Irrigation Management for Cotton

NC STATE UNIVERSITY

Guy D. Collins, Ph.D.
Cotton Extension Associate Professor

March 6-7th, 2018
Irrigation Basics

• General Rule of Thumb = 18 inches of water required to produce a cotton crop (Bednarz)

• Tifton: May 1 – September 30 (2009-2012) = 23.6 inches
  – Range of 18.3 to 32.6 inches
Irrigation Basics

• Water availability affected by several factors (soil type, crop growth stage / root development, environment)

• Dry periods affect crop development and yield differently, depending on when it occurs, severity (compounded by heat), and longevity

• Crop development….when is water needed, and how much?

• Basics on how and when to irrigate – considerations for adjusting irrigation practices

• Two primary schools of thought among growers (both are false):
  – Cut the pivot on and let it run all year
  – Avoid irrigating until you absolutely have to
Factors to consider

• Evapotranspiration (from plants and soil)
  - wind, temperature, humidity, rain, sunlight, crop growth stage

• Soil water potential (determines longevity of rain events, irrigation frequency, availability of soil water) – basis for IrrigatorPro®

• Irrigation is supplement to rainfall….easier to maintain than to play catch up
  - water demands significantly higher as soon as bloom period begins
  - want an adequate soil water supply once bloom begins
  - want an adequate soil water supply when irrigation ceases
  - we are never more than 4-5 days from a severe drought

• System efficiency
General water requirements

- Prior to bloom – \(\frac{3}{4} - 1\) inches per week
- Bloom – 1 to 2 inches per week
- Cutout to first open boll – 0.75 inches per week

- These requirements vary depending upon soil texture / water potential, evapotranspiration (heat, sunlight), crop condition, etc.

- Increase rates in sandy soils, runoff situations, hot dry forecast (June-Aug), rapid wilting during bloom
<table>
<thead>
<tr>
<th>Year</th>
<th>Rainfall</th>
<th>Rainfall + Irrigation</th>
<th>Non-Irrigated Yield</th>
<th>Irrigated Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>in</td>
<td>kg/ha</td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>8.6</td>
<td>13.8</td>
<td>900</td>
<td>1140*</td>
</tr>
<tr>
<td>2002</td>
<td>13.0</td>
<td>18.5</td>
<td>515</td>
<td>1010*</td>
</tr>
<tr>
<td>2003</td>
<td>18.9</td>
<td>24.4</td>
<td>941</td>
<td>952</td>
</tr>
<tr>
<td>2004</td>
<td>24.9</td>
<td>31.8</td>
<td>1030</td>
<td>1131</td>
</tr>
<tr>
<td>2005</td>
<td>12.2</td>
<td>18.3</td>
<td>952</td>
<td>1456*</td>
</tr>
<tr>
<td>2006</td>
<td>19.5</td>
<td>27.8</td>
<td>907</td>
<td>963</td>
</tr>
<tr>
<td>2007</td>
<td>11.5</td>
<td>21.3</td>
<td>521</td>
<td>1138*</td>
</tr>
<tr>
<td>2008</td>
<td>13.8</td>
<td>25.2</td>
<td>432</td>
<td>935*</td>
</tr>
<tr>
<td>2011</td>
<td>19.9</td>
<td>39.1</td>
<td>538</td>
<td>898*</td>
</tr>
<tr>
<td>2012</td>
<td>18.1</td>
<td>26.7</td>
<td>1529</td>
<td>1622</td>
</tr>
<tr>
<td>2013</td>
<td>19.8</td>
<td>21.8</td>
<td>1605</td>
<td>1671</td>
</tr>
<tr>
<td>2014</td>
<td>26.5</td>
<td>33.3</td>
<td>1299</td>
<td>1238</td>
</tr>
<tr>
<td>2015</td>
<td>12.9</td>
<td>25.6</td>
<td>534</td>
<td>1054*</td>
</tr>
<tr>
<td>Mean</td>
<td>16.9</td>
<td>25.2</td>
<td>900</td>
<td>1170</td>
</tr>
</tbody>
</table>

