Effects of Variable In-Season Irrigation Capacity on Cotton
Project 11-811 TX

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Within the Ogallala Aquifer region, the available irrigation capacity on a given field can change within a growing season. Typically this is due to declining water tables. More recently, it is due to growers diverting irrigation from one crop (cotton) to other crops (corn) which may have higher value, or are at a more critical growth stage than cotton, particularly in a year of low rainfall. Furthermore, water districts in the Texas High Plains will begin enforcing pumping restrictions to comply with state regulations which could cause abrupt changes in irrigation rates as limits are reached. Preplanned timing of irrigations with available water allowances and erratic rainfall will become more critical.

The objectives of this project were to:
1. Determine cotton lint yield, fiber quality, and water use efficiency as a function of combinations of irrigation capacities during three cotton growth periods; and to
2. Develop strategies to improve water management and water value in a semi-arid environment where new policies restrict irrigation volume and irrigation capacities are limited.

The treatment factors included in-season irrigation capacity (maximums of 0 in/d, 0.125 in/d, and 0.25 in/d) and irrigation application within a specific growth period. Periods were determined by heat unit (hu) accumulation and were generally designated as early vegetative/juvenile (< 950 hu), reproductive (950-1350 hu) and maturation period (>1350 hu). Combinations of these factor levels resulted in 27 irrigation regimes or treatments. A 4-span LEPA pivot was used to irrigate the 9.5 acres for this field experiment containing three replications. The pivot was modified so that each 8-row section (40-in rows) along the lateral length could automatically provide different irrigation amounts depending on the treatments being irrigated and pivot position. Groups of four valves (irrigating an 8-row plot) were actuated using signals from a controller (Farmscan 7000, Dothan, Alabama) with specific time sequences for each irrigation treatment and distance from the pivot point. Inputs to the controller were pivot location (via GPS signal) and irrigation quantity (via application map) at each 8-row x 16-degree section for each irrigation sequence.

Test results to date were obtained from years representing record breaking extremes - high rainfall in 2010 and low rainfall in 2011. In both of these years, cotton yield and water productivity data indicated that building soil water in the profile, or irrigating in excess of the evapotranspiration rate of cotton in May and June, reduced irrigation water value compared to applying irrigation later in the growing season. This was attributed to water loss from excessive evaporation (high wind, low humidity) that often occurs during this period on the Texas High Plains. Irrigation water value during reproductive and maturation periods resulted in water use efficiencies in excess of 100 lb/ac-inch of irrigation applied. Additional field tests will provide the foundation for in-season irrigation recommendations that will optimize lint yield (and water value) based on irrigation pumping rates and irrigation volume restrictions.
Comparison of Cotton Germination Among Three SDI Fields During the Drought of 2011 (Fields 2, 3 and 6h).
James P. Bordovsky, Joe Mustian, and Casey Hardin

Objective: To make general comparisons of germination and cotton yield resulting from three SDI system/plant position strategies during the drought of 2011.

Methodology: Seed germination has been a major issue when irrigating with SDI, particularly in years with little rain during the planting period. The 2011 growing season was extreme in terms of low rainfall and high evaporation rates. Cotton was drip irrigated in three separate field experiments at the Helms Research Farm. The "traditional drip" installation and planting was discussed in a previous report (Figure 1). Cotton was planted in a second field where SDI laterals were at 8 inches of depth or in a "shallow drip" installation (Figure 2). A third field, with traditional lateral installation, had been pre-plant irrigated with such poor soil wetting that the original experiment was abandoned. On June 14, to evaluate germination, cotton was planted in an alternate row pattern with one row over the lateral, the adjacent row 30 inches from the lateral, or in a "skip-row" fashion (Figure 3). The "traditional" and the "skip-row" drip were irrigated at approximately 50% ETc due to the low plant populations, the "shallow" drip was irrigated at 80% ETc.

