2012 Cropping Strategies: Split-Pivot Systems to Reduce and Spread Immediate Water Demand

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Contributors

- Cotton irrigation, Jim Bordovsky (slides 20-26)
- Extension Agents: Kerry Siders (IPM, Hockley-Cochran); Monti Vandiver (IPM, Parmer-Bailey); Mark Brown (Ag., Lubbock)
“An irrigation lateral near Hereford, Texas. The field shown is now in alfalfa. Irrigation water comes from wells ranging in depth from 50 to 200 feet. An unlimited supply of water seems assured. Electric-powered and butane-powered pumps in this area usually have capacities of 1000 to 1500 gallons of water per minute. 50,000 acres of land in the county are now irrigated by this method with no measurable effect on the water level.”

12/18/1944
Cropping With Less Water

Irrigating less vs. irrigating more efficiently—Over the past 20 years what we have accomplished is most likely the latter.

Texas Seed Trade Association newsletter reporting, Feb. 9, 2012: “Due to the new requirements of measuring and reporting irrigation water use it looks plain that most growers use less water than they believed and are better stewards of the resource than is commonly believed.” (HPWD staff).
Remember Some Basics

“A shiny steel shank is often a farmer’s worst enemy.”

M.B., Lubbock Co.

This represents tillage and moisture loss.
Three Rules for Moisture

Catch it!
Keep it!
Reap it!
Do you need re-evaluate pre-plant irrigation?

- Water use efficiency of preplant irrigation is often very low, especially when using spray mode in contrast to LEPA drag socks with furrow dikes.
  - Efficiency may be as little as 20%, especially for early spring applications
  - Wetting the entire surface of the soil greatly diminishes efficiency
Should You Be Using LEPA?

- Research documents well the advantages of increased water use efficiency
- Once the crop is established, at some point we can/should switch from spray used to establish the stand to low-set water application (especially drag hoses, also splash pads, etc.)
  - Sometimes we might need to switch back to nozzles for a period of time
Should You Be Using LEPA?

- LEPA will wet about 40% of the soil surface, and none of the foliage—more water to the root zone.
  - Less evaporation from the soil
  - Water movement into the soil at least twice as far
What About Furrow Diking?

- An “Old” technique
  - “Oh, furrow diking is so 1960s!...”
  - But less useful (and less needed) if you are using conservation tillage/no-till
- Benefits are well documented in research
- Practice may be considered a nuisance, but it is still recommended
- Benefit some years more than others
  - Up to 150 lbs./A lint, 1,000 lbs./A sorghum in best years of benefit
Irrigation Scheduling?

- Potential evapotranspiration?
  - Unfortunately the Texas AgriLife High Plains PET network was closed to the public due to lack of funding
- AquaSpy, other equipment
Overestimating Irrigation Capacity

- This gets us in trouble in years that have even ‘average’ rainfall...

- ...and we are too hopeful, too optimistic; and we delay much-needed decisions: it’s just got to rain soon!
Implications of Forthcoming Pumping Limits

Think now, how will you farm with a 15” limit?—This might not be an issue for you if you don’t have a lot of water anyway (or you are in an irrigation district that has not imposed limits).

How to manage the contiguous acres provision, to get above 15”/year.

Should we even grow anything that requires this amount of annual irrigation?
Implications of Forthcoming Pumping Limits

- Banking your 6” of water for use in future dry years (again, if this applies to you)
- What about required water meters and reporting water use? Does that seem intrusive?
  - Most producers who have used water meters have in fact found they are using less water than they thought AND the meters have proved to be a useful management tool.
## Minimum Irrigation GPM‡

<table>
<thead>
<tr>
<th>Crop</th>
<th>Minimal</th>
<th>Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>3-4</td>
<td>4.5</td>
</tr>
<tr>
<td>Peanut</td>
<td>---</td>
<td>5.0</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>5</td>
<td>7 to 8</td>
</tr>
<tr>
<td>Cotton</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Grain Sorghum</td>
<td>?</td>
<td>?</td>
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‡Mid- to late-season gallons per minute, not in May; this allows for decrease in pumping capacity through season.
## Range of Planting Dates
(Lower South Plains)

