CropManage: an online decision support tool for irrigation and fertilization

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Change in Nitrate Concentration
1993 to 2007
(Nitrate as NO₃)

Legend:
- 0.1 - 0.75 mg/L, Increase since 1993
- 0.1 - 0.5 mg/L, Increase since 1993
- No Change since 1993
- 0.1 - 0.5 mg/L, Increase since 1993
- 0.1 - 0.2 mg/L, Increase since 1993

Salinas Valley Basin Plan

TIER 3
DISCHARGERS ENROLLED UNDER
THE CONDITIONAL WAIVER OF WASTE DISCHARGE REQUIREMENTS FOR
DISCHARGES FROM IRRIGATED LANDS

This Monitoring and Reporting Program Order No. R3-2012-0011-03 (MRP) is issued pursuant to California Water Code Sections 13267 and 13269, which authorize the California Regional Water Quality Control Board, Central Coast Region (hereafter Central Coast Water Board) to require preparation and submittal of technical and monitoring reports. Water Code Section 13269 requires a waiver of waste discharge requirements to include as a condition, the performance of monitoring and the public availability of monitoring results. The Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands Order No. R3-2012-0011 (Order) includes criteria and requirements for three tiers. This MRP sets forth monitoring and reporting requirements for Tier 3 Dischargers enrolled under the Order. A summary of the requirements is shown below.

SUMMARY OF MONITORING AND REPORTING REQUIREMENTS FOR TIER 3:
Part 1: Surface Receiving Water Monitoring and Reporting (cooperative or individual);
Part 2: Groundwater Monitoring and Reporting;
Nitrate Loading Risk Factor Determination and Total Nitrogen Reporting (required for subset of Tier 3 Dischargers if farm/ranch has high nitrate loading risk to groundwater);
Part 3: Annual Compliance Form;
Part 4: Photo Monitoring (required for subset of Tier 3 Dischargers if farm/ranch contains or is adjacent to a waterbody impaired for temperature, turbidity or sediment);
Part 5: Individual Surface Water Discharge Monitoring and Reporting;
Part 6: Irrigation and Nutrient Management Plan (required for subset of Tier 3 Dischargers if farm/ranch has high nitrate loading risk);
Part 7: Water Quality Buffer Plan (required for subset of Tier 3 Dischargers if farm/ranch contains or is adjacent to waterbody impaired for temperature, turbidity or sediment);

Ag Order

Lower Salinas Nutrient TMDL

Addressing Nitrate in California’s Drinking Water
With a Focus on Tulare Lake Basin and Salinas Valley Groundwater
SWRCB SBX2 1

Lower Salinas Nutrient TMDL

California Nitrate Project,
Implementation of Senate Bill SBX2 1
Center for Watershed Sciences
University of California, Davis
http://groundwaternitrate.ucdavis.edu
Tools for Managing Water and Nitrogen Fertilizer in Vegetables

- Soil nitrate quick test
- Weather-based irrigation scheduling
Weather-based irrigation scheduling

Converting Reference ET to Crop ET:

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

\( K_c \) can vary from 0.1 to 1.2
Days after Planting

Canopy Cover (%)

Iceberg lettuce canopy cover

Days after Planting
Other information needs to be considered

- Rooting Depth
- Irrigation System Uniformity and Application Rate
- Soil Type
- Salinity of Water Source
Web-based Irrigation and N management software for lettuce

https://ucanr.edu/cropmanage

Login

To login enter your e-mail and password below.

E-mail Address: mdcahn@ucdavis.edu
Password: Password

Login
Forgot Password
Create New Account
Integrate information from multiple sources

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

Database Driven Web Application

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

Display and export water and fertilizer records

Decision support using crop models
Steps to Using CropManage

1. Establish User Login
2. Assign to Ranch or start New Ranch
3. View Planting within Ranch or Add New Planting
4. View or enter soil tests, fertilizer, or irrigation events
Current crops supported

Vegetables:
- Romaine lettuce
- Iceberg lettuce
- Broccoli
- Cauliflower
- Cabbage
- Spinach*
- Celery*
- Onions*

Berries:
- Strawberry
- Raspberry*
- Blackberry*
How is N fertilizer rate determined from the quick nitrate test?

