CropManage 3.0: Bringing water and nitrogen management decision support to the field

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Acknowledgements:

- UCCE Advisors/Specialists
- UC ANR and Breyta programming staff
- CDFA-Fertilizer Research Education Program
- CDFA-Specialty Crop Research Grant Program
- CA Dept of Water Resources
- UC Division of Agriculture and Natural Resources
- Growers and Shippers
# Nitrogen Use Reporting

**Tier 2/Tier 3 Farms with High Nitrate Loading Risk**

**Total Nitrogen Applied Report - Ranch/Risk Unit & Field/Block**

<table>
<thead>
<tr>
<th>AW#:</th>
<th>Ranch Global ID:</th>
<th>Ranch/Risk Unit or Field/Block Name:</th>
<th>Physical Ranch Acres Reporting:</th>
</tr>
</thead>
<tbody>
<tr>
<td>County:</td>
<td>APN(s):</td>
<td></td>
<td>Fallow Acres:</td>
</tr>
<tr>
<td>If ranch is a greenhouse, nursery, or hydroponic, select from the dropdown:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Section I: General Ranch Information** (Space for more parcels and multiple counties available on page 2)

**Section II: Nitrogen Applied with Irrigation Water** (Include all uses, e.g., leaching; and all sources, e.g., CSP or PVWMA delivered water)

**Section II-A: PVWMA/CSP water use**

- Average Nitrate Concentration in Well/City Water (mg/L)
- Estimated Total Volume of Well/City Water Applied to Entire Reporting Acres During Reporting Period (gallons)
- Nitrogen Applied with Irrigation Water (lbs/ranch-ac)

**Section II-B: PVWMA/CSP water**

- Estimated Total Volume of Well/City Water Applied to Entire Reporting Acres During Reporting Period (gallons)

**Section II-C: Well/city water (or other non-PVWMA/CSP source)**

**Section II-D: Nitrogen applied**

**Section II-E: Volume Check**

This field auto-calculates. After completing Sections II-A, II-B, II-C, and II-D, this field auto-calculates. Do not report this information in both sections.

**Section III: Nitrogen Applied with Compost & Amendments**

- Physical Acres Receiving Compost & Amendments
- Nitrogen Applied in Compost & Amendments (total lbs)

**Section IV: Nitrogen Applied with Fertilizers & Other Materials and Nitrogen Present in Soil** (Select from List on Page 3)

<table>
<thead>
<tr>
<th>Specific Crop(s) Grown and Harvested During Reporting Period</th>
<th>Total Crop Acres</th>
<th>Nitrogen Present in Soil (lbs/ac)</th>
<th>Nitrogen Applied in Fertilizers and Other Materials (lbs/crop-ac)</th>
<th>O/C</th>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
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</tr>
<tr>
<td>3.</td>
<td></td>
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</tr>
<tr>
<td>4.</td>
<td></td>
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</tr>
<tr>
<td>5.</td>
<td></td>
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<tr>
<td>6.</td>
<td></td>
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</tr>
<tr>
<td>7.</td>
<td></td>
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</tr>
<tr>
<td>8.</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**

- Hover over the cells/boxes with your mouse for more information on what is required. Refer to instructions for further detail.

**Click below to clear the corresponding section of the form.**

**Regional Board Order R3-2012-0011**

- Reporting Period: 09/01/2015 to 08/31/2016
- Any changes to the reporting period must be approved or forms will not be accepted.
Tools for making water and nitrogen fertilizer decisions at the field level

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

Converting Reference ET to Crop ET:

$$ET_{crop} = ET_{ref} \times K_{crop}$$

$K_c$ can vary from 0.1 to 1.2
Salinity of Water Source

Soil Type

Application Rate

Irrigation System Uniformity and

Rooting Depth

Other Information needs to be considered
and field staff can be challenging

Communication between decision maker

Consumming management decisions are time

Calculations involved for N and water

Coordinate other decisions and activities to

Multiple fields to manage and track

Water and fertilizer: On-farm challenges in implementing tools for managing
CropManage: Online irrigation and nitrogen management decision support tool

Lettuce-Romaine, 2 row, 40-inch bed
27 Mar 2017 - 31 May 2017

Events
Add:  

Upcoming | Past

23 May 2017

- Drip  6.58 hr
- 20-0-0-5  11.90 gal/acre

19 May 2017

- Drip  4.84 hr

View all events by:  

v3.cropmanage.ucanr.edu
Integrate information from multiple sources

Database driven web application

Crop ET model

Watering Recommendation

N fertilizer Recommendation

Crop N model

Display and export water and fertilizer records

Decision support using crop models

Soil and Ranch

CIMIS ETo

Soil nitrate test

Field sensors
Crops currently supported

Vegetables:
  Romaine lettuce
  Iceberg lettuce
  Leaf lettuce
  Baby lettuce (red, green)
  Broccoli
  Cauliflower
  Cabbage (red and green)
  Celery
  Spinach (baby, teen, bunch)
  Mizuna
  Cilantro

