RESEARCH RESULTS PROVE WORTH OF WATER-SAVING TECHNOLOGIES

Publishing results from research, especially that funded by the MSPB, in refereed journals gives final validation to those results because they have been through an initial author and institutional review, followed with a final journal-initiated blind review performed by knowledgeable scientists/specialists in the discipline represented by the subject matter of the published article.

Over the past few years, the MSPB has provided major funding for irrigation projects conducted under the direction of Dr. Jason Krutz [Projects 54 and 55, 2013 through 2016]. In Aug. 2017, results from these projects were published in the online journal Crop, Forage & Turfgrass Management that is part of PMN's product offering. Click "Surge Irrigation Reduces Irrigation Requirements for Soybean on Smectitic Clay-Textured Soils" [**Paper 1**] and "Irrigation Water Management Practices that Reduce Water Requirements for Midsouth Furrow-Irrigated Soybean" [**Paper 2**] to view these publications. A summary of results presented in these two papers follows.

Both papers report results from research conducted under the premises that: 1) groundwater from the Mississippi River Valley Alluvial Aquifer [MRVAA] is the primary source for water that is used to irrigate Midsouth crops; 2) the number of agricultural wells used to pump water from the MRVAA, and thus subsequent water withdrawals from it, have increased significantly; 3) the MRVAA is being depleted by withdrawal that exceeds its recharge rate, thus causing a decline in groundwater levels; 4) the majority of irrigated soybean acres in the lower Mississippi River Valley [Delta] are planted to MG IV soybean varieties that are furrow-irrigated without irrigation water management [IWM] practices using continuous-flow furrow irrigation [CONV]; 5) CONV is the quickest way to move water over a large area, but its application efficiency is only about 55% due to deep percolation losses and tail-water runoff; and 6) the uniform and timely application of irrigation water to soybeans will minimize the amount of water applied, which in turn will conserve MRVAA water and allow for the prolonged continuation of furrow irrigation in the Midsouth.

Results specific to each of the above papers follow.

PAPER 1

- Surge irrigation [SURGE] 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.
- Experiments were conducted on Sharkey clay soil near Stoneville, Miss to determine the effect of SURGE on the amount of irrigation water applied, soybean seed yield, irrigation water use efficiency [IWUE–yield/irrigation water applied], and net return to irrigation.
- Irrigation water was applied to both CONV and SURGE fields through lay-flat poly tubing using computerized hole selection.
- Irrigation water was applied when the average soil water potential in the 0- to 24-in. rooting zone was between -75 and -100 centibars during the R1-R2 to R6.5 growth stages of a MG IV variety.
- 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 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 was 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.
- 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 MRVAA can be eliminated if SURGE is implemented on CONV-irrigated soybeans grown on clay-textured soils in the region.
- Pooled over site years of the study, soybean yield averaged 66 bu/acre when using both CONV and SURGE. Thus, SURGE improved IWUE by 29% compared to CONV.
- CONV had a lower specified cost, but the advantage declines as depth that water is lifted increases.
- 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.
- In conclusion, using SURGE on the large acreage of soybean that is grown on clay-textured soils and irrigated 1) will have no adverse effect on soybean seed yield, 2) will not adversely affect net return to irrigation, 3) will result in less irrigation water being applied and reduce the time to irrigate a given site, and 4) will improve IWUE and thus reduce the decline in the MRVAA.

PAPER 2

- The objectives of the research reported in this article were to determine the effect of IWM practices that included computerized hole selection [CHS–Pipe Planner], SURGE delivery, and sensor-based irrigation scheduling on water use, soybean seed yield, IWUE, and net returns above irrigation costs on a production scale.
- Studies were conducted during the 2013 through 2015 growing seasons on 20 paired fields in the Prairie region of Arkansas and the Delta region of Arkansas and Mississippi. Each set of paired fields [IWM practices and CONV] received the same management practices. Paired irrigation sets ranged in size from 6 to 80 acres.
- Irrigation was applied to IWM fields when the weighted average of soil water potential in the 0- to 24-in. soil depth was between -85 and -100 centibars. Irrigation for IWM fields was terminated when soybean reached the R6.5 stage.
- Enterprise budgets for each site were developed using the Mississippi State Budget Generator. A baseline diesel price of $2.83/gal. and a commodity price of $11.11/bu were used to develop all budgets across the 3 years. To test the sensitivity of the IWM and CONV technologies, minimum [$1.60/gal.] and maximum [$3.70/gal.] diesel prices were used.
- Irrigation water applied to CONV and IWM fields was 11.5 and 9.1 in., respectively, or a reduction of 21% applied to IWM fields.
- Soybean seed yields of 69.3 bu/acre from CONV fields and 68.6 bu/acre from IWM fields were statistically similar.
- IWUE of 9.8 bu/acre-in. of irrigation water in IWM fields was 36% greater than the 7.2 bu/acre-in. of irrigation water in CONV fields.
- Net returns above irrigation costs were not different between CONV and IWM for either of the specified paramaters [four water lifting depths and 3 diesel prices] used in the study.

The results reported in the above two articles show that IWM can be implemented across the Midsouth without adversely affecting soybean yield or on-farm profitability from irrigated soybean production. However, IWM will reduce irrigation water use and improve soybean IWUE, thus prolonging MRVAA sustainability and furrow irrigation capability of soybean in the Midsouth.

The authors surmise that the reported results in Paper 2 are likely very conservative because of the Hawthorne effect, which states that "human subjects of an experiment change their behavior simply because they are being studied". Specifically, they noted in this research that by 2014 50% of the producers scheduled and terminated irrigation for their CONV fields based on recommendations for the adjacent IWM fields on their farms. This may explain why the overall water savings from using IWM in this study were not greater than water savings that have been reported when the CHS, SURGE, and sensor-based irrigation scheduling practices were applied alone.

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