Recommended
Fertilizer N = Future Crop N uptake

- (Quick Test N - threshold NO$_3$-N)

- Soil mineralization N

- Plant residue N

- N in irrigation water
## Fertilizer Summary

<table>
<thead>
<tr>
<th>Fertilizer Date</th>
<th>Soil NO₃-N (ppm)</th>
<th>Crop Stage</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>
<th>Soil NO₃-N (ppm)</th>
<th>Crop Stage</th>
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<th>Cumulative N Uptake</th>
<th>Fertilizer</th>
<th>Applied N (lb N/acre)</th>
<th>Applied Fertilizer</th>
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<tr>
<td>7/1/12</td>
<td>12.50</td>
<td>Planting</td>
<td>0.0</td>
<td>0.23</td>
<td>3.5-12-14</td>
<td>15.0</td>
<td>36.9 gal/acre</td>
<td>7/1/12</td>
<td>12.50</td>
<td>0.0</td>
<td>0.23</td>
<td>3.5-12-14</td>
<td>15.0</td>
<td>36.9 gal/acre</td>
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<td>7/24/12</td>
<td>15.00</td>
<td>1st drip fertigation</td>
<td>31.2</td>
<td>4.32</td>
<td>28-0-0-5</td>
<td>24.8</td>
<td>8.0 gal/acre</td>
<td>7/24/12</td>
<td>15.00</td>
<td>31.2</td>
<td>4.32</td>
<td>28-0-0-5</td>
<td>24.8</td>
<td>8.0 gal/acre</td>
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<td>2nd drip fertigation</td>
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<td>UAN28</td>
<td>56.7</td>
<td>19.0 gal/acre</td>
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<td>31.90</td>
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<td>Water Date</td>
<td>Irrigation Method</td>
<td>Recommended Irrigation Interval (days)</td>
<td>Recommended Irrigation Amount (inches)</td>
<td>Recommended Irrigation Time (hours)</td>
<td>Irrigation Water Applied (inches)</td>
<td>Kc</td>
<td>Canopy Cover (%)</td>
<td>Average Reference ET (inches/day)</td>
<td>Total Crop ET (inches)</td>
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<td>7/8/12</td>
<td>Sprinkler</td>
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<td>1.59 hrs</td>
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<td>29.70 hrs</td>
<td>6.03 in</td>
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<td>4.38 in</td>
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</table>
How much water was applied?

Flow Meter Data on Oct 17, 2012

Flow data graph showing the rate of water applied from 1:00 PM to 5:00 PM. The graph indicates a steady flow rate from 2:00 PM to 4:00 PM with a slight drop in the final hour.
Using weather based irrigation scheduling for broccoli

<table>
<thead>
<tr>
<th>Irrigation Treatment</th>
<th>Applied water inches</th>
<th>Marketable Yield</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Crown</td>
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<tr>
<td>Grower Standard (150% ET)</td>
<td>20.4</td>
<td>6797</td>
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<tr>
<td>CropManage (100% ET)</td>
<td>14.2</td>
<td>6747</td>
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<tr>
<td><strong>LSD</strong>$_{0.05}$</td>
<td><strong>NS</strong></td>
<td>1052</td>
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</table>
Summary of Commercial Lettuce Strip Trials (2012-2013)

33% (57 lbs N/Ac) less N applied following CropManage
Clientele interest

> 550 users
> 250 Ranches
> 6700 visits to CM blog since Dec 2013
The road ahead...
Would a “cropmanage” approach be helpful for growing processing tomatoes?

N management guidelines for processing tomato (Tim Hartz):

- Develop a fertigation template based on realistic yield potential, and soil type (in-season N mineralization potential)
- Determine residual soil NO₃-N early in the season, and modify the template to reflect the residual, primarily by delaying / reducing fertigation on the front end
- If irrigation water NO₃-N is high, adjust for N content
Soil residual NO₃-N varied from 23-219 lb/acre, averaged 80 lb/acre.

Grower N application ranged from 115-320 lb/acre, averaged 190 lb/acre.

Data from Horwath et al., 2013
Water is still in short supply

Dec 1, 2014

January 6, 2015
Summary

- Web applications can be useful for repackaging research results into simple to use decision support tools.

- *CropManage* has been useful for helping growers improve water and N management on field-by-field basis and document their practices.

- Opportunities exist for expanding CM to additional commodities and adding in new features and data sources.