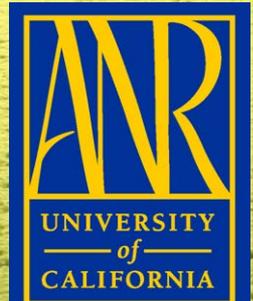
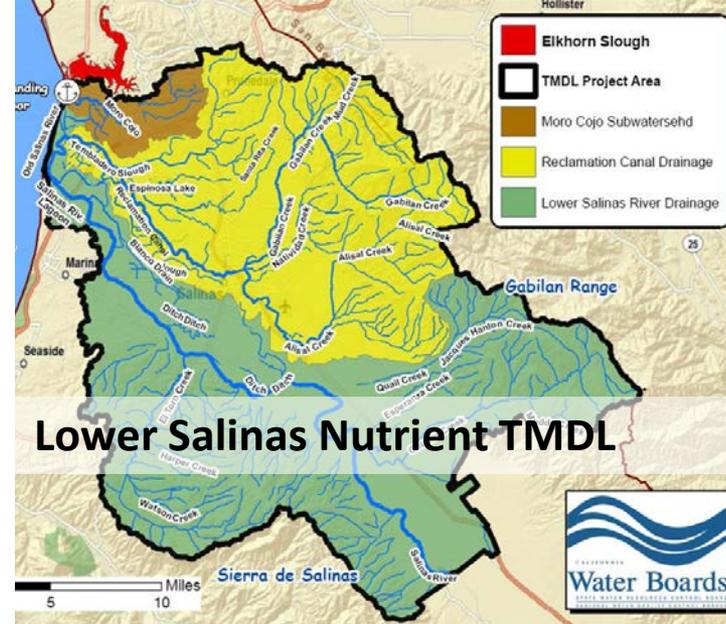
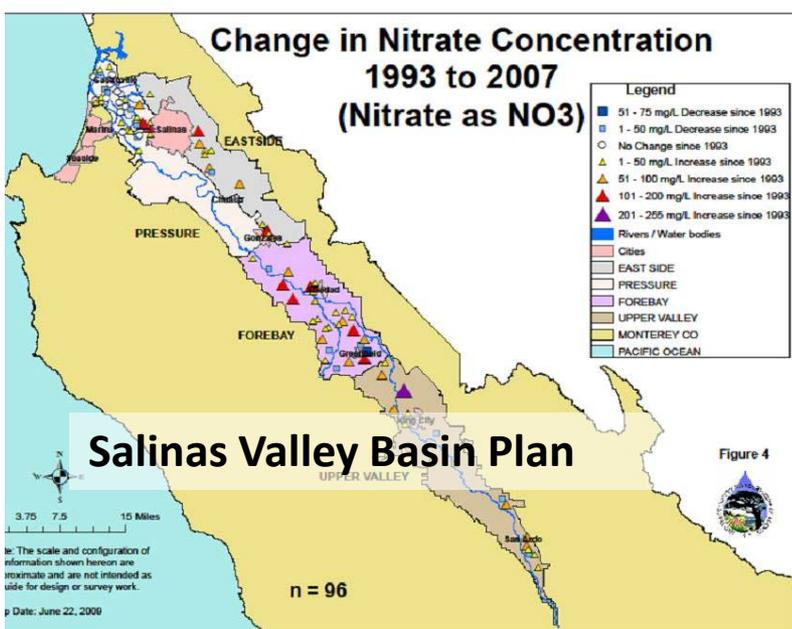


# CropManage: an online decision support tool for irrigation and fertilization



**Mike Cahn**  
Irrigation and Water Resources Advisor  
UC Cooperative Extension, Monterey County





### 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 section 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.

Ag Order

#### 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 a waterbody impaired for temperature, turbidity or sediment)*;

## Addressing Nitrate in California's Drinking Water

With a Focus on Tulare Lake Basin and Salinas Valley Groundwater

### SWRCB SBX2 1

Report for the State Water Resources Control Board Report to the Legislature



California Nitrate Project,  
Implementation of Senate Bill X2 1

Center for Watershed Sciences  
University of California, Davis  
<http://groundwater.nitrate.ucdavis.edu>

