TITLE:

Subsurface Drip Irrigation in West Texas: Summary of year 2002

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Subsurface drip irrigation (SDI) may be an alternative to overhead sprinkler systems for peanut irrigation. However, research data describing yield or economic value of SDI in peanut and associated crop rotations and management techniques are minimal. A long term SDI project was initiated in West Texas in 2000 to investigate peanut yield response to various irrigation levels, drip tube spacing, and management techniques.

The research design has four irrigation levels, three crop rotations, and two drip tube lateral spacings replicated four times for a total of 96 plots (Table 1). Laterals were placed at about 12 inch (30 cm) soil depth and at two lateral spacings, under every row and alternate row furrows (3 and 6 ft; 0.91 and 1.83 m). Four irrigation levels were monitored at 100%, 75% and 50% of estimated crop water use from meteorological data and crop coefficients. The fourth irrigation scheme employed the BIOTIC scheduling system which uses plant temperature thresholds as an irrigation trigger.

The plots were bedded using experimental tillage equipment from the National Peanut Research Laboratory (Dawson, GA) to be used on drip irrigated land. The plots were bedded in late March. The irrigation system was tested and prepared for summer use.

Approximately one week prior to planting the irrigation was electronically set to pre-irrigate the soil at 5 to 7 mm/day (0.2 to 0.27 in/day). The procedure for planting was for the planter to “shave off” the top 2.54 to 5 cm (1 to 2 inches) of the bed and plant into moist soil. Both peanut and cotton were planted on 22 April. The peanut variety was Florunner 458 and the cotton variety was Paymaster 2623.

The planting procedure worked quite well as we did get a very good stand for both crops. On about 28 May a hail storm destroyed the cotton crop. The cotton crop was replanted but did not germinate until after a rainfall event in late June.

We are still having software problems that make the irrigation controller not as reliable as we had hoped. Conversations with the electronic supplier have not answered the questions. Currently we are looking at programming procedures for possible causation of the problems.

RESULTS AND DISCUSSION

Total water applied on the peanut crop during the growing season is shown in Table 2. Irrigation data show that the irrigation system does apply the proper quantity of water for the percentages as calculated. Figure 1 shows pod yield by irrigation water level. These data indicate that the 75% irrigation level had lower pod yield than the 50% irrigation level. Common sense suggests that less water should have lower yield, thus the 50% irrigation levels should have the lower yields. By looking at pod yield by block (replication), we can get an idea of what part of the field had which yield.

Figure 2 shows pod yield by block. The higher yields were in blocks 3 and 4 (west side). Looking back at the season, we can explain this phenomena. The 75% irrigation treatment is located on the north of the experimental plots which has a higher elevation. The 75% treatment on the north west side is also close to a dryland area that is not currently being farmed. Two major problems occurred in this area. One, prairie dogs move into the irrigated area, dig up the drip tubing for either cooler temperatures or water or both. These rodents tend to chew on the tubing, cutting holes and create a flooded situation. This was kept to a minimum during the 2002 season with disking around the plots on a timely manner. However, there were a couple of incidents where prairie dog holes in the tubing were not noticed and water moved from the higher elevation to the lower elevations.

Two, in the 75% area, the side slope has eroded by wind and water to where the drip tubing is only 6 to 8 inches deep instead of the 10 to 12 inches during installation. If the tractor driver is not on the correct path, the tillage equipment can cut the drip tubing. This occurred without us knowing it. The ends of the tubing were bent back such that no water was escaping during our initial checks. Over time, with water pressure on the tubing, water began to escape and again water ran to the lower elevations.

When a rainfall event occurs such that the rainfall intensity is higher than the infiltration rate of the soil, then water will move down slope from the 75% water level to the other water levels. Therefore, blocks 3 and 4 had the higher yields as water was moving from the higher elevated 75% treatment to the lower elevated irrigation treatments. The lowest elevation on the west side is the 50% irrigation level. Pod yield in these areas for the 50% irrigation level averaged about 3500 lbs/ac. While the yield in blocks 1 and 2 for the 50% irrigation level averaged about 2850 lbs/ac.

The yield in the 75% irrigation level in blocks 1 and 2 tended to be lower than the yield 50% irrigation level. Pressurized water in the irrigation system will move to the larger holes reducing the water pressure in other parts of the field. The total water supplied is not evenly distributed and one area gets more water than the other. Thus, Blocks 1 and 2 probably did not receive the full amount of water calculated. Problem areas for holes in the drip tubing was in Blocks 3 and 4.

