Developing Irrigation Management Strategies for Soybean Production in the Southern US

2019 Final Report

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Work Conducted During 2019:
The Soybean App was released for public use and became available at no cost from both the Apple and Google Play stores on 01 April 2019. Since then, the App has been downloaded by 28 iOS and 52 Android users who have registered and used the App on 65 fields. From the past three years of research, we recognized that to operate at peak efficiency, the Soybean App requires accurate precipitation data. Data from nearby weather stations or from commercial vendors of gridded weather data such as Dark Sky provide accurate temperature data but because the summer convective thunderstorms that typically occur in Georgia are highly variable, they do not provide accurate precipitation data. To overcome this problem, the Soybean App was updated to allow grower-owned, in-field automated rain gages to provide the daily precipitation data needed by the App. Two brands of rain gages are currently supported – the iMetos Eco D3 by Pessl Instruments and the Trellis system. The Trellis system contains a Davis Rain Collector rain gage. Precipitation data from the rain gages override precipitation data from weather stations or Dark Sky. Figure 1 shows how the rain gages are selected in the App. After analyzing data from the 2018 growing season, we realized that we needed additional data before incorporating crop coefficient curves for maturity groups 4, 5, 6, and 7 into the Soybean App. Consequently, the curves were not incorporated into the Soybean App prior to its public release in April. The curves will be incorporated into the Soybean App following the 2019 growing season and made available for use with an update prior to the 2020 growing season.

We continued to evaluate the performance of the Soybean App with research plots and on-farm trials. The replicated plot study was conducted at UGA's Stripling Irrigation Research Park (SIRP) where we evaluated the performance of the four irrigation treatments and a rainfed control on Group VI soybeans (Figures 2 and 3). Soybeans were planted on 07 May 2019 and harvested on 20 November 2019. Irrigation was terminated on 14 September 2019. There were 18.7 in of rain during this period. The irrigation treatments compared the App to the UGA Extension checkbook method and two sensor based treatments (SS1 and SS2 in Figure 2). The sensor-based treatments used different soil water tension (SWT) trigger points before and after flowering. Nineteen sensors were installed to monitor SWT in the soil profile of the treatments. Since 2018 data from SIRP were not available at this time last year, Table 1 shows the results from both the 2018 and 2019 SIRP studies. The 2019 growing season had several extended periods without rain and thus more irrigation water was used than in 2018. In both years, the highest yields were obtained using irrigation scheduling methods other than the App. The App yields were not statistically significantly different from the yields obtained by scheduling irrigation with checkbook method. However, the checkbook method required 8.6 in and 6.3 in more irrigation than the App method in 2018 and 2019, respectively. Both sensor-based treatments had yields significantly lower than the checkbook and App in 2019. It is not clear why the sensor methods resulted in lower yields during 2019 when in 2018 and in the three years prior, they equaled or outperformed the App. We are currently evaluating the timing of the irrigation events from each of the methods to determine their effect on yield. Irrigation water use efficiency (IWUE) or how much additional crop was produced per inch of irrigation water used was statistically significantly higher for the App in both years.

On the UGA Tifton campus, we compared irrigation scheduling and yields on two small research fields – one scheduled using the App and the other scheduled using the farm manager's scheduling method. The results are shown in Table 2. The field irrigated by the App resulted in higher yield, slightly lower water use, and higher IWUE. Results over the past several years indicate consistently that the App performs well and can be a reliable irrigation scheduling tool for growers.

We also continued on-farm testing of the Soybean App with two soybean growers in Georgia and the Georgia Extension county agents who advise them. Grower 1 farms in Wilcox County and Grower 2 in Colquitt County. The grower and county agent selected one pivot-irrigated field in Wilcox County and two adjacent pivot-irrigated fields in Colquitt County. We divided each field in half. One-half was irrigated using the grower's standard irrigation schedule while the other half was irrigated using the Soybean App schedule. Both halves were instrumented with three UGA SSA probes to benchmark actual soil moisture conditions under both irrigation scheduling methods. We installed automated wireless rain gages in both fields so that we could accurately input rain received into the App. We used aerial images and NRCS soil maps to identify soil variability within the field and installed the probes to capture as much of this variability as possible (Figures 4-5). Both fields were harvested in late November but we have not yet processed the yield data from the yield monitors installed on the growers' combines.

Table 1. Results of the scheduling study conducted at SIRP during 2018 and 2019.

