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ON-FARM
AWESOME FACTS
on agricultural water conservation and efficiency

Surge Irrigation: Significant Potential for Water Savings in the Face of Increasing Scarcity

SUMMARY

On-farm demonstrations in the Lower Rio Grande Valley have proven that using surge valves in furrow irrigation can cut water consumption from 22 to 52 percent across a variety of crops: cotton, sugarcane, and corn.

In sugarcane, surge irrigation used 52 percent less water than furrow irrigation. In seed corn, surge irrigation produced water savings of 28 percent; two cotton studies demonstrated savings of 22 percent and 31 percent.

Texas AWE researchers currently are gathering data from another on-farm demonstration that indicates surge also produces significantly less run-off.

As part of the process that produced the 2011 Rio Grande Regional Water Plan, Texas Water Development Board economists calculated the acreage and water use of irrigated crops in the planning area. Some 27 percent of the total amount of water used for all irrigation is consumed by cotton and sugarcane, two crops where surge valves have produced demonstrated water savings. According to TWDB, 42,000 acres in the region are planted in sugarcane and 59,000 acres in cotton.

- In sugarcane, the Texas AWE studies found that surge valves produced 52 percent savings in water consumption. If all 42,000 acres of sugarcane fields in the region were irrigated using this method, water savings could amount to 56,000 acre-feet per year.
- In cotton, savings of 22 percent were realized in one study and 31 percent in the other. Using surge valves for all 59,000 irrigated acres of cotton could produce water savings as high as 30,000 acre-feet per year.

For these two crops alone, then, surge valve technology could save about 86,000 AF/yr in the region, an amount equal to about 30 percent of current municipal demand in the region.

On-Farm Demonstration Results for Surge vs. Furrow Irrigation

Crop (Date)	Volume of Water Used/Acre (in acre-inches)		Savings with Surge
	Furrow	Surge	
Sugarcane (2005)	30.68	14.64	52%
Cotton (2005)	19.53	13.48	31%
Seed Corn (2007)	23.95	17.31	28%
Cotton (2010)	18	14	22%

THE MECHANICS OF SURGE IRRIGATION

In furrow irrigation, water is typically lost to seepage and/or spilled at the end of the ditch. Surge irrigation, on the other hand, is an efficient technology for achieving "optimum furrow water velocity," according to a November 2004 report by Texas A&M AgriLife Extension (formerly Texas Cooperative Extension) on *Irrigation in Sugar Cane in Texas*:

> "For uniform distribution and minimal waste, water should flow down the furrow as quickly as possible. As it flows down the furrow, water leaches into and through the soil; the longer water must flow to push to the far end of a field, the more infiltration and the more loss occur. Therefore, so that water will move more quickly, producers should irrigate the fewest possible number of rows at one time, based on the available head. Then when the first rows are finished, the next set of rows can be started, and so on. Such an irrigation strategy requires careful attention. Sometimes, irrigators run large numbers of rows simultaneously, so the water will take longer to reach the other end of the field, allowing irrigation to left unattended for long periods (often overnight).
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> "Surge irrigation uses valves at regular intervals in the irrigation line to divert water flow first in one direction, then the other, directing water into only half the furrows at any one time. Such intermittent quick shots of water seem to seal the soil, with each subsequent shot infiltrating less. While the mechanism of this effect is not known, the benefits of surge irrigation have been proved and are widely accepted."

A report to the U.S. Bureau of Reclamation on a 1993 "Cooperative Agreement for Surge Irrigation Research and Development Program, Grand Valley Unit" provides additional details on how surge valves generate water savings:

> "Surge irrigation has been recognized for a number of years for its ability to enhance irrigation water advance across a field. The principle involves a valve operated by a motorized controller which switches the irrigation water from one side of the field to the other at prescribed times. The first application advances down a short portion of one side of the set before the water is switched over to the alternate side to advance the water the same distance. It is powered by a solar collector attached to a battery and is relatively maintenance free. The number of cycles of alternating the water from one side to the other is dependent upon the soil type, length of irrigation run and the amount of water available for the irrigation. After the initial alternating times (called 'out times') the cycles are decreased in length of time to soaking, or cutback times. At this point, the field should be wetted through to the end and excess water runoff ('tailwater') should be minimized.
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> "Several theories exist as to why surge irrigation works. The most accepted version is that the water may continue to penetrate the soil even after the irrigation water is removed from it; this may result in some soil "sealing" by breaking of some capillary flow and less penetration when the next "surge" of water is applied. Thus, the water may travel further down the furrow with less water applied than if the water had been applied continuously. As a result, vastly improved irrigation efficiencies have been realized by many irrigators and the conclusions have been published in several journals."

ECONOMICS

While significant water savings can be achieved through the use of surge irrigation, there is currently little economic incentive to adopt the technology. In the Rio Grande Valley, the cost of water is too low to justify producers investing up to $2,200 for the valve and meter. Additionally, many districts sell water on a per-irrigation event basis, rather than a per-volume basis, eliminating any financial benefit to reducing water usage.

Water shortages are a growing problem in the region now and will continue to increase in severity as demand grows across water user groups throughout the basin. Increased demand will place upward pressure on the cost of water and provoke greater interest for volumetric pricing. Both scenarios are likely to increase the adoption of efficient on-farm practices, including surge irrigation.

CREDITS

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About Texas AWE

The Texas Project for Ag Water Efficiency (Texas AWE) focuses on affordable and achievable methods for conserving irrigation water through on-farm applications and in-district delivery systems.

Texas AWE was developed and is managed by the Harlingen Irrigation District (HID) with grant funding by the Texas Water Development Board as one of two 10-year Agricultural Water Conservation Demonstration Initiatives in Texas.

Starting in 2004, HID and its project partners have gathered data on ways to manage agricultural water more efficiently. On-farm demonstration sites have proven how new irrigation technologies can conserve water and produce good crop yields, while in-district automation and networked telemetry showcase how water management can support irrigation efficiencies at the farm level.

Project findings are shared on the project website (TexasAWE.org) and at the Rio Grande Center for Ag Water Efficiency through hands-on training and workshops for producers and district personnel. The Center is also the only site in Texas to offer flow meter calibration for producers and other districts.

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