Figure 3 shows there is no significant yield difference between lateral spacing of 3 foot and 6 foot. This is correlated with data collected at subsurface drip irrigation sites in Georgia. These data include all 4 blocks. Even when looking at just blocks 1 and 2 there is no yield difference between lateral spacings.

Figure 4 shows yield data for blocks 1 and 2 for the four water levels. There is no yield difference except for the lowest yield collected on 75% water level in block 1. These data imply that irrigation at lower water levels has the same yield as irrigating at a higher water levels. This is true for yield data collected in Georgia on drip irrigation, but the yield in Georgia is 2000 lbs higher at the 75% level compared to Texas yield. The question then, is why are we not getting higher yields with higher water levels comparable to overhead irrigation. We hypothesize that the yield we saw this year was from flowers and pegs that were set when rainstorms occurred during June and the drip irrigation kept those nuts to the end. This hypothesis is supported by the farmer stock grade data shown in Table 3. There were very few number ones and other kernels implying there were very few small or immature kernels at harvest. With few immature kernels, this implies the plant was not producing new pods, hence, the plant may be flowering but the pegs are not going into the soil. It has been observed with drip irrigation that peanut plants have many pegs that have aborted. Soil and weather conditions may explain this condition. The soil may be either to dry or to hard or a combination of these conditions. We have noticed a soil crust that forms during the growing season that may prohibit peg penetration. When the crust does occur, soil moisture does not move above that crust. The hard crust tends to form just below the soil surface and is about 2 inches thick. Just below the soil crust the soil is damp to the touch. Also, the hot dry winds may be moving underneath the crop canopy not only drying the soil but also drying the pegs before they enter the soil.

Summary/Conclusions

1. Average peanut yield for all plots and treatments was 3175 lbs/ac.
2. Blocks 3 and 4 averaged 3416 lbs/ac while blocks 1 and 2 averaged 3000 lbs/ac.
3. There was no pod yield difference with lateral spacing in any of the irrigation treatments.
4. There was no grade differences between treatments.

Where do we go from here

What is the maximum pod yield for subsurface drip irrigation in West Texas?
Why are pegs not going into the soil?
What management practices need to be addressed (fertility, pesticide, other)?

Future plans

1. Follow planting procedure used in 2002. Make beds early and shave off the top of the bed and plant in moist soil.
2. Focus on alleviating controller malfunction problems so irrigation will be completely electronic.
3. Measure soil temperature and soil water content in the pod zone.
4. Nitrogen fertilizer on cotton.

NOTE: We would like to thank Texas A&M personnel for their help and equipment. Without their support the peanut crop would not have been planted or harvested in a timely manner.

Table 1. Drip tube specifications used at the WTPGA research farm.

component	Specification
Supplier	Netafim Irrigation, Inc.
Drip tube wall thickness	12.5 mil (0.317 mm)
Inside diameter	0.63 in. (16.0 mm)
Emitter spacing	18 inches (45 cm)
Emitter flow rate	0.25 gal/hr (0.94 L/hr)
Design flow rate	0.28 gal/min/100 ft (1.06 L/min/30 m)
Lateral depth	12 inches (30 cm)
Lateral wide	3 and 6 ft (0.91 and 1.83 m)

Table 2. Cumulative water applied during the 2002 growing season.

Irrigation level	Water Applied (in)	
	3 ft	6 ft
biotic	25.3	26.1
50%	14.8	15.3
75%	22.4	23.1
100%	25.2	28.8

Table 3. Peanut farmer stock grade for 2002.

Treatment plot #	TSMK %	OK %	LSK %	jumbo %	medium %	ones %
biotic 3	74.7	2.9	0.6	40.2	30.2	4.9
biotic 6	74.3	3.0	0.4	39.3	30.1	3.3
50% 3 ft	77.7	1.3	1.1	39.5	33.6	3.4
50% 6ft	77.4	1.6	0.8	36.2	37.3	3.3
75% 3ft	75.2	2.1	0.8	37.2	32.4	4.1
75% 6 ft	76.1	1.8	0.9	37.5	34.4	3.5
100% 3 ft	77.0	1.7	1.5	41.9	30.0	4.3
100% 6ft	76.5	1.8	0.8	40.4	31.5	4.3

Figure 1. Pod yield by water level for subsurface drip irrigation for the 2002 growing season. Irrigation treatments are 100% (100), 75% (75), 50% (50), and BIOTIC (BIO).

