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Final Report
NATIONAL PEANUT BOARD/SOUTHEAST PEANUT RESEARCH INITIATIVE

QUARTERLY PROGRESS REPORT FOR WORK DONE UNDER RESEARCH AGREEMENT____________________________

INSTITUTION: University of Georgia

PROJECT TITLE: Comparing Water Use Efficiency of Various Irrigation Methods Used for Peanut Production

RES. AGR. NO.: PROJECT LEADER: Gary L. Hawkins

GACCP Budget No.:

EXPIRATION DATE: June 30, 2015 NPB CONTACT: Bob Parker/Maria Mehok
NPB Budget No.: 395

REPORT OF PROGRESS:

Introduction:
The group working on this project consisted of persons from Georgia (Gary Hawkins and Nathan Smith) along with persons from Alabama (Kris Balkcom and Jessica Kelton). The project was set-up to look at the use of various tillage practices (conservation verses conventional) to determine the water los rate in both systems. We also looked at the use of no-irrigation, overhead irrigation and sub-surface irrigation. So the following procedures were used to gather the needed data.

Methods and Locations:
The sites used for the project are shown in the Table below:

County/Location:	Site Number:	Growing Condition:	Irrigated or Not:	Soil Type:
Tift County	1	Conventional Tillage – Single row	Irrigated	Tifton Loamy sand (TfB)
Tift County	2	Conventional Tillage – Double row	Irrigated	Tifton Loamy sand (TfB)
Tift County	3	Strip Tillage – Single row	Irrigated	Tifton Loamy sand (TfB)
Tift County	4	Strip Tillage – Double row	Irrigated	Tifton Loamy sand (TfB)
Worth County	1	Conventional	Irrigated	Tifton Loamy sand (TfB)
Worth County	2	Conventional	Non-Irrigated	Tifton Loamy sand (TfB)
Jenkins County	1	Strip Tillage – 15+ years – Heavy	Irrigated	Tifton loamy sand (TqB)

		Residue		
Jenkins County	2	Strip Tillage – 15+ years– Heavy Residue	Irrigated	Dothan loamy sand (DaB2)
Bulloch County	1	Strip Tillage – 15+ years– Heavy Residue	Non-Irrigated	Tifton loamy sand (Edge of TqB and TqA)
Bulloch County	2	Strip Tillage – 15+ years– Heavy Residue	Non-Irrigated	Tifton loamy sand (TqB)
Henry County, Alabama	1	Strip Tillage – 10+ years – Very light Residue	Sub-surface drip irrigated	Dothan fine sandy loam (DoA)
Henry County, Alabama	2	Strip Tillage – 10+ years – Very light Residue	Non-Irrigated	Dothan fine sandy loam (DoA)
Henry County, Alabama	3	Strip Tillage – 10+ years – Heavy Residue	Non-Irrigated	Dothan fine sandy loam (DoA)
Henry County, Alabama	4	Strip Tillage – 10+ years – Heavy Residue	Sub-surface drip irrigated	Dothan fine sandy loam (DoA)
Henry County, Alabama	5	No-Tillage – 10+ years – Heavy Residue	Non-Irrigated	Dothan fine sandy loam (DoA)
Henry County, Alabama	6	No-Tillage – 10+ years – Heavy Residue	Sub-surface drip irrigated	Dothan fine sandy loam (DoA)

At all locations, soil moisture sensors were installed at depths of 4, 8 and 12 inches below soil surface. Two sets were installed 30 feet apart with a temperature sensor placed with one set of soil moisture sensors. The soil moisture sensors used for the 2014 growing season were the resistance type sensors made by WaterMark (the mention and use of any specific sensor type or brand does not indicate endorsement of that specific product by either the University of Georgia or auburn university). During the 2015 growing season (after the time frame of the grant, but since the sensors are still usable they have been installed) a second type sensor which uses capacitance instead of resistance have also been installed in conjunction with the Watermark sensors. Data was downloaded from the Watermark dataloggers approximately every couple weeks. The collected data was used at the end of the season to calculate a rate of soil moisture loos from the soil profile under different tillage and irrigation methods.

Results and Discussion:

At the end of the 2014 growing season the total dataset was reviewed and a few times in all dataloggers the data was missed. However, there was enough data to access the rate of water loss from the different tillage and irrigation plots. Specifically, the data to determine the rate of soil moisture loss was restricted to that growth stage corresponding to a DAP between 90-120 days. This is the time on the water use curve just after the rapid flowering period and time of highest water requirements.

