Irrigation Timing, Method Affects Producers' Bottom Line

LUBBOCK—When does irrigation produce the most bang for the buck invested? Can farmers improve their irrigation water-use efficiency by simply changing their irrigation strategy or timing?

Research conducted from 1999 through 2001 by Texas Agricultural Experiment Station scientists at The Texas A&M University System Agricultural Research and Extension Center at Lubbock casts new light on these questions.

"We ran two field experiments a year for three years," said Jim Bordovsky, Experiment Station agricultural engineer. "Our goal was to improve water use efficiencies of spray, Low Energy Precision Application (LEPA), and subsurface drip irrigation systems in a semi-arid climate with limited irrigation capacity.

"We evaluated pre-plant irrigation losses by lowering pre-plant irrigation quantities relative to wetting the entire profile, and in-season water losses by shading the soil with narrow-row cotton compared to single-row plantings."

Pre-plant irrigation is a simple concept. The idea is to bank water in the soil so that plant roots will find and use it as a crop matures. The trick is putting just enough water in the soil, while accounting for potential rainfall, without exceeding the soil's holding capacity.

If that capacity is exceeded, the soil becomes oversaturated and water is lost or wasted through leaching—much like a dry sponge that is wetted beyond its limits. Leaching or evaporation losses can deprive plants of moisture when their water needs peak.

"Past research showed producers that pre-plant furrow irrigation provided an economic benefit by filling the soil profile before cotton planting," Bordovsky said. "If you pre-water from March through May, in certain situations you can easily apply more water in that period than you might apply during the entire growing season with limited and declining irrigation capacities. High winds and low relative humidity can cause high evaporative losses in this climate while pre-plant irrigation is taking place.

"In a non-replicated experiment, we checked pre-plant water losses with spray, LEPA and subsurface drip irrigation and found we could not account for 81 percent, 55 percent and 23 percent, respectively, of the 5 inches of irrigation water applied."

This led the scientists to two strategies: limited pre-plant irrigation coupled with early in-season irrigation, and full pre-plant irrigation coupled with more normal seasonal irrigations. Pumping capacity for pre-watering was restricted to one of two levels, 0.10 or 0.20 inches per day for each of the three irrigation systems.

Water losses from 30 to 45 days prior to planting remained high, ranging from 67 percent for spray to 47 percent for subsurface drip irrigation. The scientists also noted significant water movement below the 4-foot root zone when applying full pre-plant irrigation with the spray and LEPA systems.

"Although we found significant water losses with full pre-plant irrigation, these treatments stored more water for later crop use than the limited irrigation treatment," (story continued on reverse side)
Bordovsky said. "And that did increase yield compared to the very limited pre-plant irrigations. So the question becomes, 'Is there sufficient gain in yield from full pre-plant irrigation to justify the added expense of application and probably losing some of this water?"

"Averaged across all irrigation treatments for three years, full pre-plant irrigation produced 941 pounds of cotton per acre compared to 866 pounds per acre from limited pre-plant irrigation."

Subsurface drip produced more cotton and had a higher water-use efficiency than spray or LEPA systems in both pre-plant scenarios, he said.

"Subsurface drip yields came in at 1,031 pounds per acre, compared to 889 pounds with LEPA and 790 pounds with spray irrigation," Bordovsky said. "Subsurface drip irrigation boosted water use efficiency by 30 percent over spray and 16 percent over LEPA irrigation, when averaged over irrigation capacity and pre-plant irrigation strategies."

In a separate study, the scientists also compared three cotton planting patterns. They planted cotton beds with one, two and three rows of seeds per 40-inch bed, and irrigated them with spray and LEPA systems. The idea was to reduce in-season moisture losses by shading the soil with a denser plant canopy using narrow-row planting.

They evaluated yields and water-use efficiencies in all three planting scenarios and found that LEPA irrigation consistently produced higher lint yields than spray irrigation using the same quantity of water.

"There were no significant yield differences between one or two rows per bed using LEPA irrigation in all three years of this study," Bordovsky said. "We also didn't see a significant yield difference between one, two or three rows per bed using spray irrigation.

"We found no evidence that narrow-row plant spacing significantly reduced in-season evaporation losses compared to using a single row on a 40-inch bed."

Based on this research, with irrigation capacity of less than 0.2 inches per day, it appears that a combination of limited pre-plant watering, planting single rows on 40-inch beds and using efficient subsurface drip or LEPA irrigation produces good cotton yields and the most bang from each dollar spent on irrigation.

Bordovsky conducted this research with help from Dr. Dana Porter, Texas Cooperative Extension irrigation specialist, and Dr. Eduardo Segarra, Experiment Station economist. Funding for the study was provided by Cotton Incorporated.

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