PEANUT RESPONSE TO SUBSURFACE DRIP IRRIGATION AND TILLAGE IN A SANDY COASTAL PLAIN SOIL

Calvin Perry[1], Scott Tubbs[2] and Amanda Smith[2]

[1]The University of Georgia - Camilla
[2]The University of Georgia – Tifton

Objectives

1. Determine the effects of tillage (surface and deep) and irrigation amount (full and deficit) on yield, quality, and water use efficiency of a large-seeded peanut cultivar irrigated using subsurface drip irrigation (SDI).
2. Determine the effects of tillage (deep) and irrigation amount (full and deficit) on yield, quality, and water use efficiency of a large-seeded cultivar vs. a small-seeded cultivar grown under minimum tillage conditions and irrigated with SDI.
3. Evaluate the peanut inverting and harvest operations impacts on an SDI system.

Materials and Methods

This research project was located at the UGA Stripling Irrigation Research Park, near Camilla. A split-plot experimental area (approx. 3 ac total) has been established with SDI drip lines buried at 12" depth centered between the non-wheel crop rows (every other middle). Surface tillage treatment (conventional vs. strip-till) has been maintained for 6 years as has deep tillage treatment (subsoiled vs non-subsoiled). The cultivar treatment will involve a small-seeded cultivar (GA Greener) and a large-seeded cultivar (GA-06G). Irrigation treatment involved full irrigation and deficit irrigation (60% of full). Each plot was 6 rows and 100’ long wide (center two rows sampled for yield and quality) and treatments were replicated four times. Soil moisture was monitored within the peanut row in three full irrigation plots. The Ga Greener cultivar was planted only on conservation tillage plots and the Ga 06-G variety was on both conservation tillage and conventional tillage.

The amount of "full" irrigation applied was based on a water progress curve (from Beasley et al.) that has a sliding strategy based on weeks after planting which progresses maximum needed per week depending on stage of crop (see Table 1). The "deficit" irrigation amount was 60% of the "full" irrigation. Rainfall received during a week was subtracted from the weekly water need. Detailed records were maintained for each management system along with irrigation amounts and application timings. At harvest, yield and quality measurements were taken from each replication. An economic analysis of the study will also be conducted.

Table 1. Irrigation schedule followed for peanut.

Weeks of Growing Season	Weekly Crop Water Need (inches)
5-6	0.75
7-9	1.0
10-12	1.5
13-17	2.0
18-20	0.75

The crop was planted May 11 using a Monosem 2-row air planter. The crop received 0.44 inches of rainfall the day after planting creating uniform germination and emergence. Normal production and cultural practices for weed and disease control were followed throughout the season. The crop was inverted on October 10 using a 2-row KMC inverter and was harvested on October 14 using a 1960’s era Lilliston 1500 peanut combine fitted with bagging attachment. All crop for each plot was bagged, weighed, and subsampled for later quality analysis.

Results

Irrigation was started on July 18th, during the 9th week after planting (Figure 1). Rainfall prior to that date was ample for the crop development. Last irrigation was applied on October 3. For the season: Rainfall = 28.50 inches, Full irrigation = 13.17 inches, and Deficit irrigation = 7.66 inches.

