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2009-2010 WREC Peanut Subsurface Drip Irrigation (SDI) Demonstration Report

General Description

A sub-surface drip irrigation (SDI) demonstration was installed on the Wiregrass Research Center in Headland, Alabama in late spring/early summer 2009. The site has slightly rolling topography with one or two terraces and is visible from State Highway 134. Growers will be able to visit this location throughout the year and see how subsurface drip irrigation works on the light sandy soils of Southeast Alabama. Six plots, each 950 feet long by 48 feet wide, were established for a three year irrigated and rainfed (dry land) rotation of corn, cotton, and peanuts. The six plots are grouped into three, 2-plot blocks. Each block has a 16 row rainfed (dry land) plot and a 16 row irrigated zone. Each irrigation zone has 15 mil drip tape lateral buried between every other row at 15 inches deep (eight drip laterals per irrigation zone). John Deere Auto Steer was used during installation to allow future drip tape location. With 0.26 GPH emitters spaced every 2' along tape length, design tape flow rate was 0.0022 GPM/foot. Each 1.07 acre irrigated zone requires 16.81 GPM (15.73 GPM/acre). Irrigation water is supplied by a 3-hp submersible pump with pressure tank control, installed in a farm pond approximately 1/2 mile from the site. A 2-inch time and pressure automatic cleaning filter provides clean water to the three irrigated zone control heads. An irrigation controller for zone control, a Watermark Monitor with Watermark soil moisture sensors and zone pressure monitors, and a tipping bucket rain gauge were installed. A low power field radio was connected to the Watermark Monitor to allow remote reading of received rain, soil moisture, and irrigation operation from a desktop computer located in the WREC offices about 1200 feet away.

MoisMis2020, an Xcel-based irrigation scheduling program using crop growth curves, rainfall, and Watermark soil moisture feedback was to be used to schedule irrigation for the three crops. Soil Moisture deficit is calculated within MoisMis2020 as a running "to date" accumulation using crop water use curve values as positive and daily rainfall and irrigation as negative. Soil moisture feedback from a 9" and 18" sensor is used to calculate actual soil moisture deficit. The running total deficit is compared to actual and adjusted using internal algorithms that vary with rooting depth throughout the season.

This publication reports on rainfall, irrigation, and peanut yield results from the first two years of this WREC SDI demonstration operation.

2009

Drip tape laterals were installed April 23 but installation of manifolds, control station, main lines, and pond water pumping station occurred over the next two months. Georgia 06G peanuts were planted May 13. MoisMis2020 was started with a 140 (one-forty) day *peanut crop water use* curve. System start-up problems and equipment delivery delays prevented installation of the tipping bucket rain gauge, system water pressure monitors, low power radio link, and soil moisture sensors until August 5, 84 days after planting (DAP). The installed irrigation controller failed early June and irrigations were manually controlled based on MoisMis2020 (without soil moisture feedback until well into the season). Peanut harvest was October.

Figure 1 shows the magnitude and distribution of **56 rainfall events (**shown in **red)** totaling **24.87**". There were 11 **irrigation events (**shown in **blue)** totaling **8.57"** during this same period (May 13 – September 30.).

