Evaluation of Low Pressure Irrigation Systems (LPS) for Cotton in Reduced Tillage Systems

Brian Marsh and Robert B. Hutmacher, UC Shafter Research and Extension Center; Michael Dowgert, Dennis Hannaford, Jim Phene and Jim Anshutz, Netafim USA; and Claude Phene, SDI+

Recently, water, energy, fertilizer, pesticides, labor cost and the capital investment in modern irrigation systems have risen dramatically and at a rate greater than farmer returns. Studies have demonstrated that drip irrigation can improve water use efficiency, reduce fertilizer losses and reduce application of pesticides and fungicides, particularly when compared with flood, furrow and sprinkler irrigation. As drip irrigation knowledge has evolved, Netafim Irrigation has developed Low Pressure Systems (LPS) that operate at 3 psi pressure while achieving a distribution uniformity of 90% or better. The conversion of leveled furrow irrigated fields to LPS using pressurized district water eliminates additional energy expenditures. It also conserves significant water and energy and allows the use of low pressure components, thus reducing the capital inputs of LPS. Three years of research results will be used to validate LPS irrigation design and management, and to demonstrate on-farm water, energy, chemigation, and labor savings in a reduced till system.

Materials and Methods:
This project consists of two irrigation treatments on undisturbed seedbeds replicated four times in a randomized block design:

1. Low pressure system with 60 in. lateral spacing (LPS-60) on 60 inch beds
2. Low pressure system with 40 in. lateral spacing (LPS-40) on 80 inch beds

In-season irrigation was determined by calculating crop evapotranspiration (ETc), using on-site CIMIS weather station measurements (ETo) and a generic crop coefficient for this area (Kc), where ETc = ETo x Kc; feedback from the rate of change of soil moisture measurements will be used to adjust irrigation schedules, as needed. Fertility--Acid (N-pHURIC, 10/55) was injected in all LPS irrigation water to maintain the solution pH at 6.5+/-0.04. Preplant liquid fertilizer (11-52-0) was injected at planting. Subsequent N-P-K fertilizers concentrations were adjusted to meet the crop requirement and were injected in the irrigation water as needed to maintain optimal petiole tissue levels (measured weekly).

Results:
Soil moisture feedback (Figure 1) was used to manage irrigation. Emitter output (shown in Figure 2) was within the expected range. Measurements made in the subsequent year showed more variation but still within acceptable limits. Lint yield was not significantly different between treatments (Table 1). Other measured parameters were also not significantly different. Lint yields were lower than expected due to disease and nematode pressure. The plot area was rotated to blackeye beans. Some design changes were made in LPS components that increase reliability and reduced maintenance. Cotton will be grown next year.

Figure 1. Soil moisture, 60 inch bed.