<table>
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<tr>
<th>Crop</th>
<th>Early‡</th>
<th>Late</th>
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</thead>
<tbody>
<tr>
<td>Grain Sorghum</td>
<td>4/20</td>
<td>7/5 (medium) 7/15 (early)</td>
</tr>
<tr>
<td>Sunflower</td>
<td>4/10</td>
<td>Tier I, July 15 Tier II, July 22</td>
</tr>
<tr>
<td>Guar</td>
<td>5/10?</td>
<td>7/1</td>
</tr>
<tr>
<td>Sesame</td>
<td>5/10?</td>
<td>7/1</td>
</tr>
<tr>
<td>Black-eyed Pea</td>
<td>5/10?</td>
<td>7/10</td>
</tr>
<tr>
<td>Sorghum/sudan</td>
<td>4/15</td>
<td>Good, by early July Late forage, ~8/1</td>
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## Range of Planting Dates (Central South Plains†)

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<td>Tier I, July 10  Tier II, July 17</td>
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†For ‘Late’ dates, use 5 days earlier for north/northwest South Plains, 5 days later for lower South Plains; ‡Relies on warm soils & favorable 7 to 10 day forecast.
### Range of Planting Dates  
*(Northern South Plains)*

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<tr>
<th>Crop</th>
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| Grain Sorghum         | 4/30    | 6/25 (medium)  
|                       |         | 7/5 (early)                                 |
| Sunflower             | 4/15    | Tier I, July 5  
|                       |         | Tier II, July 12                             |
| Guar                  | 5/10?   | 7/1                                       |
| Sesame                | 5/10?   | 7/1                                       |
| Black-eyed Pea        | 5/10?   | 7/5                                       |
| Sorghum/sudan         | ~4/25   | Good, by early July  
|                       |         | Late forage, ~8/1                            |

‡Relies on warm soils & favorable 7 to 10 day forecast.
Crop Water Use Patterns & Optimum Timing

- When water is limited, there are better times to get a bang for your irrigation buck?
- When do you get better potential yield response?
- If you can irrigation cotton, sorghum, sunflower say 4”, when is the best time to do it (provided you can get to that point)?
Cotton Irrigation Summary
Jim Bordovsky, TX AgriLife Research, Halfway

- Cotton growth periods:
  - Vegetative (planting to very early bloom)
  - Reproductive (early bloom to just past peak bloom)
  - Maturation (after peak bloom to initial boll maturity)
Cotton Irrigation Summary
Jim Bordovsky, TX AgriLife Research, Halfway

- Declining Ogallala aquifer—availability can change dramatically during a season
- Dealing with lack of rainfall
- Shortages of water during critical growth stages
- Loss of wells due to mechanical failure
- Limited irrigation volumes imposed by regulatory mandates before the end of the growing season
When available water can’t meet the needs of crop demand, irrigation community has generally recommended and producers have followed the practice of ‘banking water’ to partially fill soil profile before planting or during early plant growth.
While a full profile is very desirable for cotton and other crops, and pre-plant irrigation is absolutely necessary in some years, our work indicates that under potential water constraints, the strategy of filling the profile by irrigation may need to change or at least be altered.
High wind, high air temp., low humidity combine to make it difficult to retain early applied water in the soil until cotton (or other crops) really need it in July and August during bloom and boll growth.

In addition, early season water applications can be lost via evaporation or excessive plant growth.

This all represents non-productive water.
South Plains data from wet and dry years (2010 & 2011):

Storing water in the soil profile in excess of cotton plant’s evapotranspiration during June was ineffective

Best time to water...
Cotton Irrigation Summary
Jim Bordovsky, TX AgriLife Research, Halfway

Results to date:

- Ensure adequate irrigation available in the reproductive and early maturation periods of cotton development
- Water applications during this stage of growth resulted in > 100 lbs./A cotton fiber growth per 1” of irrigation
- About 20 lbs./A or less cotton production per acre-inch during spring and vegetative ‘water banking’ irrigation application period
Full-Season Maturity Grain Sorghum...

Figure 1. Water needs for sorghum rise sharply at the rapid growth stage, peak during the boot stage and then drop off afterward.
Development of Grain Sorghum
Medium Maturity Grain Sorghum, 17 leaves

- **Emergence**: 6 days
- **Growing Point Differentiation**: 32 – 35 days
- **Flowering**: 32 – 35 days
- **Physiological Maturity**: 32 – 35 days

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Key Period—Irrigation!

Spikelets & Potential Seed Number Set from GPD +10 Days for Each Head
Other Crops & Water Use

- **Corn**—Peak water use about 2 weeks before and two weeks after pollen shed
- **Cotton**—early July to cut-out (5 NAWF), usually mid or late August
  - Do you irrigate too much after Cut-out?
- **Sunflower**—2 weeks before to 2 weeks after bloom (a distinct cutoff, petal drop)
- **Peanut**—Ensuring pegging, late water vs. early water
La Nina weakening, but effects persist into spring/summer

First 3-month period in modeling that shows equal chance of above/below normal rainfall is June-July-August

These odds would favor later planted crops in 2012
Split Pivot Scenarios

- Pairing two irrigated crops

- What strategies can you consider?