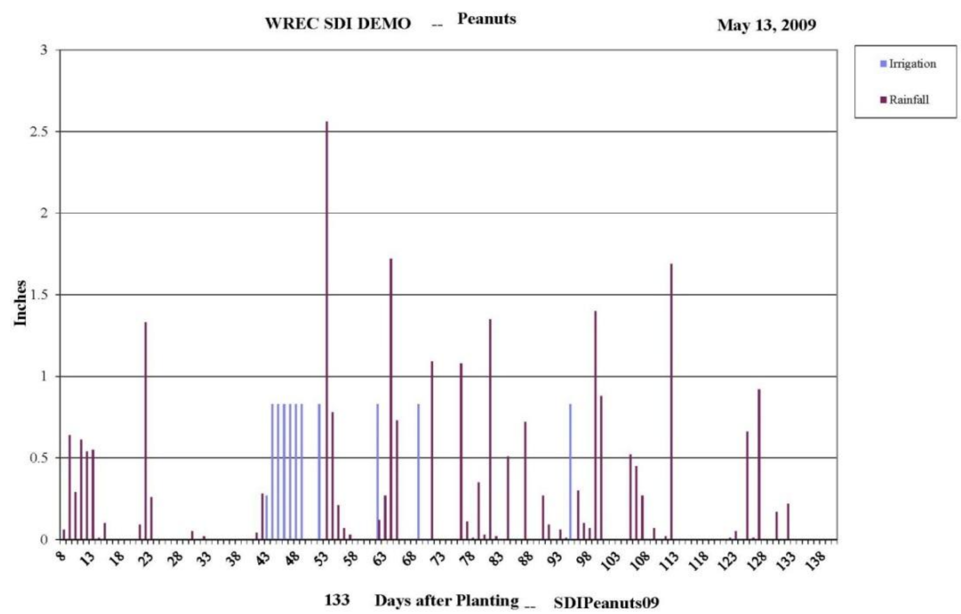

Figure 1 - 2009 Rainfall and Irrigation for WREC SDI Peanut Demo

The **24-52 DAP** period of **EarlyFlowers** and **EarlyPegging** was unusually dry with **only .39" total** rain and, with no soil moisture feedback, MoisMis2020 soil moisture deficit ran extremely high. The first irrigation occurred June 25 (43 DAP).

Seven irrigations followed until a 2.56" rain at **EarlyPodSet** (53 DAP). In the next 60 days, 17.96" rain fell in 34 events. From **EarlyPodSet** to season end, rainfall kept soil moisture deficit below the MoisMis2020 50% Available Moisture Irrigation Trigger of Dothan Sandy Loam. Last irrigation was August 16 (95 DAP).

The **Rainfall-Only Seasonal Soil Moisture Deficit** for the 2009 SDI Peanut Demo is shown in **Figure 2A**.

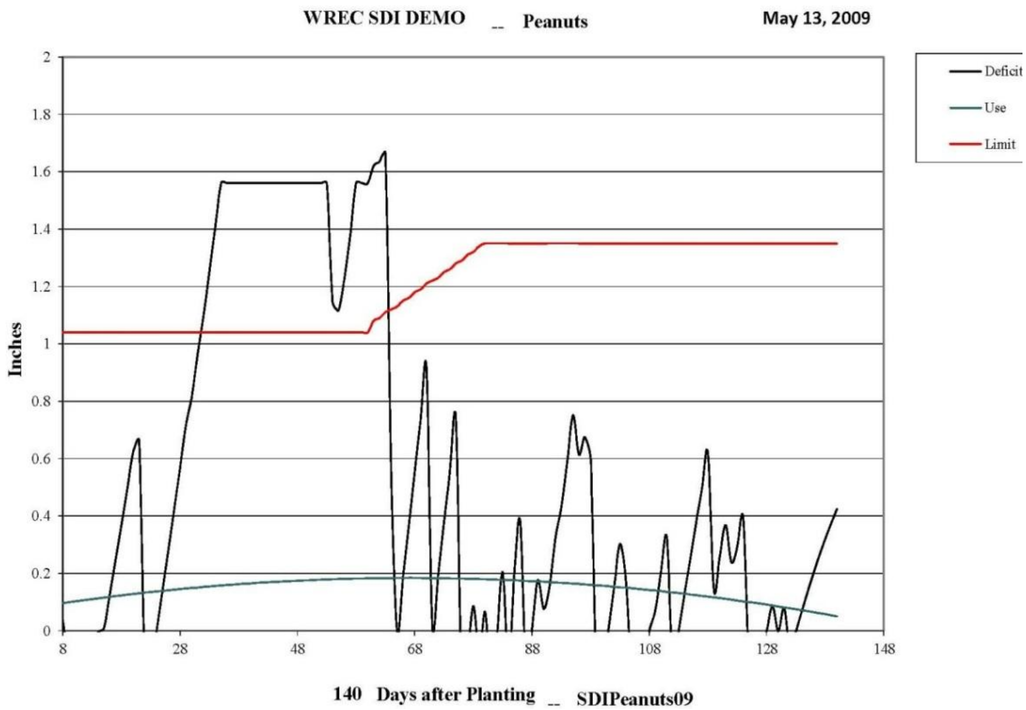

Figure 2A - 2009 SDI Peanut Demo Season RAINFALL-ONLY Soil Moisture Deficit

Figure 2B, 2009 SDI Peanut Demo Season IRR Soil Moisture Deficit shows that the 8.57" of irrigation by SDI