	2018[1]			2019[2]		
Irrigation Treatment	Yield (bu/ac)	Irrigation (in)	IWUE[3] (bu/ac-in)	Yield (bu/ac)	Irrigation (in)	IWUE (bu/ac-in)
Checkbook	67.5[b]	11.6	5.8[c]	75.4[a]	17.2	2.9[c]
Soybean App	64.3[b]	3.0	21.4[a]	71.0[a]	10.9	4.7[a]
SSA1	70.3[a]	7.0	10.0[b]	60.3[b]	9.3	4.2[b]
SSA2	65.7[a]	4.1	15.9[b]	65.1[b]	11.0	3.9[b]
Rainfed	57.4[c]	0.0	-	32.4[c]	2.6	-

[1]Rain received during the growing season was 33.8 in.
[2]Rain received during the growing season was 18.7 in.
[3]IWUE = how much additional crop was produced per inch of irrigation water used

Table 2. Results of the scheduling study conducted at the UGA Tifton campus in 2019.

Irrigation Treatment	Yield (bu/ac)	Irrigation (in)	IWUE[1] (bu/ac-in)
Soybean App	74.9	11.2	6.7
Farm Manager	52.4	13.8	3.8

[1]IWUE = how much additional crop was produced per inch of irrigation water used

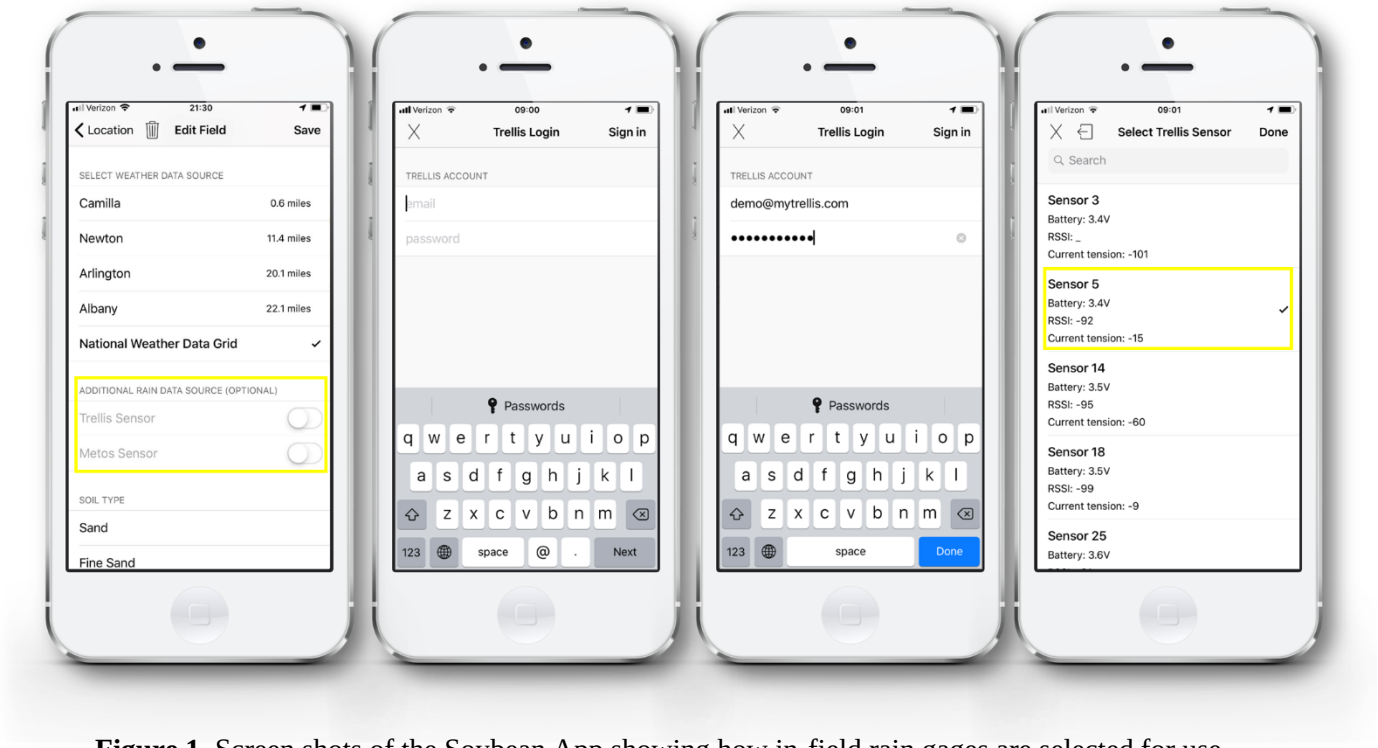

Figure 1. Screen shots of the Soybean App showing how in-field rain gages are selected for use. Login credentials for the rain gage supplier are needed for the Soybean App to have access to the data.