Data was collected and stored every hour throughout the growing season. This data was used to calculate a rate of soil moisture loss. The Watermark sensors, being a resistance sensor, provides output in terms of kPa of tension. Therefore, the resulting rate calculated is in terms of kPa per hour of loss. The data was analyzed as a result of two different conditions, those being a wet and a dry. Wet conditions were defined by a tension reading between 0 and 50 kPA while a dry condition was defines ass anything above 80 kPa.

Data indicates that conservation tillage systems retains water better than that of conventional tillage systems. Retention is defined here as a lower rate of soil moisture loss rate.

It can be seen in Figure 1 below all of the sites ass compared against each other. Individual locations are presented in the Appendix.

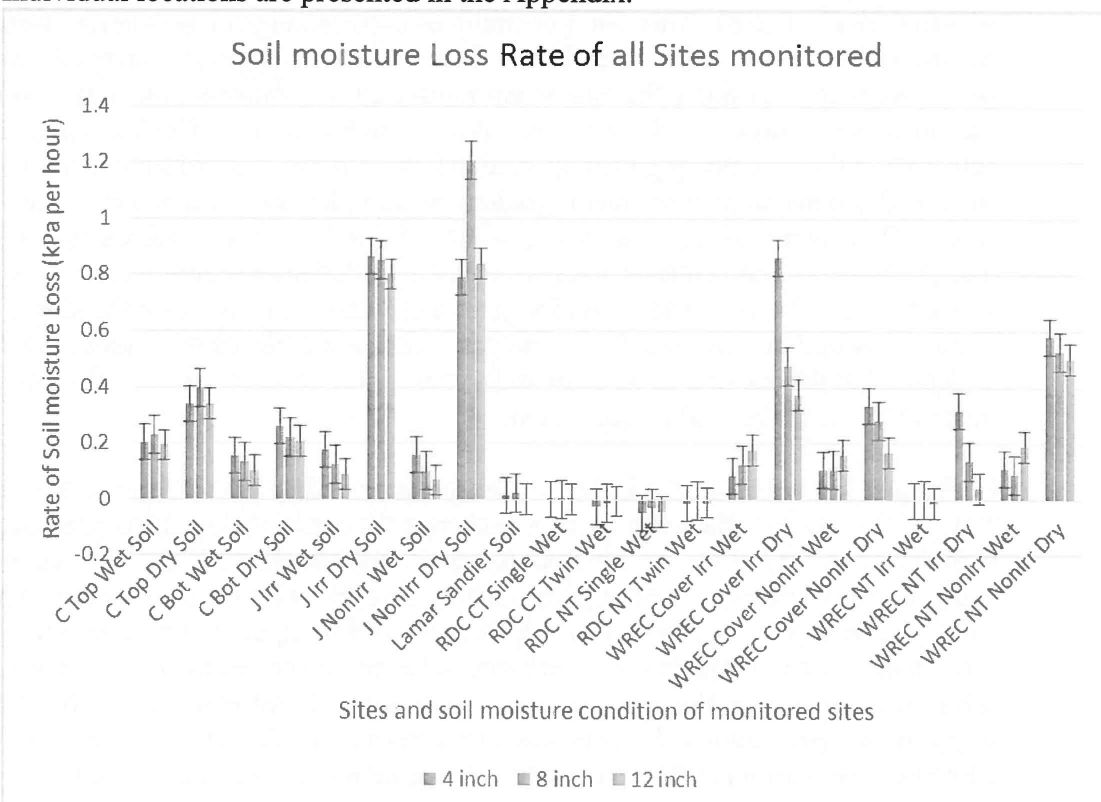


Figure 1. Soil moisture loss chart for all locations where data was colected.

As can be seen on this graph, the systems that loss water the fastest or at the highest rate was the conventional system when the soil was dry (above 80 kPa). This occurred on both the irrigated and non-irrigated conventional fields (labelled as "J Irr" and "J NonIrr"). Likewise, the sub-surface non-irrigated no-till system (WREC NT NonIrr) had a high rate of soil moisture loss. One of the surprising high rates was from the sub-surface irrigated site (WREC Cover Irr Dry) where "Cover" indicates a cover crop was used during the non-growing portion of the year.