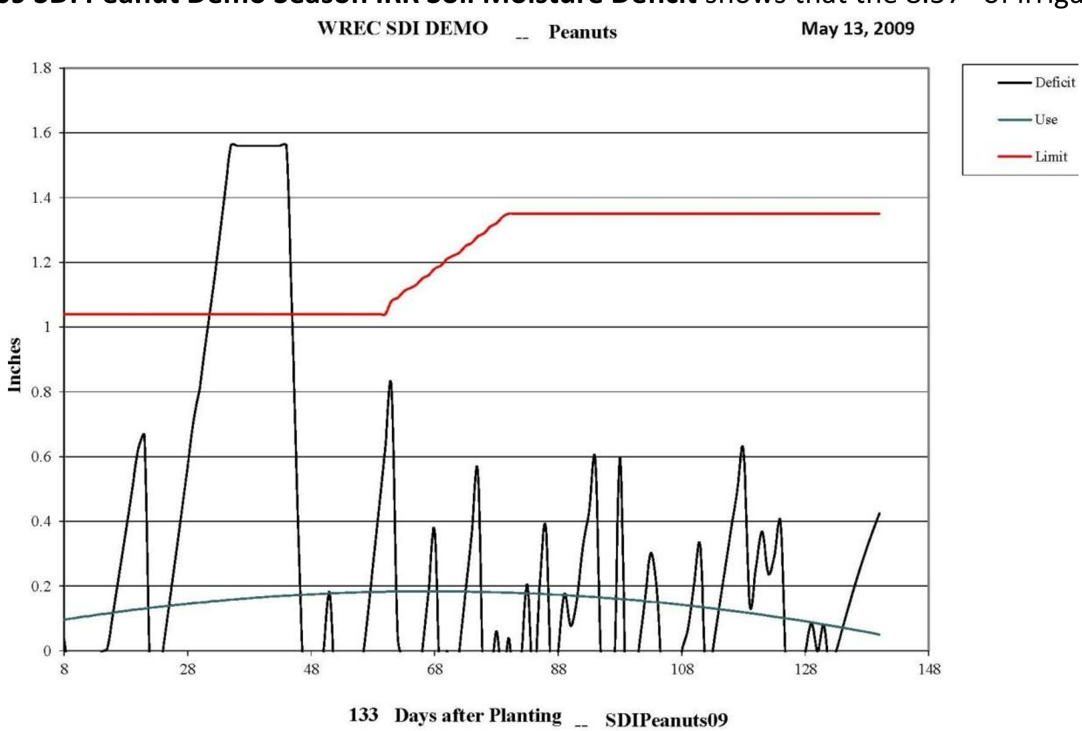

Figure 2B - 2009 SDI Peanut Demo Season IRR Soil Moisture Deficit 2010

only reduced the number of days of soil moisture deficit below the irrigation trigger (Limit) by 18 days early season.

2010

Georgia 06G peanuts were planted May 18. MoisMis2020 was started soon thereafter. A replacement controller was installed the last of May, but automatic control still failed and again, all irrigations were operated manually. Soil moisture sensors were installed June 7 within 30 days after planting as recommended by MoisMis2020. Peanut harvest was October.

Figure 3 shows the magnitude and distribution of **37 rainfall events (**shown in **red)** totaling **12.88".** There were **24 irrigation events (blue)** totaling **17.34",** during this same period (May18 – September 29). The first occurred July 8 (51 DAP). Last irrigation was September 14 (119 DAP).

