Using Web-based Software for Irrigation and Nitrogen Management in Onion Production: our Research Plan for 2013

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UCCE Los Angeles County

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UCCE Monterey County
Presentation Outline

• How CropManage works
• Water and N recommendation
• Using CropManage
• Monitoring SWT
• Research plan for 2013
Integrate information from multiple sources

- Soil and Ranch
- CIMIS ET
- Soil nitrate test
- Field sensors

Database driven web application

- Crop ET model
- Crop N model
- Watering Recommendation
- N fertilizer Recommendation

Record display and data export
Why adapt CropManage to onions production?

- Management of N and water is a big part of onion crops success
- Brilliant idea – integrates the most pertinent info in a simple way; accessibility
- Growers and managers can spend more time making use of the data than creating the data
Onions require frequent irrigation

- Shallow root system
- Stimulation of new root growth
- High sensitivity to mild water stress
Irrigation Scheduling

Correct frequency and duration of watering

- When to irrigate
- How much to irrigate
CropManage

Database driven web application

Crop ET model

Crop N model

Watering Recommendation

N fertilizer Recommendation

Soil and Ranch

Soil nitrate test

Field sensors

CIMIS ET0
Evapotranspiration (ET)
ET0

CIMIS reference ET
CropManage

Database driven web application

Crop ET model

Crop N model

Watering Recommendation

N fertilizer Recommendation

Soil and Ranch

CIMIS ET₀

Soil nitrate test

Field sensors


ETo and ETc

climate
Radiation
Temperature
Wind speed
Humidity

grass reference crop
well watered grass

Kc factor
well watered crop
optimal agronomic conditions

ETo ● Kc = ETc
\[ ET_{\text{crop}} = E T_o \times K_c \]

\( K_c \) can vary from 0.1 to 1.2

\[ \text{Canopy}_{\text{obs}} = 1.01 \times \text{Canopy}_{\text{pred}} - 0.69 \]

\( R^2 = 0.99 \)
CropManage

- Database driven web application
  - Soil and Ranch
  - CIMIS ETa
  - Soil nitrate test
  - Field sensors
  - Crop ET model
  - Crop N model
  - Watering Recommendation
  - N fertilizer Recommendation
Know the root depth +
soil type =
storage volume
Why it's not easy to create an accurate irrigation schedule?

• Root depth
• Crop canopy
• Weather
• Soil moisture
- Allowable depletion
- Irrigation system application rate
- Irrigation system application uniformity
- Leaching fraction (water salinity)
- And more
CropManage

Database driven web application

Crop ET model → Watering Recommendation
Crop N model → N fertilizer Recommendation

Soil and Ranch

CIMIS ET0

Soil nitrate test

Field sensors
How is N fertilizer rate determined?

Fertilizer N = Crop N uptake – Soil N

Soil N:
- Quick Test N (ppm NO₃-N)
- Soil mineralization N
- Plant residue N
Tools for Managing Water and Nitrogen Fertilizer in Lettuce

- Quick nitrate soil test
  (20 ppm NO$_3$-N = 70 to 80 lbs of N/acre/ft)
- Weather-based irrigation scheduling
Commercial Lettuce Nitrogen Fertilizer Trials

Std: 212 lbs N/Acre
BMP: 146 lbs N/Acre

Difference
66 lbs/A
30% reduction in N fertilizer

(Cahn and Smith, 2011)
97% of Grower

(Cahn and Smith, 2011)
Web-based Irrigation and N management software for lettuce

ucanr.org/cropmanage
Login

To login enter your e-mail and password below.

E-mail Address: asbiscaro@ucdavis.edu

Password: ******

Login

Forgot Password
Create New Account
Ranch List

Select a Ranch to work in from the list below.

