Title: Improving Furrow Irrigation Efficiency

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Background and Objectives

The permitted irrigation limit for Mississippi soybean producers is 18 inches/acre/yr. Modeling data based on climatic conditions over the past decade at Stoneville, MS indicate that irrigation efficiency is one of the primary factors determining if furrow irrigated soybeans will exceed 18 inches/acre/yr. The probability of exceeding the permitted limit for 50, 60, and 70% furrow irrigation efficiency is one out of 2 years, 2 out of 10 years, and 1 out of 100 years, respectively. Based on existing literature, it is likely that the average furrow irrigation efficiency for Mississippi Delta soils ranges from 50 to 60%. Therefore, in order to ensure Mississippi soybean producers do not exceed 18 inches/acre/yr, improved furrow irrigation efficiency is needed.

Surge irrigation is a western irrigation technique with potential to improve furrow irrigation efficiency by 25%. In surge irrigation, a butterfly valve is connected to two separate polypipe lines at the top of the field. The butterfly valve switches water from one line to the other at predetermined intervals. Alternating water between lines causes an intermittent wetting and soaking cycle in the irrigated furrows. The alternating wetting and soaking cycle causes soil particles to seal the furrow surface, reduces the infiltration rate, and facilitates the advance of subsequent irrigation surges. Surge irrigation, therefore, reduces deep percolation losses, increases irrigation uniformity, and decreases runoff losses and total irrigation water applied by up to 50% while maintaining or improving yield relative to conventional furrow irrigation events.

Report of Progress/Activity

Surge evaluations were conducted at the production scale using various approaches. In the first approach, PHAUCET ALONE was compared to SURGE + PHAUCET to determine if surge irrigation could improve irrigation application efficiency on cracking clay soils. Our preliminary data indicate that surge can improve furrow irrigation application efficiency on cracking clays, but improvements in application efficiency are positively correlated with furrow length. For example, water use efficiency was improved by 8%, 20% and 25% for SURGE + PHAUCET relative to PHAUCET ALONE for furrow lengths of 500, 900, and 1300 ft, respectively. A 25% reduction would translate into eliminating one irrigation event with a diesel fuel savings of approximately $10.00 acre/yr.
In the second approach, surge valves were evaluated on the production scale in an extension format to determine the potential for surge to overcome problems associated with low well capacity, long furrow runs, and surface sealing. In this case the producer could not irrigate a 20 acre field in less than 4 d because the flow rate was 500 gallons/min, furrow lengths were 1800 ft, and the soil was a Dundee silt loam, which has a tendency to seal. The surge valve reached the tail ditch in 24 hr and the soak cycle ran an additional 24 hr. Moreover, surge irrigation reduced yield variability at the field scale and improved yield by 7%.

In the final approach, surge irrigation + PHAUCET + soil moisture sensor scheduling was compared to production sets with no irrigation water management strategy. The combination of these three tools reduced water use in soybean on a cracking clay by 40% while maintaining yield potential and profitability.

**Impacts and Benefits to Mississippi Soybean Producers**

This research will impact approximately 1.2 million irrigated soybean acres in the Mississippi delta and the hills. Eliminating one irrigation would save Mississippi soybean producers approximately $12,000,000/yr.

**End Products-Completed or Forthcoming**

The five most important outputs where these results were presented include 1) Memphis Gin show invited talk; 2) 7 irrigation symposium talks conducted for MSPB and Mississippi Farm Bureau; 3) Conservation Tillage Meeting invited talk; 4) Agricultural Expo invited talk, and 5) Eight county extension talks.