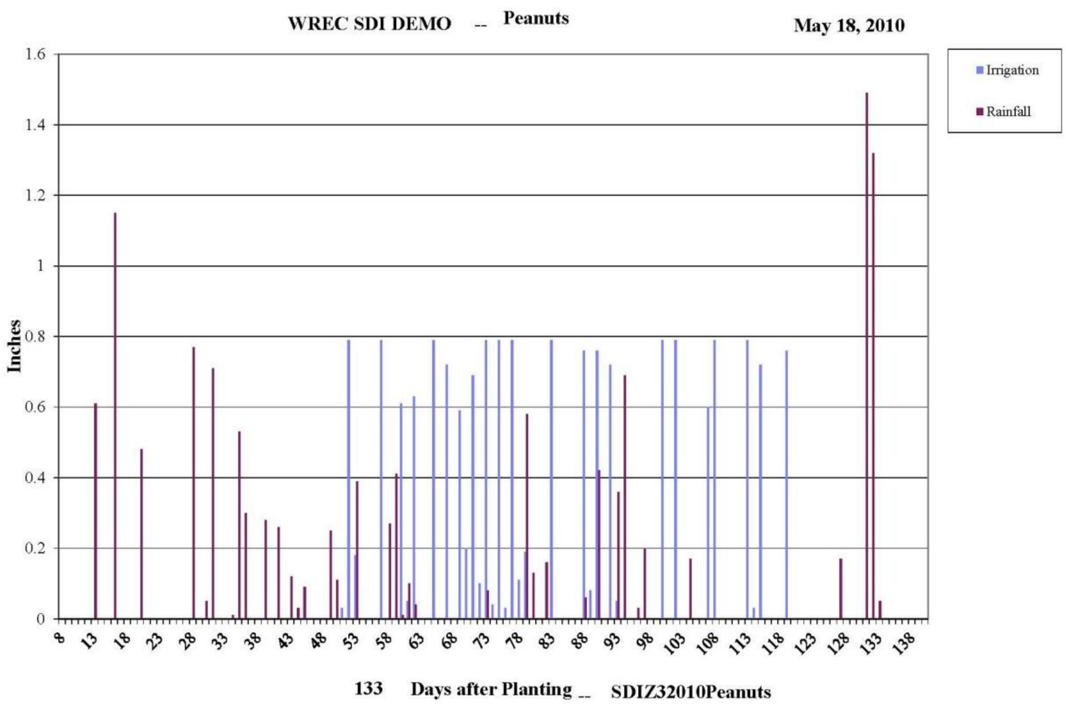

Figure 3 - 2010 Rainfall and Irrigation for WREC SDI Peanut Demo

The **Rainfall-Only Seasonal Soil Moisture Deficit** for the 2010 SDI Peanut Demo is shown in **Figure 4A** below. The **2010 Irrigation Seasonal Soil Moisture Deficit** is shown in **Figure 4B**. Red line indicates the 50% Available Water Holding Capacity (AWC) of the Dothan Sandy Loam used as the irrigation trigger in MoisMis2020.