Berries
  Strawberry (UC and proprietary varieties)
How is N fertilizer rate determined from the soil nitrate quick 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*
Crop N uptake models
Nitrogen Fertilizer Recommendation for Vegetables

\[ N \text{ fert} = 57 + 18 - 4.5 - 5 = 66 \text{ lbs N/acre} \]

N uptake curve

N uptake = 57 lbs/acre

Irrigation water = 5 lbs/acre

Soil and residue mineralization = 4.5 lbs/acre

Soil NO$_3$-N (ppm)

SNQT - Threshold = -18 lbs/acre
**CropManage Evolved**

**2005 spreadsheet**

**2011 V1.0 launched**

<table>
<thead>
<tr>
<th>Water Date</th>
<th>Irrigation Method</th>
<th>Irrigation Interval (days)</th>
<th>Recommended Irrigation Interval (days)</th>
<th>Recommended Irrigation Time (hrs)</th>
<th>Recommended Irrigation Amount (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/5/11</td>
<td>Sprinkler</td>
<td>0</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>6/10/11</td>
<td>Sprinkler</td>
<td>2</td>
<td>2.3</td>
<td>0.70 hrs</td>
<td>0.21 in</td>
</tr>
<tr>
<td>6/12/11</td>
<td>Sprinkler</td>
<td>2</td>
<td>2.5</td>
<td>0.63 hrs</td>
<td>0.19 in</td>
</tr>
<tr>
<td>6/22/11</td>
<td>Sprinkler</td>
<td>10</td>
<td>7.2</td>
<td>1.11 hrs</td>
<td>0.33 in</td>
</tr>
<tr>
<td>7/2/11</td>
<td>Sprinkler</td>
<td>10</td>
<td>8.1</td>
<td>0.33 hrs</td>
<td>0.10 in</td>
</tr>
<tr>
<td>7/8/11</td>
<td>Drip</td>
<td>6</td>
<td>5.8</td>
<td>4.15 hrs</td>
<td>0.42 in</td>
</tr>
<tr>
<td>7/15/11</td>
<td>Drip</td>
<td>4</td>
<td>12.8</td>
<td>1.45 hrs</td>
<td>0.14 in</td>
</tr>
<tr>
<td>7/18/11</td>
<td>Drip</td>
<td>6</td>
<td>7.3</td>
<td>3.90 hrs</td>
<td>0.39 in</td>
</tr>
</tbody>
</table>

**2013 V1.1**

**2015 V2 launched**

**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>Irrigation Water Applied (inches)</th>
<th>Canopy Cover (%)</th>
<th>Average Reference ET (inches/day)</th>
<th>Total Crop ET (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/6/12</td>
<td>Sprinkler</td>
<td>1.6</td>
<td>0.48 in</td>
<td>1.98 hrs</td>
<td>0.60 in</td>
<td>0.48</td>
<td>0.25 in</td>
</tr>
<tr>
<td>7/10/12</td>
<td>Sprinkler</td>
<td>2.0</td>
<td>0.47 in</td>
<td>1.97 hrs</td>
<td>0.61 in</td>
<td>0.48</td>
<td>0.24 in</td>
</tr>
<tr>
<td>7/20/12</td>
<td>Drip</td>
<td>8.5</td>
<td>0.41 in</td>
<td>2.70 hrs</td>
<td>0.45 in</td>
<td>0.49</td>
<td>0.22 in</td>
</tr>
<tr>
<td>7/24/12</td>
<td>Drip</td>
<td>9.4</td>
<td>0.19 in</td>
<td>1.25 hrs</td>
<td>0.22 in</td>
<td>0.16</td>
<td>0.25 in</td>
</tr>
<tr>
<td>7/29/12</td>
<td>Drip</td>
<td>11.2</td>
<td>0.23 in</td>
<td>1.56 hrs</td>
<td>0.15 in</td>
<td>0.18</td>
<td>0.22 in</td>
</tr>
<tr>
<td>8/4/12</td>
<td>Drip</td>
<td>9.2</td>
<td>0.46 in</td>
<td>3.03 hrs</td>
<td>0.60 in</td>
<td>0.27</td>
<td>0.24 in</td>
</tr>
<tr>
<td>8/7/12</td>
<td>Drip</td>
<td>7.6</td>
<td>0.26 in</td>
<td>1.76 hrs</td>
<td>0.20 in</td>
<td>0.40</td>
<td>0.19 in</td>
</tr>
<tr>
<td>8/10/12</td>
<td>Drip</td>
<td>4.9</td>
<td>0.44 in</td>
<td>2.95 hrs</td>
<td>0.30 in</td>
<td>0.50</td>
<td>0.25 in</td>
</tr>
<tr>
<td>8/14/12</td>
<td>Drip</td>
<td>4.0</td>
<td>0.70 in</td>
<td>4.90 hrs</td>
<td>0.00 in</td>
<td>0.06</td>
<td>0.20 in</td>
</tr>
<tr>
<td>8/19/12</td>
<td>Drip</td>
<td>4.1</td>
<td>0.82 in</td>
<td>5.49 hrs</td>
<td>0.00 in</td>
<td>0.77</td>
<td>0.20 in</td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.39 in</td>
</tr>
</tbody>
</table>
CropManage 3.0