- One crop is your main focus, the other may be managed in such a way that it ‘goes dryland’ if needed.
Cotton/Sorghum, Split Pivot

- **Two-crop/two planting date/split pivot** scenarios
  - Early cotton, late June sorghum
  - Early sorghum, delayed cotton
  - Early sorghum, late sorghum same pivot

- The goal is to minimize or even eliminate the overlap of peak irrigation
  - Much if not most of the time you are only watering a half circle

- Check with Extension (Trostle) for an explanation of possible scenarios for your farm
Cotton/Sorghum, Split Pivot

Farmers should consider splitting the pivot with different crops requiring water at different times to reduce total irrigated acres at one time.

Which crop has main emphasis?
- Cotton production, give it all you can?
- Sorghum—you signed a pounds contract?—you have to spread your crop loss/low yield risk to ensure delivery of pounds of grain.
Shifts in Projected Dates

- A specific planting date for either cotton or grain sorghum does not mean cut-out or flowering will occur on a certain day or within a few days.

- Heat unit accumulation drives physiological growth—it is potentially driven faster by heat.
  - The same hybrid planted in late April will probably take 5-7 days longer to reach half bloom vs. plantings in June.
  - But grain filling and maturation will likely then be quicker for the early planted grain sorghum.
Shifts in Projected Dates

- Early cool fall temps. can greatly slow growth
- It is not worth sickly or slow emergence on cotton or sorghum if it means you need to wait 5 days to early plant
  - The potential damage in a start in cold conditions is a greater risk than if irrigation or heat during flowering hit crop later
  - If temperatures are reasonable is there a major cold front in the next 5-7 days?
Half pivot with cotton, planted ~May 5

- Peak water use early July to mid-August
- Physiological cut out (5 NAWF) by ~August 10?
- Greatly reduce irrigation ~Aug. 20 if soil moisture is available, A&M data suggests little additional irrigation benefit esp. if some rain is received

Consider medium maturity sorghum, ~4,500 lbs./A yield goal (6-8” irrigation)

- about September 5
- Back up 65-67 days (from 9/5)—plant ~July 1
Result: cotton is up to 3 weeks past cutout prior to sorghum flowering (~Sept. 5), and lower moisture requirement

Sorghum enters peak water demand ~7 days after cotton cut out when cotton irrigation is greatly reduced

- Sorghum maturity near October 10-15 with added potential of Sept. rainfall assisting yield

Concentrate water to cotton early with 1-2 possible key waterings to sorghum prior to flowering (panicle differentiation, early boot)
Half pivot with medium-early sorghum, planted ~April 25
- Medium-early hybrid, flower by June 25-30—peak water use is declining as cotton water needs rise rapidly
- Maturity about first week of August with mid/late-August harvest

Cotton planting delayed to May 15th
- Physiological cut out ~Aug. 20th
- Little overlap in peak irrigation needs
- How strong is your water?
## Split Pivot Sorghum—2 Plantings

Dawson/Lynn/Terry Co., **Medium** Maturity

<table>
<thead>
<tr>
<th>Timing</th>
<th>Planting Date</th>
<th>Flowering</th>
<th>Maturity</th>
<th>Maximum Water Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early</td>
<td>April 25</td>
<td>July 1-5</td>
<td>Aug. 5-10</td>
<td>6/15 to 7/10</td>
</tr>
<tr>
<td>Late</td>
<td>June 30</td>
<td>Sept. 5</td>
<td>Oct. 10-15</td>
<td>8/20 to 9/15</td>
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Half pivot with cotton, planted ~May 5
- Peak water use early July to mid-late August
- Physiological cut out (5 NAWF) around Aug. 15?
- Reduce irrigation ~Aug. 25 if moisture is available, A&M data suggests little additional irrigation benefit esp. if some rain is received

Consider medium-early maturity sorghum, ~4,500 lbs./A yield goal (6-8” irrigation)
- “Schedule” flowering about September 1
- Back up 60-62 days (from 9/1)—plant ~7/1
**Result:** cotton is up to 2 weeks past cutout and higher moisture requirement prior to sorghum flowering (~Sept. 1)

