Real Farm Data - Using Irrigation Management Technology to Conserve Water and Gain Profitability

Jeff Miller - ForeFront Agronomy
Lloyd Arthur - Crosby Co Farmer
Hindsight

• We have many technologies available to look back on past performance
  • Yield Monitor - yield Data
  • Soil Moisture
  • Historical Weather Data
  • Soil Information
  • EC Data
Insight

• Having the ability to look at what is happening now.
  • Soil Moisture Probes - plant water use, rooting depth, available moisture
  • Imagery
  • Tissue/Soil Testing
  • Crop Scouting
Foresight

• The ability to predict what may happen and give us the chance to make adjustments before it happens
  • Soil Moisture Crop Modeling
  • Fertility Modeling
  • Weather Forecasting
  • Sap Analysis
  • Biological Soil Testing
Confidence is found in systems

Measurements

Analytics and Models

Local, trusted advisor

Trust and Confidence
The opportunity is in the Variability

- It's because of the variables that we need to plan
- If you fail to plan, you will plan to fail
  - Plan to fail - when and where to abandon or move water to best parts of the field
  - Identify the 50% best part of the farm we have to make money
- Manage the fixed variable that are known
- Unknown variables
  - Depleting wells, weather, commodity price
Variable Rate Irrigation Basics
Speed Control
VRI

Application rate is varied by changing the speed of the pivot

Irrigation Management Zones are “pie Sliced” shaped

Relatively inexpensive - many pivot panels are capable without additional investment

No special hardware on sprinklers

If spacial variation lines up well with pie slices

Varying application based on topography (reduced application on low spots if it lines up with pie slices

Multiple crops or varieties under one pivot

Optimize Every Acre
In Every Field
Every Time!
# Types of VRI Irrigation Prescriptions

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Consideration</th>
<th>Example Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static</td>
<td>Prescription stays the same or changes only a few times during the season</td>
<td>Relatively simple to apply. Does not account for changes in spatial variability over the season</td>
<td>Avoiding irrigation on uncrossed areas. Mining differences in soil available water capacity Windshield Wiper pivot with little spatial variability</td>
</tr>
<tr>
<td>Dynamic</td>
<td>Prescription changes frequently during the season, possibly for each irrigation event</td>
<td>May be complicated and increase management efforts. May provide maximum gross benefit</td>
<td>Varying irrigation to each part of the field as needed and adjusting areas as needs change during the season</td>
</tr>
</tbody>
</table>
### Possible VRI Uses - Thinking outside the box of Soil Variability

<table>
<thead>
<tr>
<th>Uses</th>
<th>Prescription Type</th>
<th>Management Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoid application in uncrossed areas</td>
<td>Static</td>
<td>Low</td>
</tr>
<tr>
<td>Overlapping Pivots or Windshield Wiper Pivots</td>
<td>Static</td>
<td>Low</td>
</tr>
<tr>
<td>Reduce application in wet areas to avoid water logging or leaching</td>
<td>Static &amp; Dynamic</td>
<td>Low</td>
</tr>
<tr>
<td>Reduce application rate to reduce soil surface sealing in early season</td>
<td>Static</td>
<td>Low</td>
</tr>
<tr>
<td>Irrigate lighter soils when needed while crop uses water in the heavier soils</td>
<td>Static</td>
<td>Medium</td>
</tr>
<tr>
<td>Reduced application rate to avoid runoff in part of a field</td>
<td>Static</td>
<td>Medium</td>
</tr>
<tr>
<td>Apply extra water to sloping areas to compensate for runoff after a heavy rain</td>
<td>Static &amp; Dynamic</td>
<td>Medium/High</td>
</tr>
<tr>
<td>Irrigate each part of the field as needed because variability caused by precipitation, runoff, evapotranspiration, wind, and/or drainage</td>
<td>Dynamic</td>
<td>High</td>
</tr>
</tbody>
</table>
Steps for Implementing a VRI Strategy

1. Measure field variability via a soil electrical conductivity survey (EC)
2. Build the VRI prescription layer
3. Schedule Irrigation
4. Monitor the field during the season
Keep Eyes Focused Forward to move the needle

- Performance is PAST
- Potential is FUTURE

- What's interesting is that 2.5 bales may be all that piece of ground is going to produce but with current inputs for 3 bales we are limiting the 3.5 and 4 bale regions (Who knows where the upper limit is)
Why Variable Rate Works

Precision Farming is MODERN DAY FARMING - letting the DATA lead us in that direction.

Yield Goal 1250lbs/A
24/7 alerts and monitoring from your phone

FieldNET: (FieldNET Alert) Level 2 Alert
12 is running wet, 7% / 1.10 in, with 4 psi, at 268.5 degrees, A1=off as of Fri, Aug 23 at 9:12PM CDT

FieldNET: (FieldNET Alert) Level 1 Alert
12 stopped, low pressure at 268.5 degrees as of Fri, Aug 23 at 9:15PM CDT

FieldNET: (FieldNET Alert) Level 2 Alert
12 is running reverse wet, 7% / 1.10 in, with 8 psi, at 268.5 degrees, A1=off as of Fri, Aug 23 at 9:24PM CDT
24/7 alerts and monitoring from your phone

FieldNET: (FieldNET Alert)
Level 1 Alert
1932 is stopped wet at 133.4 degrees as of Sun, Jul 21 at 6:59PM CDT