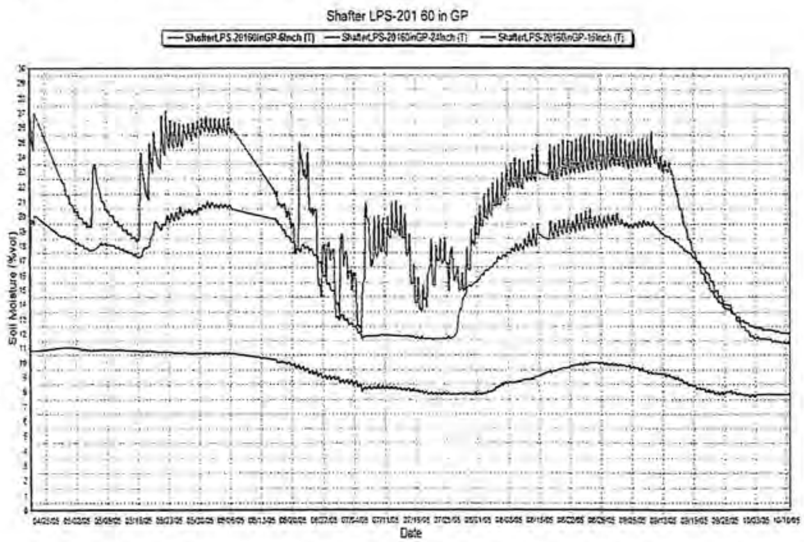

Figure 2. Emitter Output

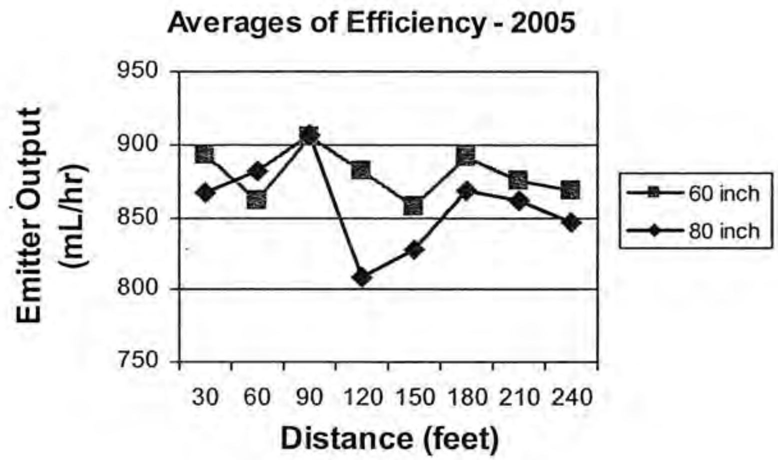

Table 1. Agronomic factors.

	Lint Yield	Plant Population	Applied Water
	-lbs/acre-	#/acre	-inches-
60" bed	965	44504	23.9
80" bed	838	46602	23.2
	ns	ns	

Figure 2. Cotton in 30" rows on 60" beds with a single drip line.

Influence of Irrigation Regime on yield of Maxxa and PhytoGen-72

Michael McGuire, Former Research Leader, 970-492-7058
michael.mcguire@ars.usda.gov
William R. DeTar, Agricultural Engineer, 661-746-8011 wrdetar@pw.ars.usda.gov
Howard A. Funk, Research Technician, 661-746-8015 hafunk@pw.ars.usda.gov

If insufficient water is applied to cotton, the resulting plant water stress can reduce yield. On the other hand, over-watering can cause rank growth and reduced yield. Somewhere in between there is a level of water application that produces maximum yield; our goal is to find that optimum level.

The subsurface drip irrigation system in field 41A (project 34) was used this season to apply water at six different and carefully controlled application rates. Water was applied daily. Treatment 4 received a nearly normal depth of water throughout the season using rates determined from previous experiments on crop coefficients (DeTar, 2004). The five other treatments received application depths which were proportional to that of treatment 4. The depth of water applied for all treatments is calculated by the equation

$$A = Ft * Cn * Ep$$

where A = depth of water to apply, inches;

Ep = normal pan evaporation;

Cn = degree of ground cover by the canopy, a decimal fraction; and

Ft = a treatment factor, which is equal to 0.3, 0.5, 0.7, 0.9, 1.1, and 1.3 for treatments 1, 2, 3, 4, 5, and 6 respectively.

The applications ranged from 33% of normal for the driest treatment to 144% of normal for the wettest treatment. Figure 1 shows the total depth of water applied this season (2006) to each treatment after planting. In addition to these numbers, there were about 5 inches of water available in the root zone at planting time.

We don't have the yields yet, but we there are some important results to report concerning plant growth characteristics. Figure 2 shows how the plant height for the PhytoGen-72 was affected by the treatments. The plant heights at the end of the season varied from 25 inches for the driest treatment to over 70 inches for the wettest treatment. The date of cutout, based on 5 nodes above white flower (NAWF), was also strongly related to the amount of water applied, as seen in figure 3. The driest treatment cut out 12 days earlier than the normal treatment. Treatment 6 is not shown in figure 3 because the plants stopped blooming before 5 NAWF was reached. The day of year (DOY) at which the plants were ready to defoliate is shown in figure 4. This is based on 4 nodes above cracked boll. At this writing (September 8, 2006), treatments 1, 2, 3, and 4 were ready to defoliate. The normal treatment was a little earlier this year than normal, possibly due to all the hot weather we've had this season. The driest treatment was ready to defoliate 15 days earlier than the normal treatment. Cutting back on the water can shorten the season considerably. Conversely, if the extrapolation holds true, over-watering by 44% could lengthen the season by about 10 days. Figure 5 shows how the soil moisture varied over the season. The soil moisture for treatment 4, the normal, held fairly constant, as it should. In fact, the slight deficit indicated increases irrigation efficiency. The soil moisture in the driest treatments is fast approaching the field wilting point of the soil, which normally averages about 3 inches of water in 5 feet of soil; field capacity is about 8 inches. Figure 6 shows how the final node count is closely related to the irrigation treatment.