- Freyer
- Home
- Onion test
- test
- UCCE ranch
- USDA-ARS Spence

[New Ranch]  [Request Access to a Ranch]

Getting Started
Add Ranch

Ranch Information

Ranch Name

Ranch Owner: Andre Biscaro

Acres: 0

Soil Type: Antioch very fine sandy loam
Info for creating a ranch and field:

Location, soil type, crop, acreage, planting and harvesting dates, previous crop, previous harvest date, sprinkler application (in/h), sprinkler distribution uniformity (%), drip application rate (in/h), drip distribution uniformity (%), leaching factor, maximum crop N uptake, default days to next fertilization, flow meter data, coordinates;
# Plantings

Showing current Plantings

<table>
<thead>
<tr>
<th>Planting</th>
<th>Wet Date</th>
<th>Harvest Date</th>
<th>Lot</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iceberg</td>
<td>2/9/2013</td>
<td>7/25/2013</td>
<td>1</td>
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<tr>
<td>romaine 2</td>
<td>1/1/2013</td>
<td>3/27/2013</td>
<td>1</td>
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</tr>
<tr>
<td>winegrapes</td>
<td>12/26/2012</td>
<td>3/27/2013</td>
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</tr>
<tr>
<td>VEG/STRAW</td>
<td>1/9/2013</td>
<td>5/4/2013</td>
<td>2</td>
<td>View Detailed View Edit</td>
</tr>
</tbody>
</table>
Crop: Romaine 2 row, 40 inch bed

**Latest Events (by type)**

- **Soil Sample**: February 8, 2013, Soil N: 44.78 (ppm)
- **Fertilization**: February 8, 2013, Applied Fertilizer: 0.0 gallons/acre
- **Watering**: February 8, 2013, Rainfall: 0.05 (inches), Rain since last irrigation: 0.07 (inches)

**Last 5 Events (by date)**

- **February 8, 2013**: Sample: 44.78 (ppm), Fertilizer: 0.0 gallons/acre, Rainfall: 0.05 (inches), Total Rainfall: 0.07 (inches)
- **February 5, 2013**: Irrigation: 0.08 (inches)
- **January 25, 2013**: Fertilizer: 14.0 gallons/acre
- **January 23, 2013**: Sample: 50.88 (ppm)
- **January 22, 2013**: Irrigation: 0.08 (inches)
### Fertilizer Summary

<table>
<thead>
<tr>
<th>Fertilizer Date</th>
<th>Crop Stage</th>
<th>Soil NO₃-N (ppm)</th>
<th>Fertilizer N Recommended (lb N/acre)</th>
<th>Cumulative N Uptake</th>
<th>Fertilizer</th>
<th>Applied N (lb N/acre)</th>
<th>Applied Fertilizer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/1/13</td>
<td>Planting</td>
<td>20.00</td>
<td>0.2</td>
<td>0.00</td>
<td>15-8-4</td>
<td>3.1</td>
<td>2.0 gallons/acre</td>
</tr>
<tr>
<td>1/25/13</td>
<td>Post-thinning</td>
<td>20.00</td>
<td>30.4</td>
<td>4.77</td>
<td>CAN-17</td>
<td>30.0</td>
<td>14.0 gallons/acre</td>
</tr>
<tr>
<td>2/8/13</td>
<td>1st sidedress</td>
<td>N/A</td>
<td>N/A</td>
<td>11.33</td>
<td>UAN32</td>
<td>0.0</td>
<td>0.0 gallons/acre</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>33.1</td>
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</table>

### 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>
<th>Average Reference ET (inches/day)</th>
<th>Total Crop ET (inches)</th>
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</thead>
<tbody>
<tr>
<td>1/1/13</td>
<td>Sprinkler</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td>1/5/13</td>
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<td>N/A</td>
<td>N/A</td>
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<td>0.06</td>
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<tr>
<td>1/9/13</td>
<td>rainfall</td>
<td>N/A</td>
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<td>1.20</td>
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**Add / Edit Watering**

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<td>N/A</td>
<td>1.20 in</td>
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<tr>
<td>1/6/13</td>
<td>rainfall</td>
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<td>N/A</td>
<td>N/A</td>
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<tr>
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<td>0.05 in</td>
<td>0.16 hrs</td>
<td>0.15 in</td>
<td>0.30</td>
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<td>0.04</td>
<td>0.07</td>
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<td>1/18/13</td>
<td>Drip</td>
<td>14.4</td>
<td>0.11 in</td>
<td>0.71 hrs</td>
<td>0.15 in</td>
<td>0.22</td>
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<td>Drip</td>
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<td>0.08 in</td>
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<td>3</td>
<td>0.07</td>
<td>0.03</td>
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# Add / Edit Fertilizer