FieldNET: (FieldNET Alert)
Level 2 Alert
1932 is running forward wet, 23% / 0.55 in, with 11 psi, at 133.4 degrees, A1=on as of Sun, Jul 21 at 7:33PM CDT
CropMetrics VO
Jell Miller ForeFront Agronomy
Soil Moisture Probes
Lloyd Arthur - Ralls, TX
<table>
<thead>
<tr>
<th>Irrigation Scheme</th>
<th>Avg Application/Pass</th>
<th>Total inches applied inseason</th>
</tr>
</thead>
<tbody>
<tr>
<td>VRI</td>
<td>0.935</td>
<td>7.20</td>
</tr>
<tr>
<td>Flat Rate</td>
<td>1.000</td>
<td>7.60</td>
</tr>
</tbody>
</table>
## VRI Farm 12

**Forward**

<table>
<thead>
<tr>
<th>Area</th>
<th>Start</th>
<th>End</th>
<th>(H_2O)</th>
<th>Chem</th>
<th>Speed</th>
<th>Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>33</td>
<td>112</td>
<td>118</td>
<td></td>
<td></td>
<td>7.7399 ft</td>
<td>0.97 in</td>
</tr>
<tr>
<td>34</td>
<td>118</td>
<td>124</td>
<td></td>
<td></td>
<td>7.6899 ft</td>
<td>0.97 in</td>
</tr>
<tr>
<td>35</td>
<td>124</td>
<td>130</td>
<td></td>
<td></td>
<td>6.05 %</td>
<td>1.24 in</td>
</tr>
<tr>
<td>36</td>
<td>130</td>
<td>136</td>
<td></td>
<td></td>
<td>6.47 %</td>
<td>1.16 in</td>
</tr>
<tr>
<td>37</td>
<td>136</td>
<td>142</td>
<td></td>
<td></td>
<td>7.5 %</td>
<td>1.00 in</td>
</tr>
<tr>
<td>38</td>
<td>142</td>
<td>148</td>
<td></td>
<td></td>
<td>7.66 %</td>
<td>0.98 in</td>
</tr>
<tr>
<td>39</td>
<td>148</td>
<td>154</td>
<td></td>
<td></td>
<td>6.87 %</td>
<td>1.09 in</td>
</tr>
<tr>
<td>40</td>
<td>154</td>
<td>160</td>
<td></td>
<td></td>
<td>7.01 %</td>
<td>1.07 in</td>
</tr>
</tbody>
</table>

**Reverse**

**Speed Adjustment:** [ ] %  [Increase]  [Decrease]
Flat Rate vs VRI Yield Comparison 3 yr – Arthur Farms

115 lbs/A advantage to VRI
Flat Rate vs VRI Loan Rate Comparisons 3yr – Arthur Farms

- Flat Rate: 0.5161
- VRI: 0.5284
<table>
<thead>
<tr>
<th>Sector</th>
<th>Yield</th>
<th>Lint</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat Rate</td>
<td>777.2</td>
<td>$0.5173</td>
<td>$402.04</td>
</tr>
<tr>
<td>VRI</td>
<td>892.2</td>
<td>$0.5284</td>
<td>$471.41</td>
</tr>
<tr>
<td>VRI Advantage</td>
<td>115.0</td>
<td>$0.0111</td>
<td>$69.37</td>
</tr>
<tr>
<td>Probe Cost</td>
<td></td>
<td></td>
<td>-$13.3/A</td>
</tr>
<tr>
<td>VRI Cost</td>
<td></td>
<td></td>
<td>-$5/A</td>
</tr>
<tr>
<td>Controller Cost</td>
<td></td>
<td></td>
<td>-$5.46/A</td>
</tr>
<tr>
<td>Water savings of 0.4” @$8/inch</td>
<td></td>
<td>$3.20</td>
<td>$48.81</td>
</tr>
</tbody>
</table>
Nozzle Spacing Differences

80” drop spacing

40” drop spacing
1518 W&E Elevation Change
# Nozzle Spacing Comparison

<table>
<thead>
<tr>
<th>Irrigation Type</th>
<th>Yield</th>
<th>Loan</th>
<th>$/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>40” Drop Spacing</td>
<td>731.6</td>
<td>$0.5161</td>
<td>$377.55</td>
</tr>
<tr>
<td>80” Drop Spacing</td>
<td>563.1</td>
<td>$0.5048</td>
<td>$284.20</td>
</tr>
</tbody>
</table>

2 yr Avg - 10.4” of irrigation in season
Other Uses for VRI
Water on turn rows/how many gallons wasted?
1932 - 2018 Seed Germination
1518 West VRI/48 VRI-Fert
Variable Rate Irrigation to address Wiper or Split Pivots

For wiper pivots or pivots that reverse, VRI prescriptions can be smartly adjusted to speed into and out of each prescription. These prescriptions help ensure more uniformly managed application depths at the field edges while preventing over-irrigation and slower overall windshield wipes.

- **Constant Speed at 1.5”**
- **26 bu/Ac yield difference between N side and S side**
Variable Rate Irrigation

For wind stress, VRI prescriptions can be easily programmed to increase irrigation to any edge of the field that shows crop damage or potential yield loss as determined by visual observation.
For optional Variable Rate Seeding prescriptions, VRI prescriptions can more precisely match irrigation to increased or decreased seed densities to further optimize yields.

Variable Rate Seeding

Variable Rate Irrigation

Variable Rate Seeding VRI Rx - Matches Irrigations to Seed Populations from As-Applied VRS Maps
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