Incorporating Volumetric Water Content (Capacitance) Sensors into the Irrigator Pro-Based Irrigation Scheduling Tool – Final Report

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Objective

The most current version of Irrigator Pro developed by Co-PI Butts uses soil matric potential measured with soil moisture sensors at 8, 16, and 24 inches to estimate the plant available soil water in the soil profile. This limits the model's use to sensors that can measure soil matric potential. These types of sensors are marketed by a limited number of vendors. The **objective** of this proposal was to modify the model to accept data directly from volumetric water content (VWC) sensors that are also referred to as capacitance sensors. These are the most common sensor-type on the market and some have excellent telemetry systems that ensure reliable delivery of data to the cloud server.

Work Completed in 2021

During 2021, we conducted a replicated plot study at UGA's Stripling Irrigation Research Park (SIRP) and the USDA ARS Hooks-Hanner Environmental Research Center (HERC) to compare irrigation scheduling with VWC sensors to the existing versions of the model (Figure 1). Specifically, irrigation was scheduled using sensors and the soil temperature and soil matric potential version of Irrigator Pro. Scheduling methods were: UGA SSA (irrigation triggered with a matric potential threshold); VWC (irrigation triggered with VWC threshold using Sentek drill and drop capacitance sensors); Irrigator Pro (Temp) (model uses soil temperature and precipitation); Irrigator Pro (UGA SSA) (model uses matric potential data); and Rainfed (no irrigation except to promote germination and activate herbicides). 2021 was a rainy growing season with 679 mm of precipitation and about 20% of the usual irrigation was applied. Results are shown in Table 1. The most efficient irrigation method was scheduling with VWC sensors although the rainfed treatment outperformed all irrigation scheduling treatments.

Figure 1. Sentek VWC sensor (a) and UGA SSA matric potential sensor (b) installed in peanut plots. Peanut harvest with bagging combine (c) and weighing of bags to determine plot yields (d).

Table 1. Irrigation scheduling treatments results from SIRP.

Treatment	Yield (kg ha^{-1})	Irrigation (mm)	IWUE* (kg ha^{-1} mm^{-1})
UGA SSA (matric potential)	6604 [a]	73.7	173
VWC (Sentek sensors)	6479 [b]	54.6	340
Irrigator Pro (Temp)	6444 [b]	130.8	68
Irrigator Pro (UGA SSA)	6509 [a]	111.8	85
Rainfed	6779 [a]	35.6	–

Economic Significance and Project Deliverable

The deliverable of the project is a version of Irrigator Pro that is capable of reading data from multiple sensor types. This will allow Georgia peanut growers who use the model with greater flexibility and allow them to improve their irrigation water use efficiency, increase yields, and increase profitability.