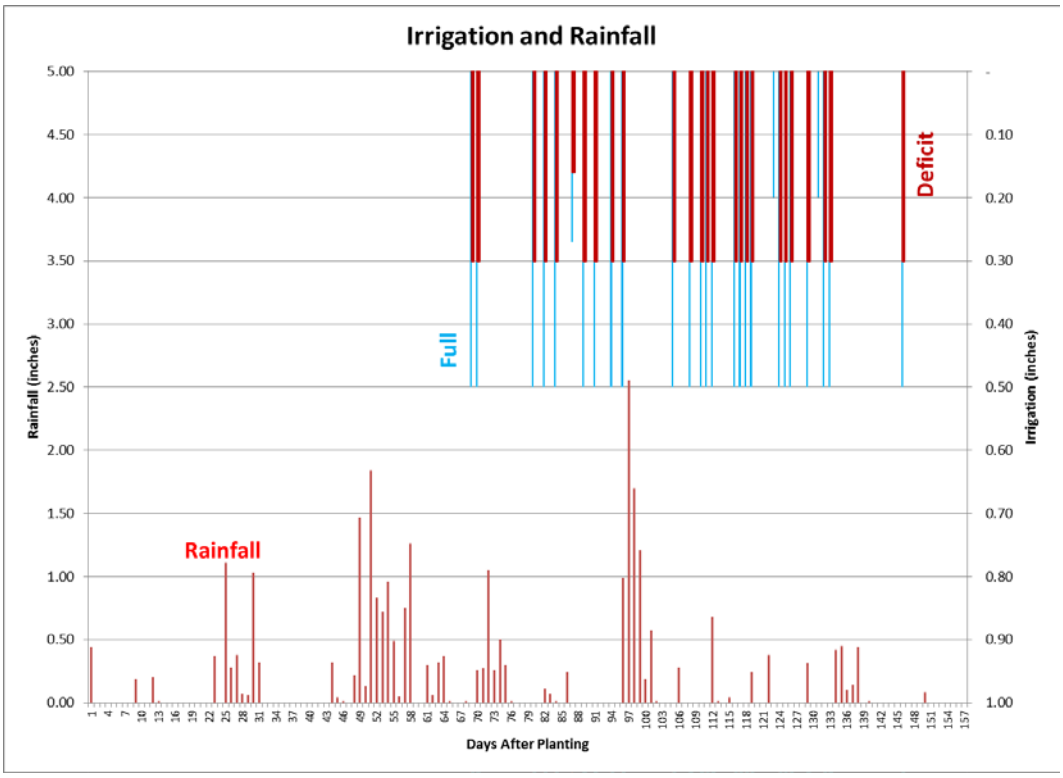


Figure 1. Rainfall and irrigation received by or applied via SDI to the 2013 peanut crop. Graph shows Full irrigation amounts and Deficit irrigation amounts.

The yield results for the Ga Greener and Ga 06-G cultivar plots are presented in Figures 2 and 3. For the Ga Greener cultivar, there were no significant differences between irrigation and/or tillage treatments. With the Ga 06-G cultivar (on both conventional and conservation tillage), yields ranged from 5194 lb/ac (conservation, subsoiled, full irrigation) to 6677 lb/ac for conventional, non-subsoiled, deficit irrigated. Interestingly, the two highest 06-G yields numerically were not subsoiled and received deficit irrigation amounts. Conversely, the lowest yielding treatment was in conservation tillage, subsoiled, full irrigation.

Figure 4 provides a comparison of yield results for the Ga Greener vs. Ga 06-G cultivar plots (all conservation tillage only). There were some significant differences detected in this comparison, with the conservation, subsoiled, full irrigation plots of both cultivars yielding significantly lower than the other plots in the comparison. The Ga 06-G had numerically higher yields (non-subsoiled, deficit and full irrigation).

Figure 5 provides soil moisture status of one of the fully irrigated plots. Clearly the abundant rainfall and 13+ inches of irrigation (as recommended by the checkbook method) kept the soil profile very wet throughout the growing season.

