Development of a web-based irrigation and nitrogen management tool for caneberries

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Tools for Managing Water and Nitrogen Fertilizer in Vegetables

- Quick nitrate soil test
- Weather-based irrigation scheduling
Raspberry:
Applied Water vs Relative Fruit Yield
(Fall Crop, 2004, Trials 5-7)

$R^2 = 0.54$

Relative Seasonal Yield (%)

Applied Water (inches)

100% ETc
\[ \text{ET}_{\text{crop}} = \text{ET}_{\text{ref}} \times K_{\text{crop}} \]

\( K_c \) can vary from 0.1 to 1.2
CropManage Web-based Tool:

Goal: Assist growers in making decisions on irrigation and nitrogen fertilizer management

✓ Intuitive, simple, quick to use.
✓ Accessible from smart phone, tablet computer, desktop computer
✓ Guide irrigation schedules using CIMIS weather data.
✓ Guide nitrogen fertilization decisions using quick nitrate test data and crop N uptake models.
✓ Maintain and share irrigation, fertilizer, and soil test records for multiple fields and farms.
Integrate information from multiple sources

- Soil and Ranch base info
- CIMIS ETo
- Soil nitrate test
- Field sensors
- Crop ET model
- Crop N model
- Watering Recommendation
- N fertilizer Recommendation
- Record display and data export

Decision support using crop models
CropManage

Login

To login enter your e-mail and password below.

E-mail Address
mtdahn@ucdavis.edu

Password

Login

Forgot Password
Create New Account
## Irrigation Summary

<table>
<thead>
<tr>
<th>Water Date</th>
<th>Irrigation Method</th>
<th>Recommended Irrigation Interval (days)</th>
<th>Recommended Irrigation Amount (inches)</th>
<th>Recommended Irrigation Time (hours)</th>
<th>Irrigation Water Applied (inches)</th>
<th>Kc</th>
<th>Canopy Cover (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/17/12</td>
<td>Sprinkler</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>0.94 in</td>
<td>0.00</td>
<td>0</td>
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<tr>
<td>4/19/12</td>
<td>Sprinkler</td>
<td>0.7</td>
<td>0.35 in</td>
<td>1.15 hrs</td>
<td>0.49 in</td>
<td>0.70</td>
<td>0</td>
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<tr>
<td>4/21/12</td>
<td>Sprinkler</td>
<td>0.6</td>
<td>0.40 in</td>
<td>1.34 hrs</td>
<td>0.61 in</td>
<td>0.70</td>
<td>0</td>
</tr>
<tr>
<td>4/23/12</td>
<td>Sprinkler</td>
<td>0.6</td>
<td>0.38 in</td>
<td>1.28 hrs</td>
<td>0.58 in</td>
<td>0.70</td>
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<tr>
<td>4/26/12</td>
<td>Sprinkler</td>
<td>1.3</td>
<td>0.09 in</td>
<td>0.30 hrs</td>
<td>0.28 in</td>
<td>0.48</td>
<td>0</td>
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<tr>
<td>5/6/12</td>
<td>Sprinkler</td>
<td>2.9</td>
<td>0.41 in</td>
<td>1.36 hrs</td>
<td>1.30 in</td>
<td>0.16</td>
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<tr>
<td>5/18/12</td>
<td>Drip</td>
<td>4.9</td>
<td>0.58 in</td>
<td>3.84 hrs</td>
<td>0.91 in</td>
<td>0.20</td>
<td>12</td>
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<tr>
<td>5/22/12</td>
<td>Drip</td>
<td>6.5</td>
<td>0.24 in</td>
<td>1.61 hrs</td>
<td>0.74 in</td>
<td>0.23</td>
<td>21</td>
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<tr>
<td>5/27/12</td>
<td>Drip</td>
<td>4.7</td>
<td>0.45 in</td>
<td>3.03 hrs</td>
<td>0.64 in</td>
<td>0.37</td>
<td>35</td>
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<tr>
<td>6/1/12</td>
<td>Drip</td>
<td>3.4</td>
<td>0.70 in</td>
<td>4.65 hrs</td>
<td>0.44 in</td>
<td>0.56</td>
<td>52</td>
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<tr>
<td>6/3/12</td>
<td>Drip</td>
<td>3.0</td>
<td>0.35 in</td>
<td>2.34 hrs</td>
<td>0.11 in</td>
<td>0.69</td>
<td>58</td>
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<tr>
<td><strong>Totals</strong></td>
<td></td>
<td><strong>3.95 in</strong></td>
<td><strong>20.89 hrs</strong></td>
<td></td>
<td><strong>7.04 in</strong></td>
<td></td>
<td></td>
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<tr>
<td>Fertilizer Date</td>
<td>Crop Stage</td>
<td>Soil NO₃-N (ppm)</td>
<td>Fertilizer N Recommended (lb N/acre)</td>
<td>Cumulative N Uptake</td>
<td>Fertilizer</td>
<td>Applied N (lb N/acre)</td>
<td>Applied Fertilizer</td>
</tr>
<tr>
<td>-----------------</td>
<td>---------------------</td>
<td>------------------</td>
<td>-------------------------------------</td>
<td>---------------------</td>
<td>------------</td>
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<td>--------------------</td>
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<tr>
<td>5/5/12</td>
<td>Pre-thinning</td>
<td>15.79</td>
<td>14.2</td>
<td>4.02</td>
<td>15-8-4</td>
<td>78.0</td>
<td>50.0 gallons/acre</td>
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<tr>
<td>5/22/12</td>
<td>1st drip fertigation</td>
<td>14.74</td>
<td>21.5</td>
<td>13.82</td>
<td>28-0-0-5</td>
<td>37.1</td>
<td>12.0 gallons/acre</td>
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<tr>
<td>5/27/12</td>
<td>2nd drip fertigation</td>
<td>23.68</td>
<td>4.9</td>
<td>18.88</td>
<td>28-0-0-5</td>
<td>30.9</td>
<td>10.0 gallons/acre</td>
</tr>
<tr>
<td>6/7/12</td>
<td>3rd drip fertigation</td>
<td>23.68</td>
<td>11.8</td>
<td>36.25</td>
<td>28-0-0-5</td>
<td>30.9</td>
<td>10.0 gallons/acre</td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td></td>
<td>52.4</td>
<td></td>
<td></td>
<td></td>
<td>176.9</td>
</tr>
</tbody>
</table>
How much water was applied?