*Significance at p≤0.05 within each year

Edmisten, 2016
Summary

- Response to irrigation 54% of the time

- Increase due to irrigation averaged 270 pounds lint/acre

- Increase due to irrigation averaged 463 pounds lint/acre in the 7 out of 13 years with statistically significant response to irrigation

- Lint yield of irrigation was only numerically lower in 1 of 13 years
Irrigation Considerations

• Know efficiency of irrigation system (60-95%) and soil water holding capacity (0.6-1.8 inches per foot)
  – High pressure Impact sprinklers (75-85%), Low pressure Spray sprinklers with drop hoses (90-95%) (Vellidis 2014), travelling gun = 50%...maybe 60% (Bednarz)
Fig. 3.9. Diagram showing the relative amounts of available and unavailable water in soils ranging from sand to clay. Amounts are expressed as percentages of soil volume and as centimeters of water per centimeter of soil. (From Cassell, 1983.)
Irrigation Intervals

- Sandy – 3 to 4 days
- Sandy loam, loamy sand, loam – 4 to 6 days
- Fine sandy loams, clay – 5 to 8 days

Intervals vary depending upon soil texture / water potential, evapotranspiration (heat, sunlight), crop condition, etc.

- Irrigator Pro®

(2010 Cotton Production Guide)
Irrigation Considerations

• Know efficiency of irrigation system (60-95%) and soil water holding capacity (0.6-1.8 inches per foot)
  – High pressure Impact sprinklers (75-85%), Low pressure Spray sprinklers with drop hoses (90-95%) (Vellidis 2014), travelling gun = 50%...maybe 60% (Bednarz)

• Keep close track of growth stages
  – 1st square
  – 1st bloom
  – 1st open boll (length of bloom period may vary)

• Utilization of sensors in concert with weekly checkbook
  – Adjust for soil type and retention of moisture (20-60 kPa) (Vellidis, 2014)
  – Account for rainfall....when to resume irrigation
  – Quantify when stress may be encountered
    • ET, Heat, boll demands, etc
    • Wilting indicates you are WAY too late
Soil Moisture Sensors

Numerous products,
All provide useful information

Irrometer Watermark
Decagon MPS-2
Decagon EC-5

Vellidis, 2014
Irrigation Considerations

• Split apply weekly rates into 2-3 applications
  – System capacity and time required for application
  – Adjust for rainfall (any meaningful rainfall > 0.2-0.3 inches)
  – Soil uptake, runoff, slope, depth to subsoil
  – Prevent complete depletion of soil moisture
  – Short-lived drought can have significant negative effects on yield
Lint Yield (lbs/A) (averaged across locations)
Irrigation increased yields 337 – 519 lbs
40 cb > 70 cb = 182 lbs/A
91 lbs/A per additional inch of irrigation
SDI -40 cb vs 100% CHBK

• 0.1 to 44 % water savings in 2011
  – 0.1 to 3.2 inches

• 51 to 60 % water savings in 2012
  – 2.2 to 4.6 inches
• FM 1740 > DP 1050 = 40 cb, 70 cb, and 100%
• FM 1740 = DP 1050 = dryland, 65% UGA recs.
Using Heavy Rye Covers For Sustainability

Culpepper, 2013
Predawn Water Potential

LSD = 2.074

100% Checkbook

Dryland

A

A

B

C

RYE

CONV
Predawn Leaf Water Potential

6/17/2013: A, B
6/26/2013: NS
7/18/2013: NS
7/8/2014: NS
7/30/2014: A, B

MPa

Conv.
Rye
Cotton Irrigation Management for Humid Regions
Cotton Irrigation Management for Humid Regions

http://www.cottoninc.com/fiber/AgriculturalDisciplines/Engineering/Irrigation-Management/

Resources for You

Cotton Portal Website:  http://cotton.ces.ncsu.edu/

NC Variety Calculator:  https://trials.ces.ncsu.edu/cotton/

Facebook:  
North Carolina Cotton  
facebook.com/groups/344058599029946

Twitter:  
List: NCSU Cotton  
Keith Edmisten: @NCcotton  
Guy Collins: @Cotton_Guy  
Dominic Reisig: @DominicDReisig