*Bringing CropManage to the field*

- Simplify user interface
- Easy to read on smart phones and tablet computers
- Intuitive to navigate
- Simple for field staff to use (irrigators, foremen)
- Designed better for communicating between decision makers and field staff
# Ranch List (all)

## Filter Ranches by Name

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>E</td>
<td>F</td>
</tr>
<tr>
<td>G</td>
<td>H</td>
<td>I</td>
</tr>
<tr>
<td>J</td>
<td>K</td>
<td>L</td>
</tr>
<tr>
<td>M</td>
<td>N</td>
<td>O</td>
</tr>
<tr>
<td>P</td>
<td>Q</td>
<td>R</td>
</tr>
<tr>
<td>S</td>
<td>T</td>
<td>U</td>
</tr>
<tr>
<td>V</td>
<td>W</td>
<td>X</td>
</tr>
<tr>
<td>Y</td>
<td>Z</td>
<td>#</td>
</tr>
</tbody>
</table>

## Ranches

<table>
<thead>
<tr>
<th>Ranch Name</th>
<th>Owner</th>
<th>Active Plantings</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALBA student demo plot</td>
<td>Laura Murphy</td>
<td>0</td>
</tr>
<tr>
<td>Aptos</td>
<td>Michael Cahn</td>
<td>0</td>
</tr>
<tr>
<td>Arts Ranch - UC trial</td>
<td>Andre Biscaro</td>
<td>0</td>
</tr>
<tr>
<td>Backus</td>
<td>Michael Cahn</td>
<td>0</td>
</tr>
<tr>
<td>Bird</td>
<td>Michael Johnson</td>
<td>1</td>
</tr>
<tr>
<td>Blanco</td>
<td>Manuel Mercado</td>
<td>0</td>
</tr>
<tr>
<td>Bondenson</td>
<td>Michael Cahn</td>
<td>0</td>
</tr>
<tr>
<td>Bondsen</td>
<td>Kyle Pollock</td>
<td>8</td>
</tr>
<tr>
<td>Borchard</td>
<td>Michael Cahn</td>
<td>0</td>
</tr>
<tr>
<td>Broome Ranch</td>
<td>Richard Smith</td>
<td>0</td>
</tr>
<tr>
<td>Bruscia</td>
<td>Michael Johnson</td>
<td>0</td>
</tr>
<tr>
<td>Byron's Test</td>
<td>Byron Noel</td>
<td>0</td>
</tr>
</tbody>
</table>
Ranch List (favorites)
Ranch Settings
Planting Summary

- Strawberry bed: 30 Nov 2016 - 31 Oct 2017
- Broccoli Planting: 13 Jul 2017 - 9 Oct 2017
- Quick Nitrator Strip: 14 Aug 2017
Planting Summary

Broccoli test
Lot 3
Broccoli 2 row, 40-inch bed, summer, sprinkler
13 Jul 2017 - 9 Oct 2017

Events
Upcoming | Past

15 Aug 2017 | Today
No Events Today
Planting Summary

Broccoli test
Lot 3

Broccoli 2 row, 40-inch bed, summer, sprink...
13 Jul 2017 - 9 Oct 2017

Events
Upcoming | Past 1

15 Aug 2017
Today

No Events Today

View all events by:
<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Manager</th>
<th>inches</th>
<th>0.20 in./day</th>
<th>0.33</th>
<th>90.00%</th>
<th>11 Days</th>
<th>0%/100</th>
<th>0.01 in.</th>
<th>0.82 = (0.20 inches x 0.33 x 11 x 100) / 90.00</th>
<th>0.81 = (0.82 in. / (1 - 0) - 0.01 in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CropManage</td>
<td>hours</td>
<td>recommendation Summary</td>
<td>Average ET</td>
<td>Average Crop Coefficient</td>
<td>Distribution Uniformity</td>
<td>Days Since Last Irrigation</td>
<td>Leaching Requirement</td>
<td>Total Precipitation</td>
<td>Base Amount = (Average ET x Average Crop Coefficient) x Days Since Last Irrigation x 100 / Distribution Uniformity</td>
</tr>
</tbody>
</table>
Broccoli test
Lot 3

Broccoli 2 row, 40-inch bed, summer, sprinkle...