We have documented the degree to which moisture regime controls plant height, final node count, and length of season.

LITERATURE CITED:

1. DeTar, W.R. 2004. Using a subsurface drip irrigation system to measure crop water use. Irrig. Sci. 23:111-122.

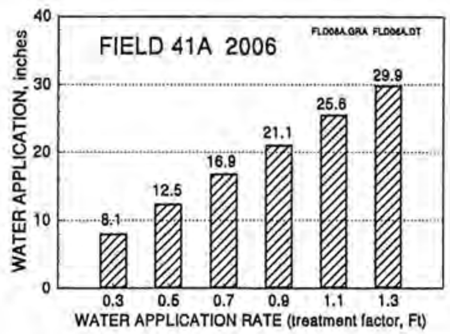

Figure 1. Depth of water applied after planting, in inches, for treatments 1 through 6 (l. to r.) in 2006.

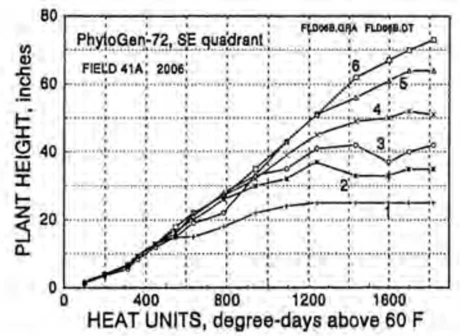

Figure 2. Plant heights vs. heat units for various treatments with PhytoGen-72 in 2006

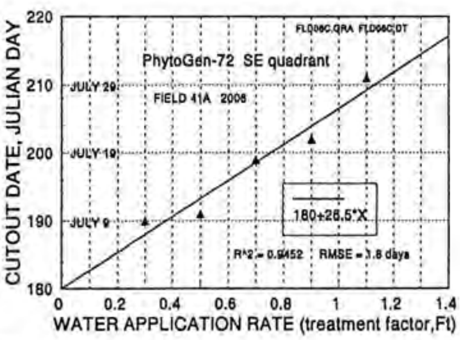

Figure 3. Cutout date as a function of irrigation treatment, PhytoGen-72, 2006

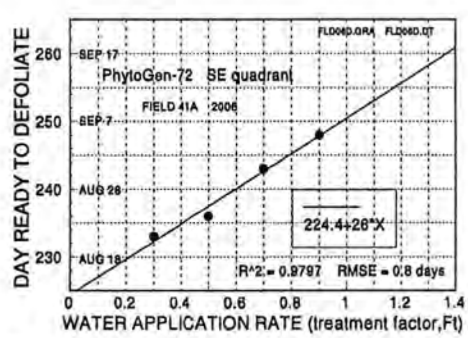

Figure 4. Julian day ready to defoliate as a function of irrigation treatment, 2006.

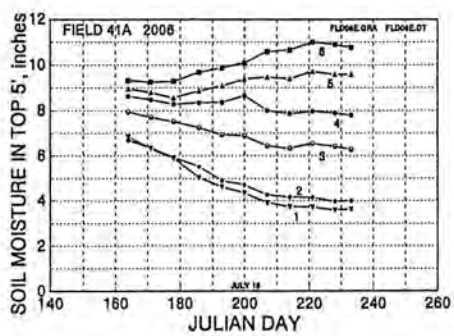

Figure 5. Moisture content of top 5 ft of soil.

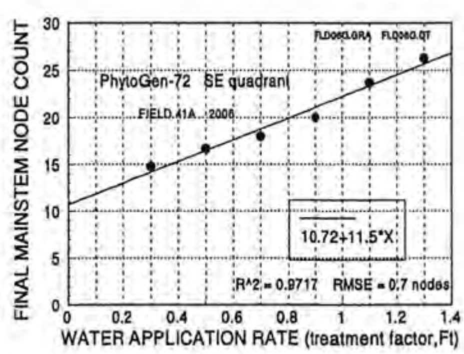

Figure 6. Final main stem node count.