From the same graph, it can be seen that the "C Top Dry Soil" site, which is a dryland non-irrigated site using conservation tillage had a soil moisture loss of 0.4 kPa per hour which is three times less than that of the conventional tilled non-irrigated site (J NonIrr Dry Soil). For the "C" site which is located in Bullock County, the Bottom of the hill location (C Bot) had a slightly less rate of soil moisture loss, but not significantly different than the top of the hill in that field (C Top). The graph also indicates that the rate of soil moisture loss between the "wet' soil and the "dry' soil on the Bullock county site (C Top and C Bot) is not significantly different at any level in the two different locations (top and bottom of hill). This also indicates that even under dry conditions as measured by the tension of the soil, conservation tillage systems loss water at a slow rate.

The other interesting data collected for this project is that from the Tifton site (RDC). At this site, the peanuts were planted in two different configurations and tillage types. They were planted in single and twin row under both conservation and conventional tillage systems. As can be seen on the graph, the soil moisture was actually increasing (here a negative loss is a gain). This can potentially be explained by a few different factors that we are unable to fully determine. The plants could have been over watered during the period we used to evaluate the rate of soil moisture loss. Another potential reason for the increasing soil moisture is that since this is a research site on the UGA campus, irrigation activities of the crop being grown up-gradient of the peanuts could have caused an increased soil moisture in the down-gradient peanut plots due to sub-surface flow of water. There is no definitive answer as to why the soil moisture is increasing. One thing that can be seen in the graph (all segments are provided after Figure one for better clarity) is that the rate of soil moisture loss (or gain in this case) is greatest for the single no-till plots. As would be expected there is no "dry" data available for these plots. This indicates that the use of a cover crop and a conservation tillage system holds the water better than a conventional tillage system.

Looking at just two sites, the Bullock (Conservation Tillage) and Worth (Conventional Tillage) County sites the average days to change the pressure 30 units is presented for both the "Wet" and "Dry" conditions. As can be seen in Figure 2, the Worth County site (Conventional Tillage) would require water every either 11.5 days on average whereas the Conservation Tillage soils (Bullock County) would require water approximately every 8 days when the soil profiles are wet and averaged across the top 12 inches of the soil profile. However, the opposite is true when the soil profile dries out. When the soil is dry, the Conservation Tillage (Bullock County) site would require water every 4 days while the Conventional 9Worth County) site would require water every day.