13 Jul 2017 - 9 Oct 2017

Events
Upcoming | Past 1

Add:

15 Aug 2017
Drip

5.40 hr
Edit Watering Event

08/15/2017

Irrigation Method: Drip

Recommendations:

Crop Manager: 5

Water Applied: 

Save

Cancel

Delete
Broccoli 2 row, 40-inch bed, summer, sprinkler...
13 Jul 2017 - 9 Oct 2017

Events

Upcoming | Past

15 Aug 2017 Today

Drip

5.00 hr

Michael Cahn 8/15/2017 - 10:07 AM
<table>
<thead>
<tr>
<th>Events</th>
<th>Upcoming</th>
<th>Past 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 Aug 2017</td>
<td>Drip</td>
<td>10:00 hr</td>
</tr>
<tr>
<td>04 Aug 2017</td>
<td>Sprinkler</td>
<td>2:00 hr</td>
</tr>
</tbody>
</table>

**Broccoli**

Lot 3

13 Jul 2017 - 9 Oct 2017

Broccoli 2 row, 40-inch bed, summer, sprinkler...
## Summary Table

### All Events

**Broccoli test | 3**

<table>
<thead>
<tr>
<th>Date</th>
<th>Water</th>
<th>Water Quantity</th>
<th>Fertilizer</th>
<th>Fertilizer Quantity</th>
<th>Soil Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/15/2017</td>
<td>Drip</td>
<td>10.0 hr</td>
<td>28-0-0-5</td>
<td>15.00 gal/acre</td>
<td></td>
</tr>
<tr>
<td>8/14/2017</td>
<td>Sprinkler</td>
<td>2.0 hr</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8/4/2017</td>
<td>Sprinkler</td>
<td>1.5 hr</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8/1/2017</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7/25/2017</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Totals

- **4.50 in.**
- **46.45 lbs N/acre**
- **2 Events**
## Summary Table (Water)

<table>
<thead>
<tr>
<th>Date</th>
<th>Irrigation Method</th>
<th>Irrigation Interval</th>
<th>Recommended Max Irrigation Interval</th>
<th>Recommended Water</th>
<th>Applied Water</th>
<th>Rainfall</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/15/2017</td>
<td>Drip</td>
<td>11 days</td>
<td>8.4 days</td>
<td>5.0 hr</td>
<td>10.0 hr</td>
<td>0.00 in.</td>
</tr>
<tr>
<td>8/4/2017</td>
<td>Sprinkler</td>
<td>10 days</td>
<td>6.3 days</td>
<td>1.6 hr</td>
<td>2.0 hr</td>
<td>0.00 in.</td>
</tr>
<tr>
<td>7/25/2017</td>
<td>Sprinkler</td>
<td>8 days</td>
<td>4.4 days</td>
<td>1.5 hr</td>
<td>0.0 hr</td>
<td>0.00 in.</td>
</tr>
<tr>
<td>7/17/2017</td>
<td>Germination Sprinkler</td>
<td>2 days</td>
<td>1.1 days</td>
<td>1.8 hr</td>
<td>2.0 hr</td>
<td>0.00 in.</td>
</tr>
<tr>
<td>7/15/2017</td>
<td>Germination Sprinkler</td>
<td>2 days</td>
<td>1.3 days</td>
<td>2.0 hr</td>
<td>2.0 hr</td>
<td>0.00 in.</td>
</tr>
</tbody>
</table>

**Totals**
- Rainfall Data: 4.50 in. (4.50 in. + 0.00 in.)
- Flowmeter Data: 2.82 in. (Recommended Water), 4.50 in. (Applied Water), 0.00 in. (Rainfall)
Flowmeters can be used to evaluate irrigation application
Spatial CIMIS ET0 Reporting
Future developments...
Summary

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

- *CropManage* is designed to help growers improve water and N management practices

- UC will continue to adapt CM to more commodities and add new features

- *CropManage* hands-on workshops will be scheduled for winter