



SURGE IRRIGATION FOR INCREASED IRRIGATION EFFICIENCY

Water withdrawal for irrigation from the Mississippi River Valley Alluvial Aquifer (MRVAA) is occurring at a rate that is depleting the aquifer—i.e., it is not sustainable. Therefore, methods to increase the efficiency of irrigation water application to crops, especially soybeans, are required to curb this over-withdrawal.

Conventional continuous flow furrow irrigation (CONV) is the predominant delivery system for irrigation water that is applied to soybeans grown on the clay-textured soils in the Midsouth. This water delivery is done through lay-flat polyethylene tubing which is attached to a well or riser, and then laid perpendicular to the furrows at the upper end of a field. Holes are then punched in the tubing to allow the continuous flow of water down each furrow. Even though this method allows rapid delivery of water down the furrows, its application efficiency is low. This low efficiency is attributed to deep percolation losses (infiltration exceeds irrigation requirement), tail water runoff at the end of the furrows, and slow wetting advance time.

Surge irrigation (SURGE) is a technique that may improve furrow irrigation efficiency on these clay-textured soils. During SURGE, water is applied intermittently to furrows on each side of the water inlet by alternating a series of relatively short on and off time periods. This intermittent water application is accomplished by using a programmed automated valve which automatically cycles irrigation water between the two sides of the inlet, and results in water moving to the end of irrigated furrows quicker than when applied by continuous flow.

A Univ. of Nebraska article titled “[Surge Valves Increase Application Efficiency](#)” (NebGuide G1868) presents information to guide growers in using Surge Valves to accomplish surge irrigation. Dr. Chris Henry at the Univ. of Ark. and Dr. Jason Krutz at Miss. State Univ. published “[Surge Irrigation Information](#)” that provides definitions of terms associated with surge irrigation, a description of a surge valve and its components and operation, and

how to use surge irrigation on soils with varying texture.

An [article](#) on the Miss. Crop Situation blog site contains a [link to a video presentation that explains the setup and use of a typical surge valve](#). The article also contains helpful points for setting up a surge valve to irrigate both silt/sandy loam soils and clayey soils.

Over the past few years, the MSPB has provided major funding for irrigation projects conducted under the direction of Dr. Krutz [Projects 54 and 55, 2013 through 2016]. Results from the surge irrigation portion of these projects were published in an article titled “[Surge Irrigation Reduces Irrigation Requirements for Soybean on Smectitic Clay-Textured Soils](#)” (Crop, Forage, and Turfgrass Management, Aug. 17, 2017). These results are summarized below.

- Surge irrigation is a technique that may improve furrow irrigation application efficiency on clay-textured soils, the predominant soil type used for soybean production in the region.
- The objective of the research was to determine the effect of SURGE vs. CONV on 1) amount of irrigation water applied to soybean, 2) soybean seed yield, 3) irrigation water use efficiency (IWUE—yield/irrigation water applied), and 4) net return above irrigation costs when used on clay-textured soils in the Delta.
- The research consisted of paired fields, with the same MG IV soybean variety planted on the same date within each year on each of the paired fields.
- Irrigation water was applied to both CONV and SURGE fields through lay-flat poly tubing using computerized hole selection (PHAUCET)
- Irrigation water was applied when the average soil water potential in the 0- to 24-in. soil depth was between -75 and -100 centibars during the R1-R2 to R6.5 growth stages.
- Economic analysis utilized the [Mississippi State Budget Generator](#) for both CONV and SURGE at four different well depths. A constant diesel price of \$2.83/gal. and a constant soybean price of \$11.11 were used for all 3 years of the study. The



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sensitivity of both technologies to differences in diesel price was tested using both a high [\$3.70/gal.] and low [\$1.60/gal.] diesel price.

- Water applied per SURGE event and total water applied using SURGE were reduced by 22 and 24%, respectively, compared to water amounts applied with CONV.
- Water savings with SURGE compared with CONV increased by 2% for each 100 ft. of row length as rows increased from 540 to 1800 ft. long, and the increase was linear.
- Pooled over site years of the study, soybean yield averaged 66 bu/acre when using both CONV and SURGE.
- SURGE improved IWUE by 29% compared to CONV.
- The results show that using SURGE will reduce the time required for any one well to be committed to an irrigation set, thus allowing more acres to be irrigated from the same well.
- The data suggest that 25% of the agricultural overdraft from the MRVAA can be eliminated if SURGE is implemented on CONV-irrigated soybean acreage on clay-textured soils in the region.
- Net returns above irrigation costs were not different between CONV and SURGE regardless of diesel fuel cost or pumping depth. Thus, higher costs for SURGE associated with the purchase of surge valves and associated equipment are offset by reduced water use.

- Conclusions from this research are: 1) A significant portion of the overdraft from the MRVAA can be eliminated by SURGE adoption; 2) SURGE vs. CONV will improve IWUE by soybeans grown on clay-textured soils in the Midsouth without sacrificing yield; 3) SURGE vs. CONV will reduce the time required to irrigate a site devoted to soybeans; and 4) Midsouth soybean producers can adopt SURGE on the shrink-swell clay soils in the region without adversely affecting on-farm profitability because the water savings due to SURGE use will compensate for the increased capital investment required for its implementation.
- Producers are encouraged to use surge irrigation along with irrigation scheduling techniques and computerized hole selection to increase the efficiency of irrigation of soybeans in the Midsouth.

A July 2020 MCS blog article titled “[Surge Valves Update](#)” by Drew Gholson and Dan Roach provides the specifics of using the SURGE water-saving technology on both silt loam and clay soils.

The issue, then, is not how soybean producers can reduce their use of irrigation water, but rather when will they realize that SURGE and other water saving technologies discussed/presented on this website must be adopted now and not later if the MRVAA is to continue as a viable source of irrigation water. To delay will certainly limit the future of irrigation of all crops in the Midsouth.

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