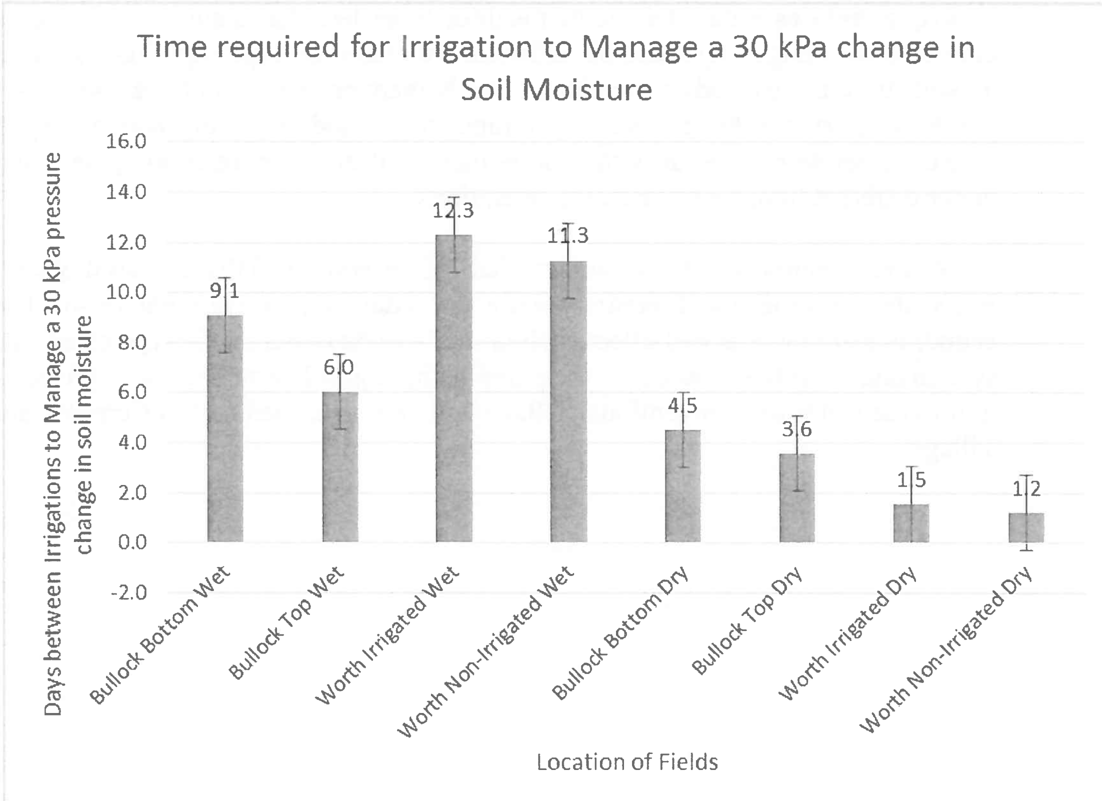


Figure 2. Time required between watering events to manage a 30 kPa change in pressure when measuring soil moisture with Watermark sensors.

Economics

The rate of soil moisture loss in conservation tillage systems is slightly more than that for a conventional tillage system when the soil is wet (Figure 1 and 2). However, the rate of loss is higher in Conventional Tillage systems as compared to Conservation Tillage when the soil is dry. The data in figure 2 indicates that when the soil is "Dry' there is an approximate 3 day difference in the time required to provide moisture to the soil profile through either irrigation or natural rainfall. If irrigation is the method of applying water, the farmer will save money by using Conservation Tillage in that the plants will only need to get water every 4 days. This time should be ample to run the irrigation system (assuming center pivot) around the field. Whereas, in the Conventional Tillage system, the peanuts would have to stress for a couple days if the center pivot does not make a complete circle in a day. If the center pivot can make a compel circle in a single day, the data indicates that the farmer would save by using Conservation Tillage since the center pivot would only have to be operated every 4 days. The dollar value of this savings would depend on the type of irrigation system used (gasoline verses electric) as well as the loss to the peanut crop that is stressed.

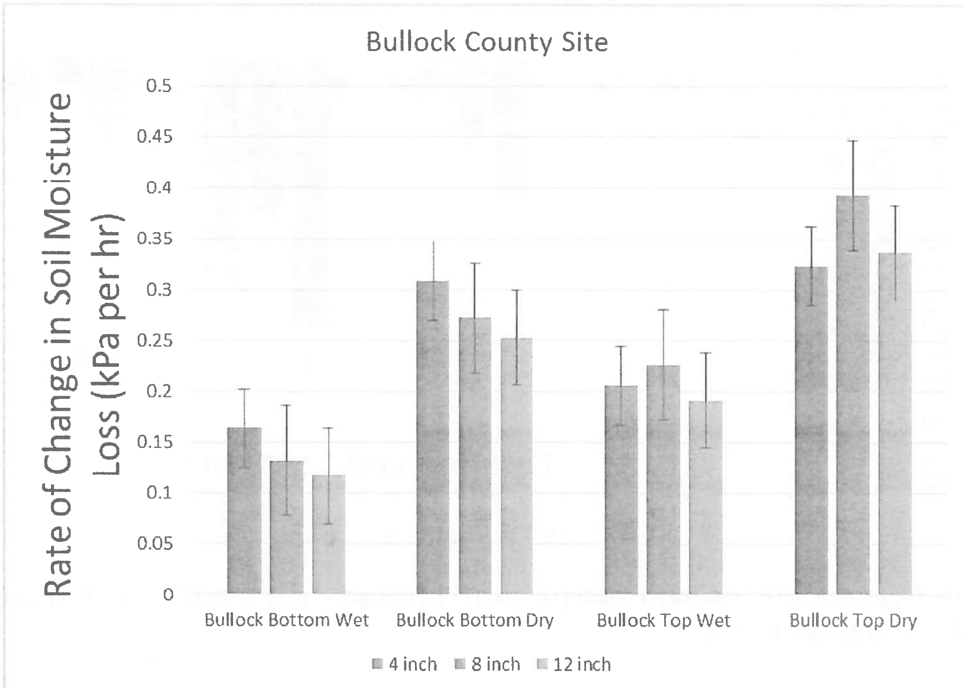
Conclusions

Data was collected from five different fields with eleven different locations to determine if the tillage method used and the type of irrigation used has an effect on the rate of soil moisture loss from a peanut field. The data indicates that a conservation tillage field with no irrigation loses water at a rate that is three times less than a similar field that uses conventional tillage. It should be understood that the soil type was slightly different, but all soils used in this study were either a sandy loam or loamy sand. The sensors purchased as part of the project will continue to be used in coming years to expand the data collected to provide us with a larger picture of the water retention potential of soils under different tillage and irrigation operations.