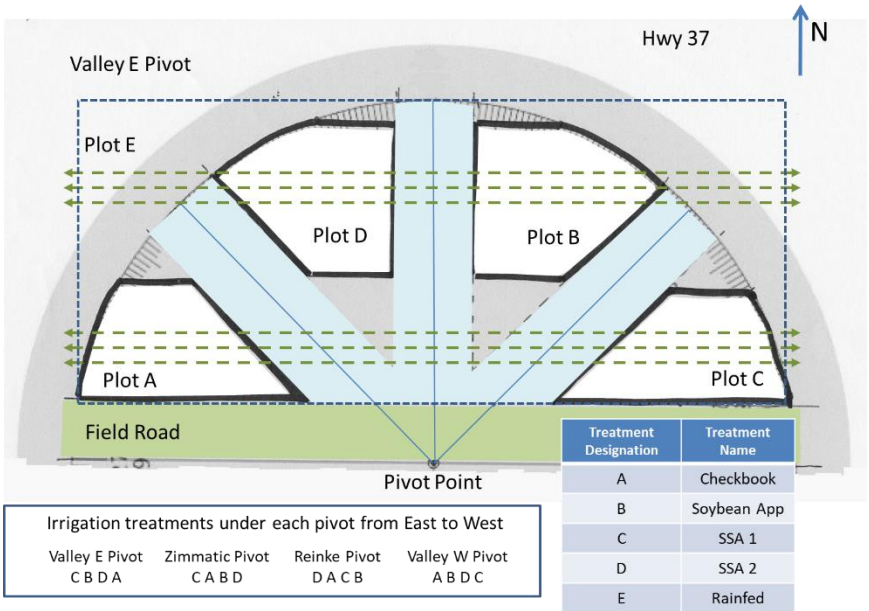

Figure 2. Experimental design of the replicated irrigation study at the Stripling Irrigation Research Park (SIRP). The layout shown in the figure was repeated under four one-tower pivots for a total of 16 irrigated plots. The areas outside the wetted circle of the pivots were used for three rainfed plots.

Figure 3. Aerial view of the plots at SIRP showing the location of UGA SSA probes installed in the plots. Three of the four plots of each irrigation scheduling treatment were instrumented with probes.