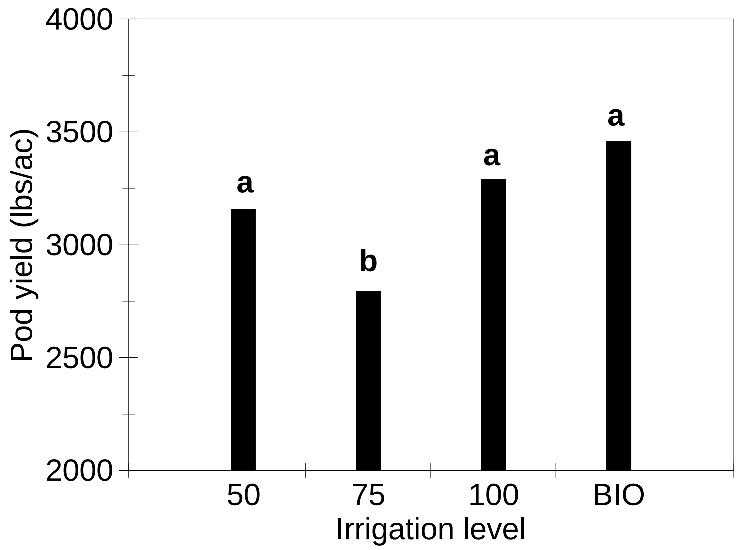

Figure 2. Pod yield by block (replication) where block 1 is on the east side and block 4 is on the west side.

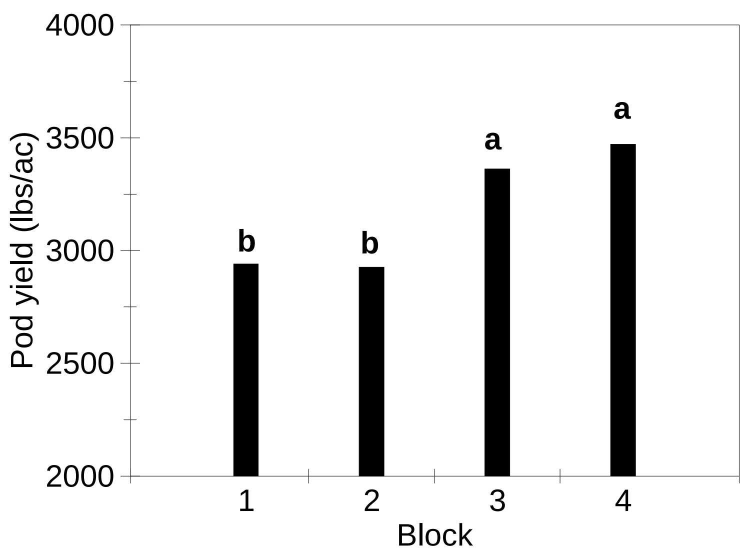

Figure 3. Pod yield by lateral spacing for subsurface drip irrigation for the 2002 growing season. Lateral spacing is 3 foot (underneath every row) and 6 foot (alternate furrows).

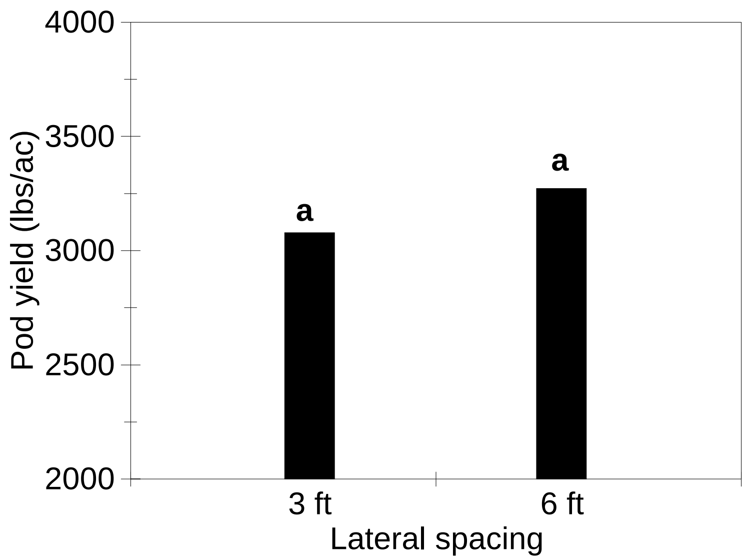

Figure 4. Pod yield by water level for blocks 1 and 2. Irrigation treatments are 100% (100), 75% (75), 50% (50), and BIOTIC (BIO). Block 1 and 2 are on the east side of the plot.