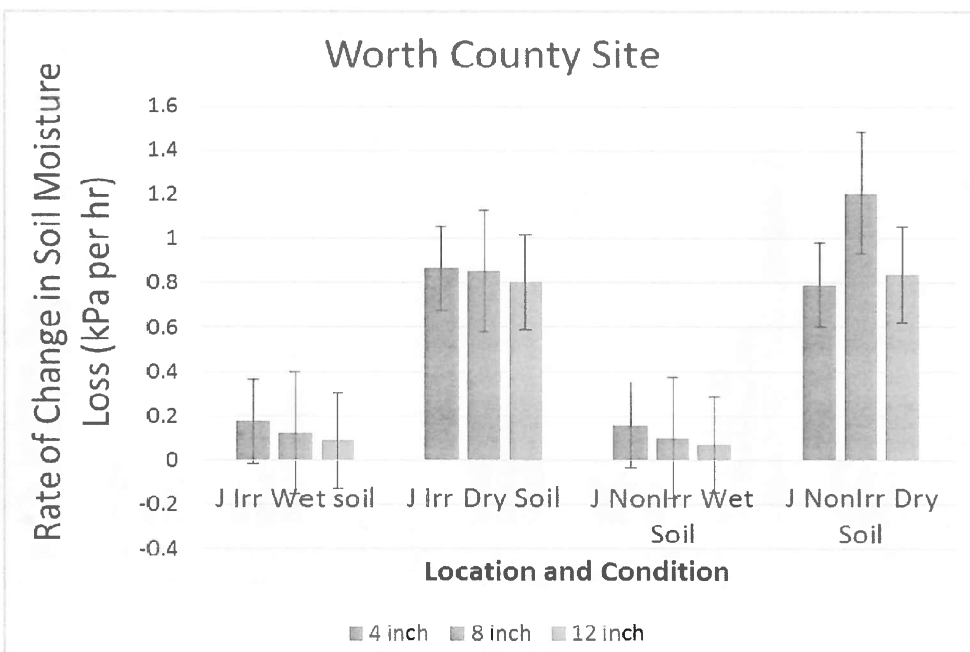
As for the economics, the data suggest that if Conservation Tillage is used when the soil is dry, the soil profile will require water every 4 days verses every day or so. The economics of how this will effect each farmer will be based on the type of irrigation system and the power source for the pump being it gasoline or electric. Overall, the cost to provide water for Conventional Tillage will be higher than that of Conservation Tillage.

