WATER RESOURCE DEVELOPMENT AND IRRIGATION MANAGEMENT FOR SPRINKLER AND SDI IN THE TENNESSEE VALLEY

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Abstract

Cotton is a major agricultural commodity in the Tennessee Valley region of north Alabama with more than 200,000 acres produced in a five county area along the Tennessee River. Annual yield fluctuations are quite common and often these fluctuations are related to drought or irregularly distributed rainfall. With financial and technical support from the Tennessee Valley Authority, an irrigation research and demonstration facility was constructed at the Tennessee Valley Research and Extension Center (TVREC) in 1994-95 to evaluate the potential for enhancement of water resources in that region and to conduct research related to irrigated cotton production. A nontraditional off stream storage reservoir was first constructed at the TVREC to harvest abundant water available in the winter and spring for irrigation during the summer. Using this water source, cotton irrigation research has been underway since 1996 with data reported here for 1997 through 2000.

Discussion

A number of different cotton irrigation experiments are in place at the TVREC. One of the first experiments was established to evaluate irrigation water requirements and irrigation scheduling. This study was designed to determine the minimum irrigation system design flow rate capability that would produce optimum yields. Yield data from 1997-1998 (Figure 1)* indicate positive irrigated yield results over non-irrigated in each year with systems capable of applying l inch in 5.4 days, l inch in 2.5 days and a very wet treatment where the soil moisture deficit in the root zone was not allowed to exceed 0.6". Differences in irrigated treatments were small but some yield suppression was noted for the extremely wet treatment.

In 1999 and 2000 an experiment was developed to evaluate a wider range of irrigation application capabilities to try to zero in on the minimum design flow rate for irrigation systems that would still maintain optimum yields. The growing seasons in 1999 and 2000 proved to be extremely dry and yield data indicated a progressive increase in yields with treatments from no irrigation to a capability of more than 2 inches per week (Figure 2). Even with the maximum irrigation capability some water mining was observed from the deeper soil profile (Figure 3).

A second major area of study involves use of Subsurface Drip Irrigation (SDI) for cotton production. In one experiment irrigation drip tubing with emitters two feet along the tubing is buried permanently at a depth of fifteen inches between every-other-row (controlled traffic) and perpendicular to rows (random traffic) with the same number of outlets and same amount of tubing on a per acre basis. (Figure 4). Irrigation is applied daily based on calculated pan evaporation provided by The Alabama Weather Information Service (AWIS) for that location. Irrigation amounts are equal to 30%, 60% and 90% of pan evaporation after full crop canopy with corresponding percentage adjustments prior to full canopy. These rates result in amounts of approximately .1"/day, 0.2"/day and 0.3"/day respectively during periods of peak water use. Significant yield differences occurred in 1998,1999 and 2000. (Figure 5).

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A second subsurface drip irrigation study initiated in 1998 is designed to compare 5 different drip irrigation tape products with a fertigation component included. This study was installed in an area where continuous crops have been produced for many years with emitters two feet along the tape and tape buried 15" between every other row. Rows 340 feet in length were used to better simulate field conditions. Each tape product is being evaluated with conventional fertilizer and fertigated treatments. (Table 1). A tape product is also used on the surface with the conventional fertilizer treatment. In 1998 little difference between fertility treatments was observed. In 1998 sufficient rainfall occurred late in the growing season so that fertilizer in the upper layers of the soil was more readily available. In 1999 significant yield differences were observed for the fertigated vs conventional plots. In 1999, extreme dry conditions in the upper layers of the soil profile made conventional applied fertilizer less available resulting in significant yield reduction compared to fertilizer applied through the irrigation system. In 2000, a slight yield reduction trend was observed for fertigated treatments. Significant yield differences were observed each year between non-irrigated plots and tape plots with fertility treatments. Figures 6 and 7 illustrate yield results for 1998, 1999, and 2000 for conventional and fertigated treatments. To date only minimal differences have been observed between the different drip irrigation tape products.

Summary

While yield results for SDI are attractive, questions remain related to the cost, longevity and suitability of products currently available for the rolling farmland in the Tennessee Valley.

* In 1997-1999 the variety planted was NuCotn 33B with bales per acre based on 38% yield from seed cotton with 500# lint/bale. In 2000 the variety planted was DPL428B with bales per acre based on 38% yield from seed cotton with 500# lint/bale.

Table 1. Fertility Treatments.

	Irrigated		Nonirrigated	
	Fertigated	Conventional	Drip tape on surface	
Preplant	75#N + 60#K	75#N + 60#K	75#N + 60#K	75#N + 60#K
Sidedress[1]	60#N + 60#K	60#N + 60#K	60#N + 60#K	60# N

[1]Early to mid square for conventional and drip tape on surface; eight equal applications for fertigated beginning early to mid square.

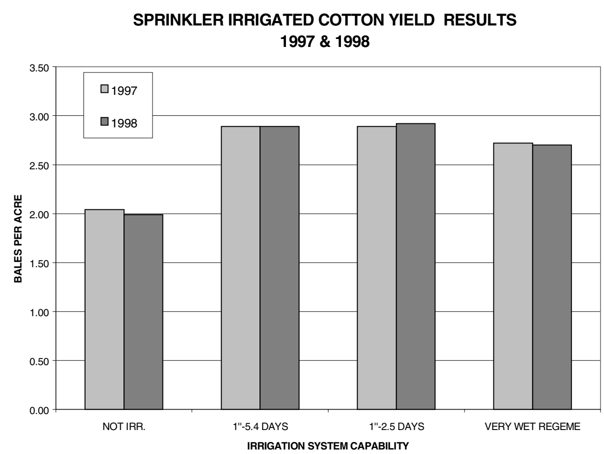


Figure 1.