- Sorghum enters peak water demand about time of cotton cut out but before end of cotton irrigation
  - Sorghum maturity near October 5-10 with added potential of Sept. rainfall assisting yield
- Concentrate water to cotton early with 1-2 possible key waterings to sorghum prior to flowering (panicle differentiation, early boot)
Half pivot with medium-early sorghum, planted ~April 25 (watch soil temps. if cool)
- Medium-early hybrid, flower by ~July 1—peak water use is declining as cotton water needs rise rapidly
- Maturity about August 5th & harvest begins ~Aug. 20

Cotton planting delayed to May 15
- Physiological cut out ~Aug. 25th
- Little overlap in peak irrigation needs
- How strong is your water?
Split Pivot Sorghum—2 Plantings
Hockley/LBB/Crosby/Floyd/Hale, **Medium Maturity**

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</thead>
<tbody>
<tr>
<td>Early</td>
<td>4/25-5/1</td>
<td>6/30-7/7</td>
<td>Aug. 5-15</td>
<td>6/20 to 7/15</td>
</tr>
<tr>
<td>Late</td>
<td>June 25</td>
<td>~Sept. 1</td>
<td>~Oct. 5-10</td>
<td>8/15 to 9/10</td>
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This is harder to separate irrigation of the two crops than to the south and east.

- Half pivot cotton, planted ~May 10
  - Plant cotton earlier if you safely can due to soil temp.
  - Peak water use early July to late August
  - Cut out (5 NAWF) about August 20-25th?

- Consider medium-early maturity sorghum, ~5,000 lbs./A yield goal (6-8 irrigation)
  - “Schedule” flowering by ~Sept. 1st
  - Back up 60-62 days (from 9/1)—plant by June 30th (the cut-off for a medium-early maturity)
Result: cotton is about 1 week past cutout before sorghum flowering (~Sept. 1)

Cotton cutout about 0-7 days after peak sorghum water demand begins
- Sorghum maturity near October 5-10 (this is close to early frosts) with potential of Sept. rainfall assisting yield

Concentrate water to cotton early with 2 possible key waterings to sorghum prior to flowering (panicle differentiation, boot)
Parmer/Castro/Bailey/Lamb/Cochran
Early G.S. vs. May 10 Cotton

- More separation in water use than late sorghum?
- Half pivot with sorghum, planted ~May 1
  - Medium-early hybrid, flower by ~July 4
  - Peak sorghum water demand reduces after July 10
- Can’t advocate delaying cotton
- Half pivot cotton, planted ~May 10
  - Peak water use early July to late August
  - Cut out (5 NAWF) about August 20-25th?
Parmer/Castro/Bailey/Lamb
Early Corn, Late Grain Sorghum

- Half pivot 108- to 115-day relative maturity corn, planted ~April 15
  - Compare heat units requirements for specific hybrids
  - Peak water use ~V10 and especially from silking to past milk (through ~July 25); maintain good soil water to near ½ starch line
  - Don’t cut the corn short...

- Consider medium maturity sorghum, ~5,000 lbs./A yield goal (6-8” of irrigation
  - “Schedule” flowering by ~Sept. 1st
  - Back up 65-67 days (from 9/1)—plant by June 20-25th (the cut-off for a medium-early maturity is 6/25)
Result: half circle of corn is essentially fully irrigated, but for grain sorghum
- One watering to establish stand (late June)
- Before corn is finished, a possible second water ~4 weeks after planting in advance of growing point differentiation (increase spikelet & seeds per spikelet set)

Grain sorghum maturity by ~Oct. 10 (this is close to early freezes) with potential of Sept. rainfall assisting yield
- Modest population for grain sorghum to better prepare the crop to wait until after corn irrigation is completed
## Split Pivot Sorghum—2 Plantings

Parmer/Castro/Bailey/Lamb/Cochran, Medium-Early Maturity

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Sunflower Irrig. on Split Pivot

- Farmer consideration: splitting pivot with different crops requiring water at different times—or very limited but timely irrigation to the ‘complementary crop, e.g. sunflower or grain sorghum, to reduce total irrigated acres at one time

- Which crop has main emphasis?
  - Cotton production, give it all you can?
  - Corn—you signed a pounds contract?
  - Sunflower—widest range of planting dates
Sunflower Irrig. on Split Pivot

- Two-crop/two planting date/split pivot scenarios
  - Early cotton, late June/early July sunflower
  - Early sunflower, delayed cotton
  - Corn & Sunflower
  - Sunflower offers more flexibility than grain sorghum

- The goal is to minimize or even eliminate the overlap of peak irrigation
  - Much if not most of the time you are only watering a half circle