Appendix

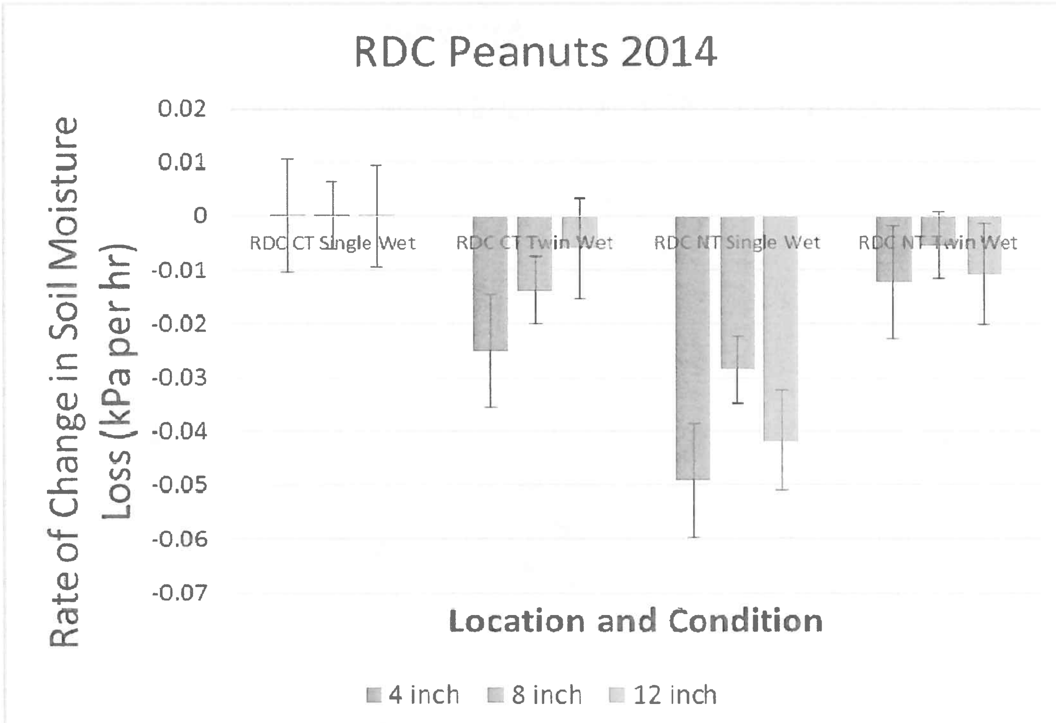
The Appendix has all of the sites separated out for ease of seeing the data.



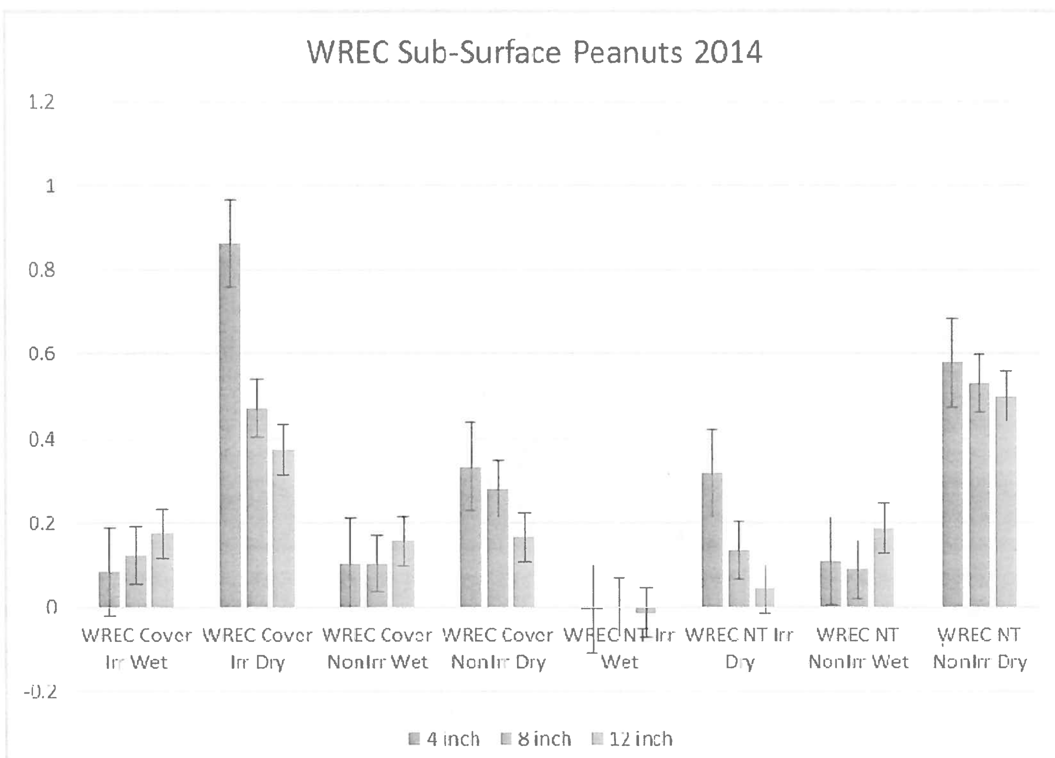
Conservation tillage – Non-irrigated site – 2 locations, top and bottom of hill



Conventional tillage – Irrigated and non-irrigated – same field two halves of field



UGA Research plots on the Tifton campus – irrigated – single and twin—conservation and conventional tillage



Wiregrass subsurface irrigation – no-till and strip-till