Innovations in Center Pivot Irrigation with Hay Crops

VRI and LESA

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Variable Rate Irrigation on Center Pivots

Different amounts of water to different areas of the field.
Variable Speed Irrigation
Variable Zone Irrigation
They work!

Center Pivot VRI systems currently being sold have been shown to accurately implement the uploaded VRI prescriptions.

Most vendors have VRI control systems.

- Zimmatic
- Reinke
- Valley
Variable Rate Irrigation in Response to Variable Soils

“*The sandy/rocky soils need more water.*”

- Sandy/rocky soils need water more *frequently*.
- Hay growing there doesn’t *use* more water. The soil can’t *hold* very much water.
- Good management (no stress *OR* excess water) in these areas, and the rest of the field will be fine.
Soil Water Content (soil moisture measurement)

Field Capacity (full)

Soil Water Content (soil moisture measurement)

Wilting Point (empty)

Irrigation or Precipitation = Water In

Deep Percolation = Overflow

Water Holding Capacity (AW * Rz) = Size of Reservoir

ET = Water Out

Soil is a Water & Nutrient Reservoir
Variable Rate Irrigation?
Different Amounts of Water to Different Areas

Deep Silt

Deep Sand

Shallow Silt

Shallow Sand

ET

ET

ET

ET

Most soil variability problems can be fixed through uniform irrigation management for the problem soils.
Managed for Sandy/Rocky Soils

Shallow Sandy/Rocky Soils

Deep Silt Soils
Managed for Silt Soils

Shallow Sandy/Rocky Soils

Deep Silt Soils
Variable Rate Irrigation in Response to Variable Soils

“Water is ponding in some areas.”

- It’s likely you are applying more water than the crop needs and the excess water is draining out of the profile in most areas and ponding in areas with poor drainage.
  - Cut back on water everywhere.

- **Runoff:** Applying more water to areas with runoff won’t increase infiltration. *All* extra water will also run off, making the problem worse.
  - Increase infiltration in problem areas using alternative tillage, sprinklers with a larger wetted diameter, or use boombaks.
When VRI can Save Water

- Areas of the field getting water from other sources. (high water table)
- Different areas using different amounts of water. ET is not constant.
  - May be due to disease or pest pressure.
  - South facing vs. north facing slopes.
  - To save water, irrigate areas doing poorly less, not more. Counterintuitive.
Managing to Maintain Space for Significant in-season rainfall.

Requires very close water management in time and space.
Creating and modifying VRI Prescriptions. Not Trivial!

- Can be time consuming, expensive, and plagued by high degrees of uncertainty.
- Requires educated and skilled personnel.
- Depending on objectives, prescriptions must be reevaluated many times during the season (change in time and space).
  - This can be especially challenging due to continuously variable soils.
Greatest Profit Potential for VRI

Consistent prescription maps.

1. No irrigation to non-cropped surfaces
2. Crops getting consistent amounts of water from alternative sources.

May be required if injecting chemicals that can’t legally be applied to non-cropped areas.

Variable speed irrigation likely profitable more often than variable zone due to the high costs of variable zone.
Low Energy Precision Application (LEPA) & Low Elevation Spray Application (LESA.)
High Pressure Impacts

- Irrigation Efficiency ~60%
- Operating Pressure 40-80 psi.
- Outlet Spacing ~20-30 ft.
- Application rate: Medium
• Irrigation Efficiency ~85%
• Operating Pressure: ~40 psi.
• Outlet Spacing: ~10ft
• Application Rate: High
Low Elevation Spray Application (LESA)

- Irrigation Efficiency ~97%
- Operating Pressure: ~15psi.
- Outlet Spacing: <5ft
- Application rate: Very High
18% more water to the ground in LESA than MESA

LESA vs MESA Catch Depth

- A: LESA
- B: MESA

Bar graph showing a comparison of catch depths between LESA and MESA.
Highly Recommended If:

- You are required to cut back (Idaho)
- Don’t have enough water.
  - Improved efficiency = higher yields...
  - Or more ground in production.
- Hot and windy during the summer.
- No problems with runoff.

Plenty of water? Still consider it...
Life-Cycle Cost Analysis
Does it Pay to Convert?

Costs/year. (5 year life span)

<table>
<thead>
<tr>
<th></th>
<th>LESA</th>
<th>MESA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment</td>
<td>$902.16</td>
<td>$768.85</td>
</tr>
<tr>
<td>Labor/Maintenance</td>
<td>$617.72</td>
<td>$284.15</td>
</tr>
<tr>
<td>Annual Pumping Costs</td>
<td>$3,344.17</td>
<td>$5,115.60</td>
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<tr>
<td>Pump Rework</td>
<td>$462.34</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total/year</strong></td>
<td><strong>$5,326.39</strong></td>
<td><strong>$6,168.60</strong></td>
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<tr>
<td><strong>Difference/year</strong></td>
<td><strong>$842.21</strong></td>
<td></td>
</tr>
</tbody>
</table>
Soil Water Dashboard

Field:

N Pod Pasture, 2014; Grass (Pasture)

<table>
<thead>
<tr>
<th>This Morning's Soil Water Deficit:</th>
<th>0.9 in.</th>
<th>5.4 hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Today's Irrigation:</td>
<td>0.00</td>
<td>hrs</td>
</tr>
<tr>
<td>I Irrigated Today:</td>
<td></td>
<td>hrs</td>
</tr>
</tbody>
</table>

Green is good. Crops increasingly stressed below green.

Save

Dashboard

Daily Budget Table

Soil Water Chart

More Charts

Field Settings