- Check with Extension (Trostle) for an explanation of possible scenarios for your farm
Central/Lower TX South Plains
Early Cotton, Late Sunflower

- Half pivot with cotton, planted ~May 5
  - Peak water use early July to mid-August
  - Physiological cut out (5 NAWF) by ~August 10-15?
  - Significantly reduce irrigation ~Aug. 25 if soil moisture is available, Texas AgriLife data suggests much reduced irrigation benefit esp. if modest rain is received

- Sunflower @ 1,500 lbs./A yield goal,
  - “Schedule” flowering about September 10-15
  - Back up 55-60 days (from 9/10)—plant ~July 10
Central/Lower TX South Plains
Early Cotton, Late Sunflower

- Result: cotton is now at reduced moisture requirement and 3 weeks or more past cutout prior to sunflower bloom (~Sept. 10)
- Sunflower enters peak water demand 1-2 weeks after cotton cut out when cotton irrigation is significantly reduced
  - Sunflower maturity near October 15 (two weeks before average first freeze) with added potential of Sept. rainfall assisting yield
- Concentrate water to cotton early with 1-2 possible key waterings to sunflower prior to flowering (esp. buds ~0.5-1.0"
Central/Lower TX South Plains
Early Sunflower, Delayed Cotton

- Half pivot with sunflower, planted ~April 15
  - Flower in ~60 days by June 15—peak water need lasts about two more weeks to ~July 1 (petal drop)
  - Maturity about July 20 & harvest begins in early August
  - This crop is essentially finished before cotton requires peak water in early July

- Cotton planting delayed to May 15th (or the last irrigated cotton you plant)
  - Physiological cut out ~Aug. 20-25th
  - Little overlap in peak irrigation needs
  - How strong is your water?
split pivot scenarios with sunflower and grain sorghum are highly flexible as sunflower has a very wide range of planting dates and is less affected by cool fall weather.

- Suggested sunflower planting, lower South Plains, April 10-July 15
- Northwest South Plains, April 20-July 10
Peanut/Sorghum Scenario

- Half pivot with runner peanuts and grain sorghum
  - You can not diminish water to peanuts!
  - Peak peanut water use early July to early/mid September
  - Recommended crop rotation min. 1 year peanut in 3
  - Preferable to let each sorghum and peanut rotate with cotton but not each other

- Consider medium-early maturity sorghum, 4,000 lbs./A yield goal, and planting late April
  - Flower by end of June, peak water use decline early July—if you water at all (choose lower seed drop)
  - Some sorghum water sharing with peanut needed
Sorghum/Peanut (Gaines, Terry Cos.)

- Result: sorghum is at or past flowering (~June 30) before peanut enters peak water demand
- Concentrate water to peanut after July 1 with only 1 possible additional watering to sorghum, esp. if soil water is banked
  - Sorghum maturity by ~August 5
Peanut/Sorghum Scenario

- Dilemma for early sorghum and runner peanut:
  - You are watering the sorghum at the possible expense of peanut unless rainfall is good.
  - Hold water off sorghum (other than establishment) until you have profile moisture for peanut (irrigated to peanut ground or rainfall received).
    - At no time would you want to re-direct moisture to sorghum if profile moisture in peanut needs to be replaced.
Possible Early Peanut

- ~May 1 Valencia peanut maturing in 127-130 days to digging
  - Must dig to avoid loss of large pods
  - Most remaining irrigation could go to sorghum by about Sept. 1

- Consider medium-early maturity sorghum
  - “Schedule” flowering about September 10 (lower South Plains)
  - Back up 60-62 days (from 9/10)—plant by end of first week of July (7/10 cut-off for medium early)
More Flexibility, Less Risk if Main Crop is Planted First

- If you plant your “companion” crop early, you could regret watering it too much if the year turns out dry.
- If companion crop is planted later, you are in the driver’s seat on your decision making—you can keep the water on the primary crop 100% if needed.
  - If sorghum, a seeding rate that can get by if minimally watered
Factors in Decision Making

- The role or ‘attractiveness’ of certain crop insurance products
- Ag loans & financing—Net return dollars are the bottom line, but sometimes the loan process may be tilted toward cotton and other high dollar/high cost crops
Moving Forward—Less Water

- Technology
- Superior hybrids and varieties—can you slightly reduce maturity and preserve yield
- Irrigation timing
- NOT irrigating and using water for higher value situation
http://lubbock.tamu.edu/programs/disciplines/irrigation-water/