Flow Meter Data

Flow Meter Data on Oct 17, 2012

Average Gallon Per Minute

0 150 300 450 600
1:00 PM 2:00 PM 3:00 PM 4:00 PM 5:00 PM
Parameters must be determined for crop model

<table>
<thead>
<tr>
<th>Planting Settings</th>
<th>Soil Settings</th>
<th>Crop Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Planting Name</strong></td>
<td><strong>Soil Type</strong></td>
<td><strong>N uptake coefficient A</strong></td>
</tr>
<tr>
<td>CSUMB titl</td>
<td>Chualar loam</td>
<td>0.0186</td>
</tr>
<tr>
<td><strong>Year</strong></td>
<td><strong>Soil Series</strong></td>
<td><strong>N uptake coefficient B</strong></td>
</tr>
<tr>
<td>2012</td>
<td>Chualar</td>
<td>4.0028</td>
</tr>
<tr>
<td><strong>Lot</strong></td>
<td><strong>Soil Texture</strong></td>
<td><strong>Fertilizer Yo</strong></td>
</tr>
<tr>
<td>4N</td>
<td>loam</td>
<td>-0.0198</td>
</tr>
<tr>
<td><strong>Acres</strong></td>
<td><strong>Sand 1ft (%)</strong></td>
<td><strong>Minimum Rooting Depth Time (days)</strong></td>
</tr>
<tr>
<td>0.43</td>
<td>44</td>
<td>10</td>
</tr>
<tr>
<td><strong>Crop</strong></td>
<td><strong>Silt 1ft (%)</strong></td>
<td><strong>Maximum Rooting Depth Time (days)</strong></td>
</tr>
<tr>
<td>Iceberg 2 row, 40 inch bed</td>
<td>41</td>
<td>50</td>
</tr>
<tr>
<td><strong>Wet Date</strong></td>
<td><strong>Sand 2ft (%)</strong></td>
<td><strong>Maximum Crop N Uptake (lb N/acre)</strong></td>
</tr>
<tr>
<td>5/4/2012</td>
<td>45</td>
<td>125</td>
</tr>
<tr>
<td><strong>Harvest Date</strong></td>
<td><strong>Silt 2ft (%)</strong></td>
<td><strong>Canopy A</strong></td>
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<td>7/10/2012</td>
<td>35</td>
<td>6.7801</td>
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<tr>
<td><strong>Previous Harvest Date</strong></td>
<td><strong>Soil Bulk Density 1ft (g/cc)</strong></td>
<td><strong>Canopy B</strong></td>
</tr>
<tr>
<td>m/d/yyyy</td>
<td>1.4</td>
<td>-11.61</td>
</tr>
<tr>
<td><strong>Previous Crop</strong></td>
<td><strong>Soil Bulk Density 2ft (g/cc)</strong></td>
<td><strong>Canopy GMax</strong></td>
</tr>
<tr>
<td>Lettuce</td>
<td>1.4</td>
<td>80</td>
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<tr>
<td><strong>Initial Residue Mineralization Rate (lb N/acre/day)</strong></td>
<td><strong>Saturated Soil Tension 1ft (cbar)</strong></td>
<td><strong>Canopy Intercept</strong></td>
</tr>
<tr>
<td>1.5</td>
<td>7</td>
<td>0.63</td>
</tr>
<tr>
<td><strong>Leaching Factor (%)</strong></td>
<td><strong>Saturated Soil Tension 2ft (cbar)</strong></td>
<td><strong>Canopy C</strong></td>
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<tr>
<td>0</td>
<td>5</td>
<td>1.5</td>
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</tbody>
</table>
Developing a web-based application for caneberries:

• Crop model development
• Software development
• Field testing and outreach
Developing a web-based application for caneberries:

Decision support algorithms needed:

- Canopy and root development model
- Nutrient (nitrogen) uptake model
- Soil moisture tension threshold
- Soil nitrate threshold
- Integrate effects of cultural practices (macro-tunnels, trellising, pruning)
Data collection plan

Year 1
- 3 fields 1st year raspberry (Proprietary Variety)
- 3 fields 1st year blackberries (Proprietary Variety)

Year 2
- 3 fields 2nd year raspberry
- 3 fields 2nd year blackberries
Canopy Cover
Canopy Cover of Raspberries (1st year)

Days after Planting

% Canopy Cover

Site 1
Site 2
Site 3
Average

Days after Planting

% Canopy Cover
Canopy Cover of Blackberries (1st year)

- Days after Planting: 120, 140, 160, 180, 200, 220, 240, 260, 280
- % Canopy Cover: 0, 20, 40, 60, 80, 100

- Site 4
- Site 5
- Site 6
- Average

Days after Planting vs. % Canopy Cover graph
1\textsuperscript{st} Year Raspberry, Watsonville CA
Rooting depth of caneberries
Rooting depth of raspberry (1\textsuperscript{st} year)

Days after Planting

Root Depth (inches)

Site 1
Site 2
Site 3
Average
Rooting depth of blackberry (1\textsuperscript{st} year)

![Graph showing root depth over days after planting for different sites.](image)

- **Site 4**
- **Site 5**
- **Site 6**
- **Average**

Days after Planting:
- 120
- 140
- 160
- 180
- 200
- 220
- 240
- 260

Root Depth (inches):
- 0
- 10
- 20
- 30
- 40

Graph indicates a downward trend in root depth as days after planting increase.
Biomass of 1\textsuperscript{st} year Raspberries

![Graph showing the biomass of 1\textsuperscript{st} year Raspberries with data points for canes, leaves, fruit, and total biomass over time.]
Biomass of 1st year Blackberries

Days after Planting

Dry Biomass (lbs/acre)

Canes
Leaves
Total

Biomass of 1st year Blackberries

Days after Planting
Additional Data Collected

- Soil nitrate at 1 and 2 foot depths
- Fertilizer N applications (total N applied preplant and in season)*
- Fruit yield (monthly for calculating N uptake in fruit)*

*Data provided by Grower
The road ahead...
Soil moisture monitoring

Date

soil moisture tension (cbars)

0
10
20
30
40

8 inches
18 inches

Date
Final Thoughts

- Web-based applications can integrate complex data and models into simple to use decision support tools.

- We will need your participation to make this tool relevant to your needs.

- We will offer training workshops on CropManage beginning March 2013.