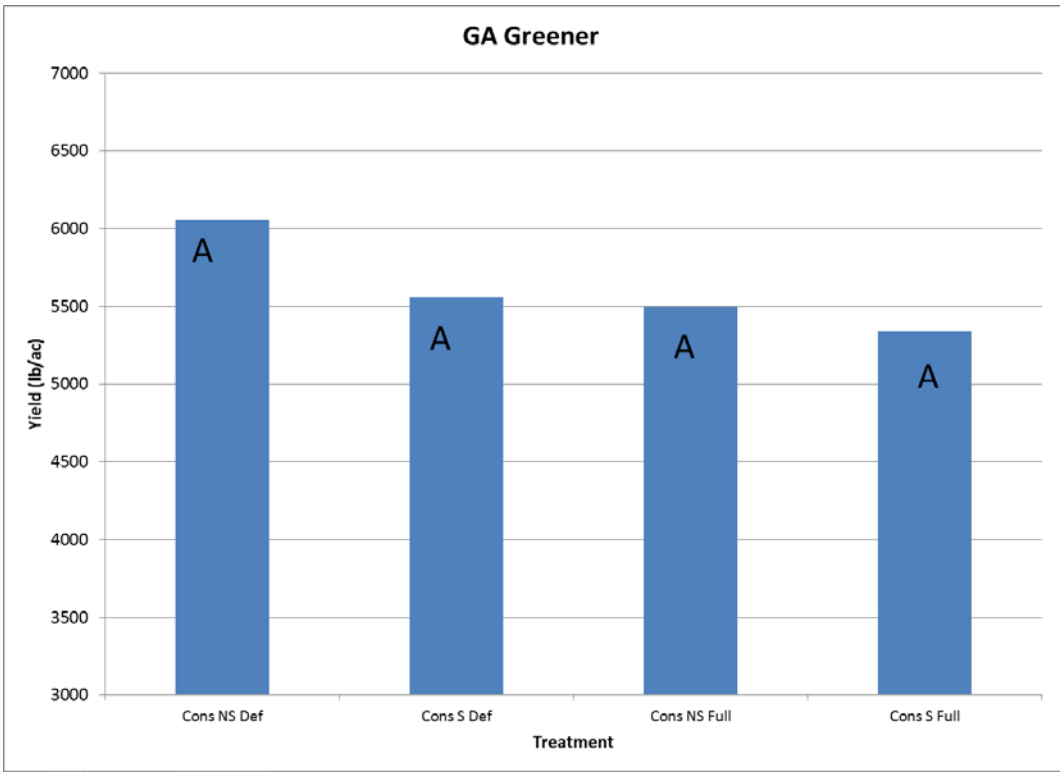


Figure 2. Yield results for the Ga Greener cultivar plots. All Ga Greener plots were conservation tillage "Cons" surface tillage. "S" indicates plots with deep subsoil tillage. "NS" indicates non-subsoiled plots. "Def" and "Full" refer to deficit and full irrigation, respectively. Different letters, if any, denote significant yield differences at the P ≤ 0.05.

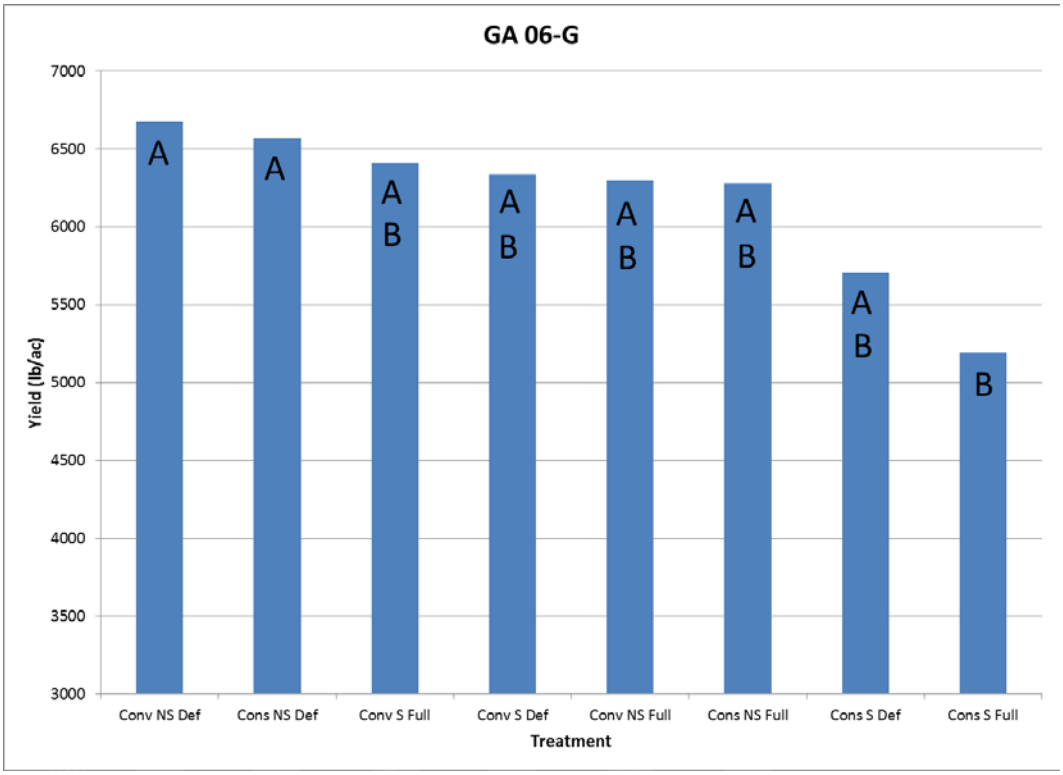


Figure 3. Yield results for the Ga 06-G cultivar plots. Ga 06-G plots were strip-till ("Strp") or conventional ("Conv") surface tillage. "SS" indicates plots with deep subsoil tillage. "NS" indicates non-subsoiled plots. "Def" and "Full" refer to deficit and full irrigation, respectively. Different letters, if any, denote significant yield differences at the P ≤ 0.05.

