectively (see table 2). However, when 10.2” was applied starting at “match head square under the 1.5” per week rate, yield was reduced to 1688 lbs/ac. Irrigated yield was also less than the optimum yields when

1.0" and 0.5" per week was applied. When irrigation was initiated during the post bloom period, 2.2" applied at the 0.5" per week rate resulted in 1,391 lbs/ac while 4.5" applied at the 1.0" per week rate resulted in 1,627 lbs/ac. Additional irrigation applied prior to the post bloom period did not provide any additional yield benefit. Finally, all irrigated treatments produced more than the dryland treatment yield of 923 lbs/ac. At $0.60/lb on a 200 acre center pivot, optimal irrigation would have grossed more than $100,000 as compared to dryland cotton.

Table 2. 2007 yield results.

Treatment	Lint (lbs/ac)	Irrigation (in)
Square - 1.5"/week	1687.7[b]	10.2
Bloom - 1.5"/week	1842.1[a]	7.7
Post Bloom - 1.5"/week	1850.1[a]	6.7
Square - 1.0"/week	1689.7[b]	6.8
Bloom - 1.0"/week	1622.9[b]	5.2
Post Bloom - 1.0"/week	1627.6[b]	4.5
Square - 0.5"/week	1345.9[c]	3.4
Bloom - 0.5"/week	1319.1[c]	2.6
Post Bloom - 0.5"/week	1391.9[c]	2.2
Dryland	923.0[d]	0.0