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<td></td>
<td><strong>33.1</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Previous Fertilization

- **Fertilization Date**: 2/8/2013
- **Days To Next Fertilization**: 10
- **Crop Stage**: 1st sidedress
- **Soil Sample**: N (avg): 0.00 lbs/gallon
- **Fertilizer Type**: UAN32 - Liquid: 11.1 lbs/gallon
- **Fertilizer Applied**: 0 lbs N/acre, 0.0 gallons/acre
Previous Fertilization

Fertilization Date: 2/8/2013
Days To Next Fertilization: 10
Crop Stage: 1st sidedress
Soil Sample: N (avg): 0.00 lbs/gallon
Fertilizer Type: UAN32 - Liquid: 11.1 lbs/gallon
Fertilizer Applied: 0 lbs N/acre, 0.0 gallons/acre

Fertilization Date: 02/11/2013
Days To Next Fertilization: 10
Crop Stage: 1st sidedress
Soil Sample: 2/8 - Post-thinning. N (avg): 0.00 lbs/gallon
Fertilizer Type: Select fertilizer Type

Save Fertilizer
Fertilization Date: 2/8/2013

Days To Next Fertilization: 10

Crop Stage: 1st sidedress

Soil Sample: 2/8 - Post-thinning, N (avg): 1

Fertilizer Type: UAN32 - Liquid: 11.1 lbs/gallon

Fertilizer Details:
- UAN32
- Formulation: Liquid
- Nutrients: Nitrogen, 32%

Previous Fertilization:
- Fertilization Date: 1/25/2013
- Days To Next Fertilization: 15
- Crop Stage: Post-thinning
- Soil Sample: 1/23/2013
- Pre-thinning, N (avg): 12.50 lbs/gallon
- Fertilizer Type: CAN-17 - Liquid: 12.6
- Fertilizer Applied: 30 lbs N/acre 14.0 gallons/acre

Recommended Fertilizer: 43.0 lbs N/acre at 32.0% = 12 gallons/acre

Fertilizer Applied: 0 lbs N/acre = 0.0 gallons/acre
Soil Water Tension Data

- Watermark sensors
- 2 onion fields in Lancaster
- 4 irrigation sections per field
- 2 depths (8 and 18 inches)
- Drip irrigated
- Mostly loamy sand and sand loam
Sensors

Watermarks

Tensiometers

Dielectric
... a few questions if you don’t mind:

- How many of you are growers or PCA’s?

- How many of you have used soil moisture sensors for irrigation management before?

- What about ET data from CIMIS?
Minn Sensor 1 - Loamy sand

<table>
<thead>
<tr>
<th>% time dry</th>
<th>8w</th>
<th>8c</th>
<th>8e</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>13</td>
<td>17</td>
<td>19</td>
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</table>
### % time dry

<table>
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<tr>
<th></th>
<th>8w</th>
<th>8c</th>
<th>8e</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry</td>
<td>35</td>
<td>35</td>
<td>37</td>
</tr>
</tbody>
</table>
Be Aware of Soil Spatial Variability
Conclusions from Scott and Shasta Valleys Study

• Summary of 85 alfalfa fields

Over  Under  Over & Under  Ok

83% could be improved!

(Orloff, 1999 and 2000)
Research Plan for 2013

Monitor 3 onion fields devising algorithms for CropManage

Weekly measurements:
• Infra-red photos of canopy cover – Kc
• Rooting depth
• Biomass samples and total N analysis - N uptake curve
• Soil moisture release, bulk density

Also:
• Use CIMIS data and quick nitrate test
• Soil water tension
• Soil EC and texture maps
• Yield
Summary

- Monitoring SWT and using CIMIS data are important irrigation scheduling tools for shallow rooted vegetables like onions.

- Managing irrigation can be deceiving.

- Water and N recommendation calculations can be complicated and time consuming.

- CropManage can assist onion growers in improving management of nitrogen fertilizer and water.
Potential IPM Related Benefits?

- Reduce plant water stress
- Keep pesticides in the root zone
Thank you note:

- Calandri Sonrise Farms
- Garlic and Onion Board
- Mike Cahn, UCCE Farm Advisor

Questions?