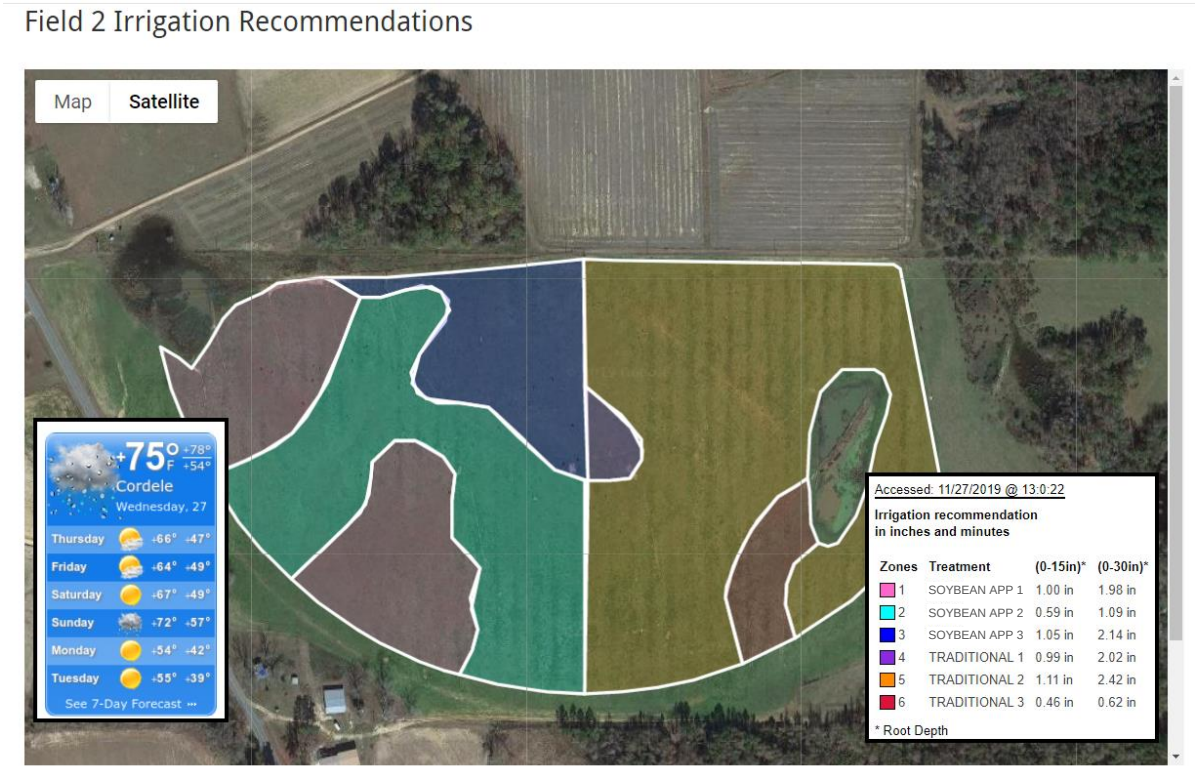

Figure 4. The Grower 1 field in Wilcox County Georgia. Irrigation in the western (left) half of the field was scheduled using the Soybean App. The grower used his standard method in the eastern (right) half. The colored areas indicate zones with different soil types. Irrigation recommendations are based on soil moisture sensor data from the UGA SSA probes but were not used.

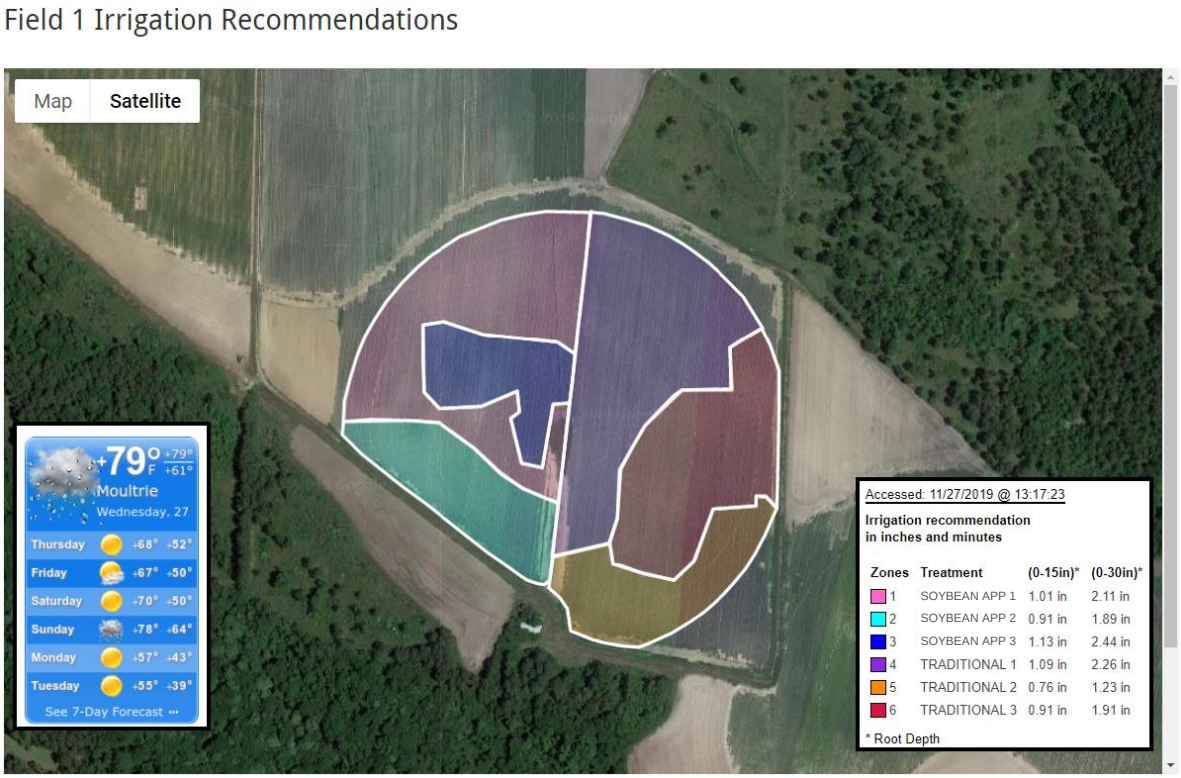

Figure 5. One of the two Grower 2 fields in Colquitt County Georgia. Irrigation in the western (left) half of the field was scheduled using the Soybean App. The grower used his standard method in the eastern (right) half. The colored areas indicate zones with different soil types. Irrigation recommendations are based on soil moisture sensor data from the UGA SSA probes but were not used.