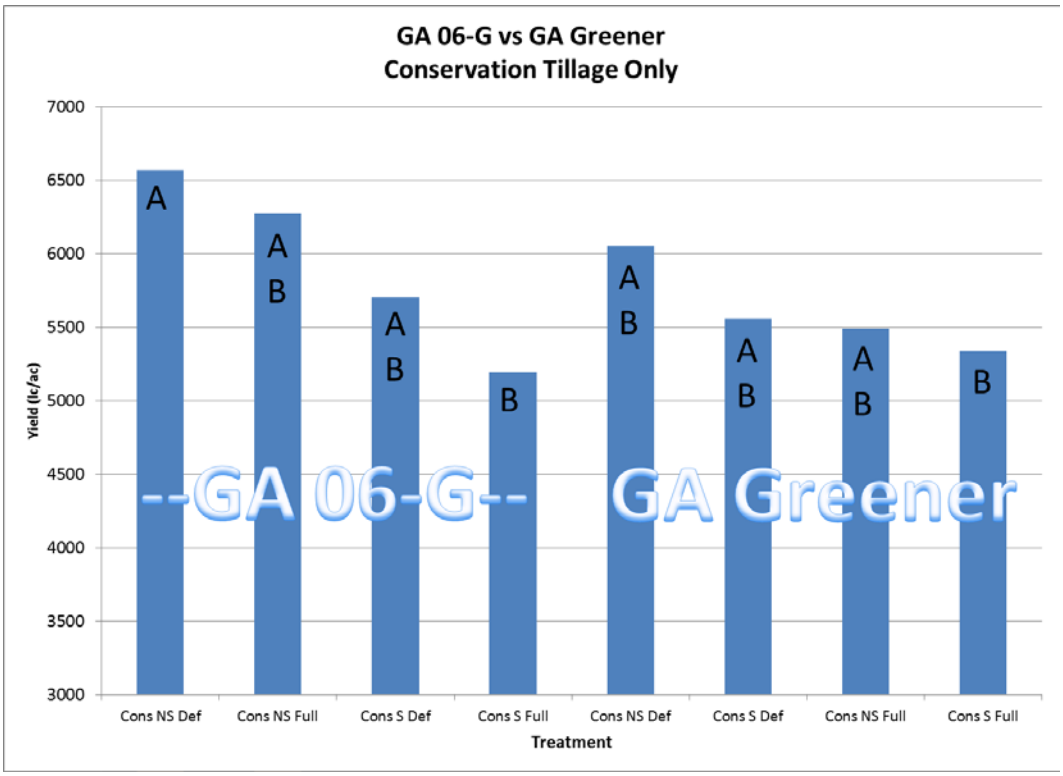


Figure 4. Comparison of yield results for the Ga Greener vs. Ga 06-G cultivar plots with conservation tillage only. “S” indicates plots with deep subsoil tillage. “NS” indicates non-subsoiled plots. “Def” and “Full” refer to deficit and full irrigation, respectively. Different letters, if any, denote significant yield differences at the P ≤ 0.05.



Figure 5. Soil moisture status from full irrigation plot. Blue line indicates full profile, tan line represents refill point (low soil moisture), and green band indicates optimal soil moisture range.

Conclusions

For the second year in a row, the yield results appear to indicate that abundant rainfall that occurred throughout the growing season essentially negated any significant effects from0 irrigation level (full vs. deficit), tillage (conservation vs. conventional) or deep tillage (subsoiled vs. non-subsoiled). Ga Greener had

numerically lower yields than the Ga 06-G cultivar, but those differences were only statistically significant for the conservation tillage, subsoiled, full irrigation treatment.

The graph of soil moisture status indicates the rainfall and irrigation (recommended by checkbook method) kept the soil profile very wet – perhaps too wet since deficit irrigated plots had the highest yields for both cultivars. However, there is some good news in this as there was concern that SDI might not be able to keep a soil profile properly moist given our sandy soils.

With SDI drip tape at 12 inch depth, there were no observed negative impacts on the integrity of the drip tape from any of the field operations, including inverting and harvest.