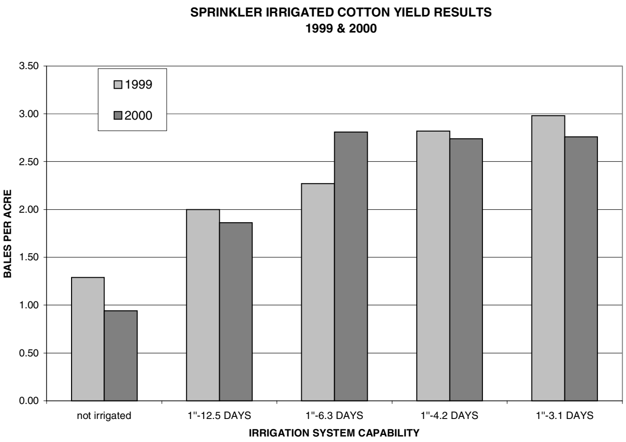
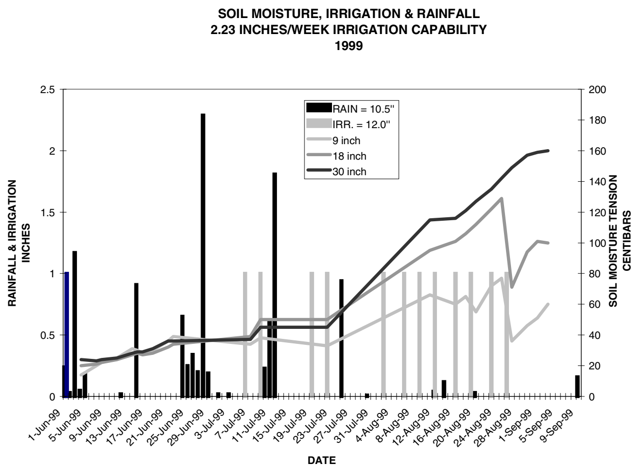


Figure 2.



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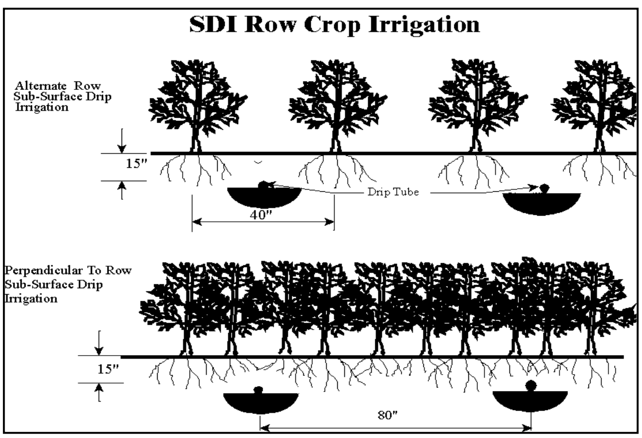

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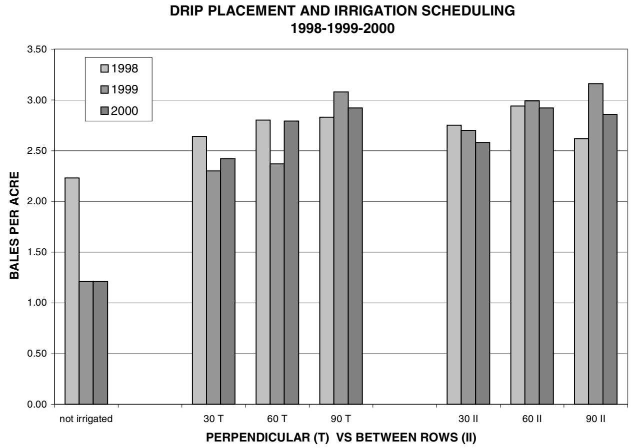

Figure 5.

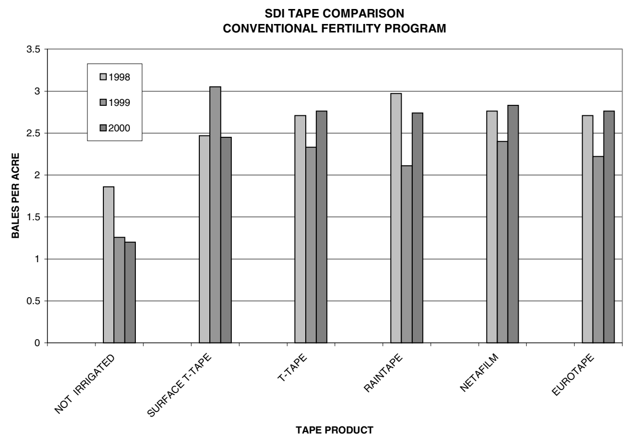

Figure 6.

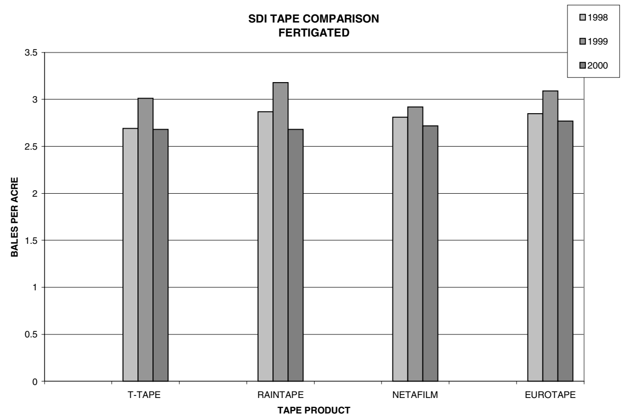

Figure 7.