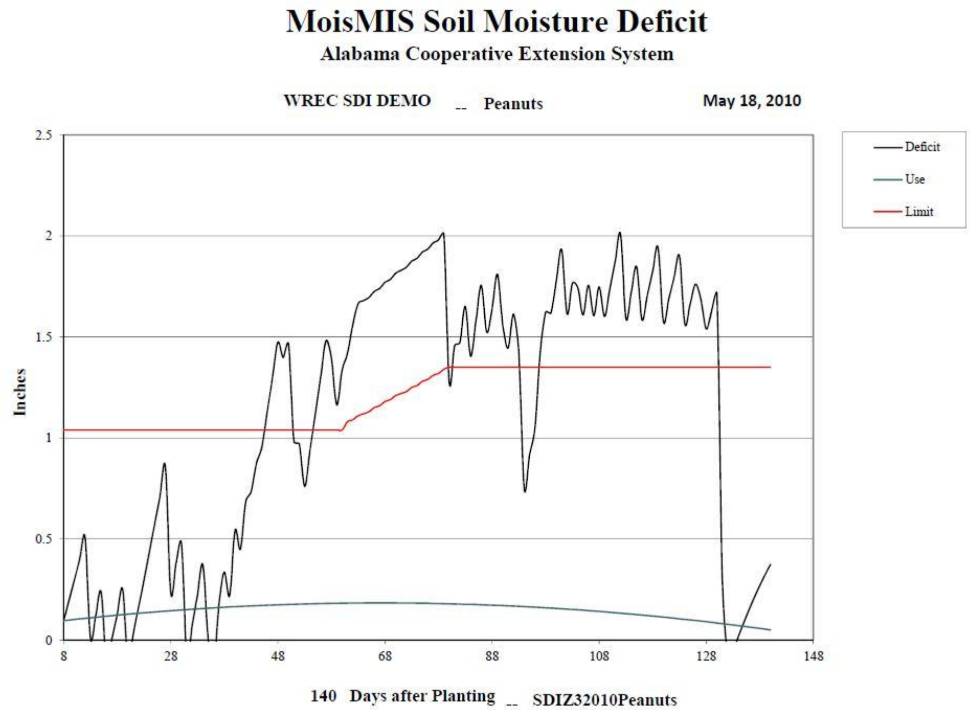

Figure 4A - 2010 SDI Peanut Demo Season RAINFALL-ONLY Soil Moisture Deficit

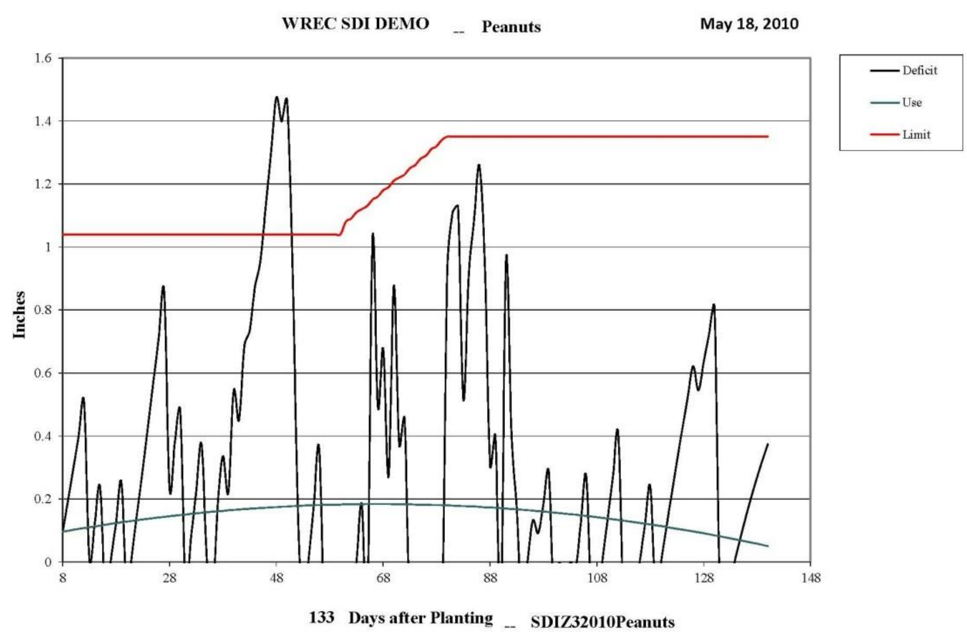

Figure 4B - 2010 SDI Peanut Demo Season IRR Soil Moisture Deficit

Figure 4B shows that the 17.34" of irrigation by SDI beginning July 8 kept soil moisture deficit below the irrigation trigger (Limit) the rest of the season.

Yield Results from Rain and Irrigation

There were four checks within each treatment each year. These checks were compared and averaged to give the final rainfall only (dryland) and irrigated peanut yield. Yearly irrigated yield increases are shown in red in table below.

