ONLINE IRRIGATION SCHEDULING CONSULTANT FOR THE BELLE FOURCHE IRRIGATION DISTRICT

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Presentation Outline

- Project Background
- Methods Used
- Online Scheduler
- Results From First Year of Implementation
- Future Challenges
Belle Fourche Irrigation District (BFID)

- 57,183 Acres
- Crops: 
  - Alfalfa, corn, wheat, and barley
- Surface Irrigation Dominated
- Annual Water Availability
  - ~13” Precipitation
  - ~20” Allotted water
Best Management Practices

Delivery Improvements

- Upgraded Water Order/Billing System
- Canal Automation
- Canal Lining
- Canal Operational Model

On-Farm Improvements

- Surface to Sprinkler Irrigation
- Irrigation Scheduling

= 12,000 acre-ft

NRCS Natural Resources Conservation Service
3-Year Project

Components

- Extensive weather network
  - Four weather stations
  - Nine rain gage sites
- Soil moisture stations
- Web-based irrigation scheduling consultant for producers (20 total producers)
  - Easy to set up
  - Accurate, reliable, and adaptable
Existing Radio Network
Weather Stations

Legend
- Weather Station
- Belle Fourche River
- Inlet Canal
- Automated, Real-Time
- South Canal
- Belle Fourche Reservoir
- North Canal
Water Balance

- **Calculate Available Water**
  
  \[ \text{Available H}_2\text{O} = \text{Previous Day Available H}_2\text{O} - \text{ET} + \text{Rainfall} + \text{Irrigation} \]

- **Evapotranspiration (ET) Estimates**
  
  Calculated using data from installed weather instruments (ASCE standardized alfalfa)

  \[ \text{ET}_c = \text{ET}_{sz} \times K_c \times K_a \]

- **Rainfall**
  
  Collected from installed rain gages

- **Irrigation**
  
  Entered by the producer
\[ \text{ET}_c = \text{ET}_{sz} \times K_c \times K_a \]

- **K_c** – Crop Coefficient
  - *Methods in FAO 56*
  - *Based on percent maturity of the crop*

**Graphs**

- **Corn K_c**
- **Alfalfa K_c**

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<thead>
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<th>Percent Maturity (%)</th>
<th>K_c</th>
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NRCS Natural Resources Conservation Service
$$ET_c = ET_{sz} \times K_c \times K_a$$

- **$K_a$** – Plant Available Water Coefficient
  - *Crop independent*
  - *Based on available water*

![Graph showing the relationship between available water balance and $K_a$.]
ET Forecasting

- Used to Determine Timing and Depth of Irrigation
- Typical to Use Historic ET Estimates
- Use Average of Previous 4 Days to Predict the Next 3 Days
ET Forecasting

Sum of Differences
Historic = 7.67"
4 Day Average = 1.67"
**User Interface**

**Weather Data**

- Station ID: Newell
- Temperature: 82 °F
- Humidity: 32%
- Wind Speed: 8 mph
Setup ~ Field Selection

Producer Information
Name: Jared Oswald
Phone #: 605 384 6400
Password: 
Confirm: 
Submit
Area Weighted Water Holding Capacity (WHC)

<table>
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<tr>
<th>Soil Type</th>
<th>Percent of Area</th>
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<tbody>
<tr>
<td>HeA</td>
<td>10%</td>
</tr>
<tr>
<td>LnA</td>
<td>70%</td>
</tr>
<tr>
<td>LnB</td>
<td>5%</td>
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<tr>
<td>MaA</td>
<td>15%</td>
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\[ WHC_{13-24} = (1.92046 \times 0.10) + (1.80046 \times 0.70) + (1.5604 \times 0.15) + (1.80046 \times 0.05) \]
Precipitation Zones
Soil Moisture Sensors
Current Readings:
Site 1 Shallow = 20 cbar
Site 1 Deep = 22 cbar
Site 2 Shallow = 175 cbar
Site 2 Deep = 22 cbar

Current Calculated Soil Moisture = 25%

Edit Soil Moisture
2008 Example

- 23 acres
- Savo Silt Clay Loam
- Water Holding = 2.12"/ft
- Gated Pipe
- Goal: Maximize First Two Cuttings
2008 Calculated Balance
2008 Example

Soil Tension (bars)

- North 1 Foot
- North 3 foot
- Irrigation Needed
- Dry Soil
- South 1 Foot
- South 3 Foot

NRCS Natural Resources Conservation Service
2008 Calculated Balance
2008 Model Results

[Graph showing soil moisture levels over time with labels for rainfall, irrigation, field capacity, current balance, and minimum allowable.]

NRCS Natural Resources Conservation Service
17 Total Cooperators
850 Acres
Crops
- Alfalfa
- Corn
- Barley
- Soybeans
- Wheat
Future Challenges

- Understand Irrigation Efficiency Better
- Better Correlation Between Soil Moisture Readings and ET Estimates
- Further Develop User Interface
Questions?