Results: The cotton lint yields were 859, 1540, and 900 lb lint/ac from selected treatments of the "traditional", "shallow", and "skip-row" fields, respectively (Table 1). Considering the extreme weather conditions, seasonal IWUE was good (>50 lb/ac) in all fields. Due to the high pre-plant irrigation, total irrigation efficiency was poor in the "traditional" and "skip-row" fields at less than 50 lb/ac-in. If the skip-row field had been planted earlier, yield and IWUE would have been greater. Results indicate germination can be improved in dry years if alternate furrow SDI laterals are installed at depths of 8 to 9 inches or if rows are planted directly over the drip laterals.

Table1. Yield and water use efficiency from treatments in SDI fields at the Helms Research Farm, 2011.

<table>
<thead>
<tr>
<th>Planting Date</th>
<th>Traditional Drip</th>
<th>Shallow Drip</th>
<th>Skip Row Drip</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre &amp; At Plant</td>
<td>5/13/2012</td>
<td>5/13/2012</td>
<td>6/14/2012</td>
</tr>
<tr>
<td>Irrigation (in)</td>
<td>8.6</td>
<td>7.3</td>
<td>13.71</td>
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<tr>
<td>Seasonal Irrigation (in)</td>
<td>10.8</td>
<td>15.4</td>
<td>9.26</td>
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<tr>
<td>Yield (lb/ac)</td>
<td>859</td>
<td>1540</td>
<td>900</td>
</tr>
<tr>
<td>Seasonal Irrigation WUE (lb/ac-in)</td>
<td>58</td>
<td>85</td>
<td>72</td>
</tr>
<tr>
<td>Total Irrigation Use Efficiency (lb/ac-in)</td>
<td>44</td>
<td>68</td>
<td>39</td>
</tr>
</tbody>
</table>

From Texas AgriLIFE Research, Helms Research Farm Summary Report for 2011. James P. Bordovsky, P.E. 806 889 3315 j-bordovsky@tamu.edu
Subsurface Drip Irrigation Pre-plant Irrigation Timing Effects on Germination and Cotton Yield (Field 2).
James Bordovsky and Joe Mustian

Objective: To determine the effects on germination and cotton lint yield of three pre-plant irrigation sequences using SDI.

Methodology: Plot size was 8 rows by 1300’ with three replications. Treatment factors were pre-plant irrigation sequence and depth of planting. SDI laterals were spaced at 60 inches. Crop rows were spaced 30 inches apart with two rows planted on single 60 inch beds. All tillage and seedbed shaping occurred immediately following the 2010 harvest, therefore, the seedbeds were undisturbed from December 2010 until cotton planting in May 2011. Three irrigation sequences were replicated three times in a complete randomized block design and are depicted graphically in Figure 1. Additional treatments within each of the three sequences included removing dry soil from the planting bed surface with disks in front of planter units in an attempt to place seed into wetted soil (deep planting).

Results: Germination was low and erratic in all treatments with final plant stands at less than 25% of initial seed drop (Figure 2). All treatments were identically irrigated through the growing season at approximately 40% ETc. In-season rain was low at 1.5 inches. Plots from each treatment and replicate were harvested by traditional methods. Although plant stands were extremely poor, average cotton lint yield of all treatments was 859 lb/ac (Figure 3). Removing dry soil in front of the planter failed to improve germination, failed to consistently improve yield, and would have caused additional germination problems with significant rain immediately following planting. When considering normal planting methods, applying a large pre-plant irrigation immediately prior to planting (T3) resulted in significantly less yield than applying a sequence of smaller irrigations (T1 and T2). The 2011 growing season was extremely hot, dry, and windy, particularly during the early stages. As such, these single year test results may not represent those of a more typical growing season.

Figure 1. Pre-plant and early season irrigation sequences in germination study at the Texas AgriLife Research Center, Helm Farm, 2011.

Figure 2. Subsurface drip irrigated cotton germination test plot. This picture was taken on July 6 during the record drought of 2011 at the Helms Research Farm.

Figure 3. Cotton lint yield resulting from pre-plant irrigation sequences of 0.2 in/d for 25 days (T1), 2.5 inch plus 0.2 in/d for 12 days (T2), and 5.0 inch immediately prior to plant (T3). Cotton was planted with normal planter settings and also following the removal of some dry soil or “deep planting” at the Helms Research Farm, Halfway, TX, 2011.