Year	Plant Date	Rain (#) Total	Irrigation (#) Total	Yield (Lb/Acre)
2009	**May 13**	**(56) 24.87"**	**-**	**5,850**
		(56) 24.87"	**(11) 8.57"**	**5,895 (+45 IRR)**
2010	**May 18**	**(37) 12.88"**	**-**	**2098***
		(37) 12.88"	**(24) 17.34"**	**4795* (+2697 IRR)**

*calcium deficiency discovered mid- to late 2010 season causing "pops" and reduced yield

For these two years, one with typically adequate rainfall and one with typically inadequate rainfall during the peanut season, average **Rainfall-Only yield was 3974 pounds/acre**. Average subsurface drip irrigated **(SDI) yield was 5345 pounds/acre**. This is a 1**371 pound increase (35%) with SDI**.

Conclusion

Critical periods for soil moisture for 152-day peanuts are given in the table below, from "Management and Cultural Practices for Peanuts", Wright, et.al.

Week of Growth	Growth Stage	Water Requirements
Week 1 to 2 (7-14DAP)	Planting to emergence	Moderate
Weeks 3-8 (15–56DAP)	Emergence to flowering/pegging	Low
Weeks 8-15 (56-105DAP)	Flowering/pegging and pod formation	High
Weeks 16-22 (112-152DAP)	Pod formation to maturity	Moderate

These growth stage water requirements hold for 140-day peanuts also, although growth stages are somewhat shorter. Response to the presence or absence of available soil water was noted throughout the two growing seasons of this demonstration. ***Greatest difference is soil moisture was observed during the critical "Flowering/pegging and Pod Formation" period, typically 7 to 14 weeks in the mid-season peanut growth stage of 140-day peanuts.*** The 140 day peanut crop water use curve in MoisMis2020 calls for 0.61" of rain/irrigation during "Plant/ Emergence" (0-14 DAP). From "Emergence to Flowering/Pegging" (15-49 DAP), curve call is 5.9". **The critical "Flowering/pegging and Pod Formation" period curve call is 9.6",** and for the balance of the season, "Pod Formation to Maturity", only 3.8". *This is a total season call of around **19.9" net** soil water with **57% (9.6") during Flowering/ Pegging and Pod Formation.***

Even though a 30 day period with little rain occurred early in the 2009 season, the first 49 DAP got 4.87" of rain *(75% call),* **the "Flowering/pegging and Pod Formation" period received 12.66" rain *(132% call)*,** and the "Pod Formation to Maturity" period got the remaining 7.34" *(193% call)* of the 24.87" total rainfall. **5.25" of**

SDI (of 8.57" SDI total) brought the **total "Flowering/pegging and Pod Formation" water to 15.98"** ***(166% call)*** and **added only 45 lb/acre yield** above Rainfall-Only yield.

With the 2010 crop, rainfall started out well. The first 49 DAP got 5.64" of rain *(96% call*), but the critical **"Flowering/ pegging and Pod Formation" period received only 4.04" rain** ***(42% call).*** The "Pod Formation to Maturity" period got the remaining 3.2" *(84% call)* of the 12.88" total rainfall. **12.07" of SDI** (of 17.34" SDI total) brought the **total "Flowering/pegging and Pod Formation" water to 16.11"** ***(168% call)*** and **added 2465 lb/acre yield** to the Rainfall-Only yield.

These results suggest that as long as the critical high water requirement of **around 10" for the "Flowering/ pegging and pod formation" growth stage** is satisfied, **water received is not a limiting factor** for excellent peanut yield and that **SDI systems can provide this water adequately**.

Closer attention to manual soil moisture feedback or automatic soil moisture feedback control might have reduced applied irrigation 2009 early season and 2010 mid- to late- season in this demonstration. Equipment problems contributed to apparent over-irrigation during these periods, though not to apparent excellent yield response from SDI irrigation.

SDI appears to work well in slightly rolling Dothan soils in the Wiregrass. These first two years of large-plot SDI irrigation at the Wiregrass Research and Education Center in Headland have demonstrated the **ability of timely applications of irrigation water using a permanently buried drip tape system to produce SDI yields 135% of typical rainfed (dryland) peanut yield**. A soon-to-follow life-cycle economic analysis based on WREC SDI Demo yields and installed and operational costs should highlight accompanying economic advantages of small-field SDI irrigation in the Wiregrass.

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