# Tools for Managing Water and Nitrogen Fertilizer in Vegetables

- Soil nitrate quick test
- Weather-based irrigation scheduling



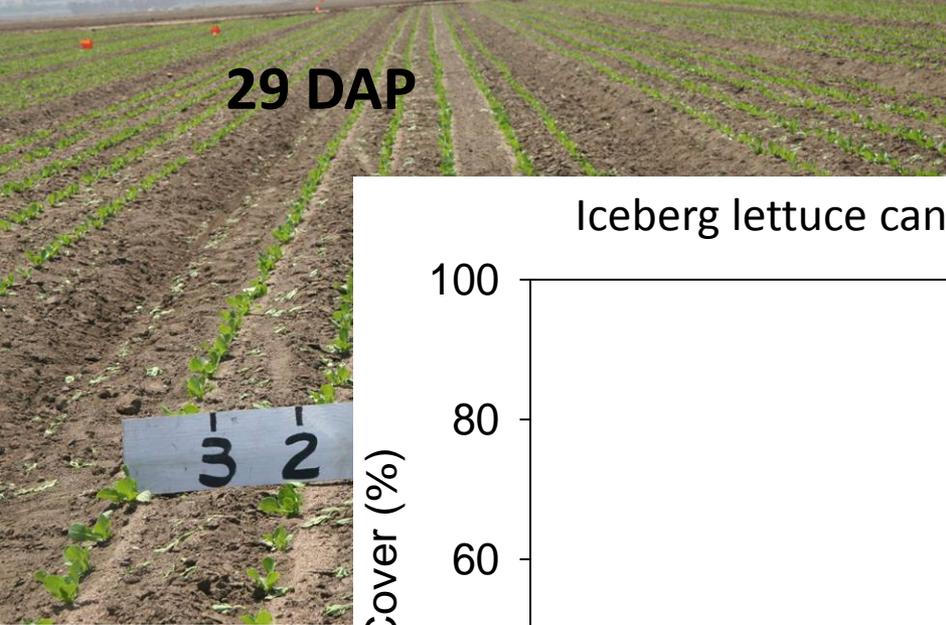
# Weather-based irrigation scheduling



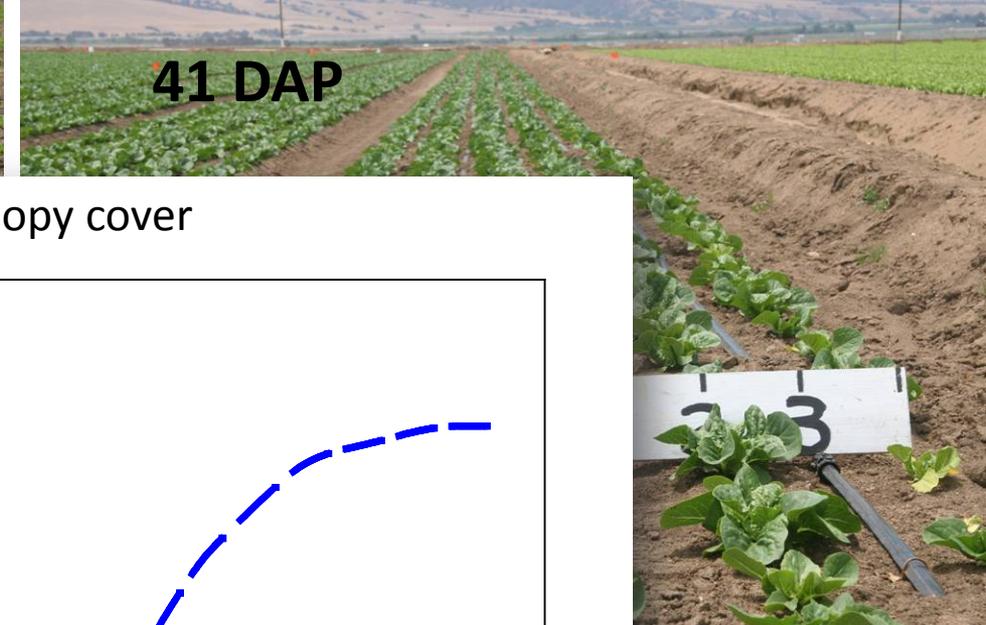
Converting Reference ET to  
Crop ET:

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

$K_c$  can vary from 0.1 to 1.2



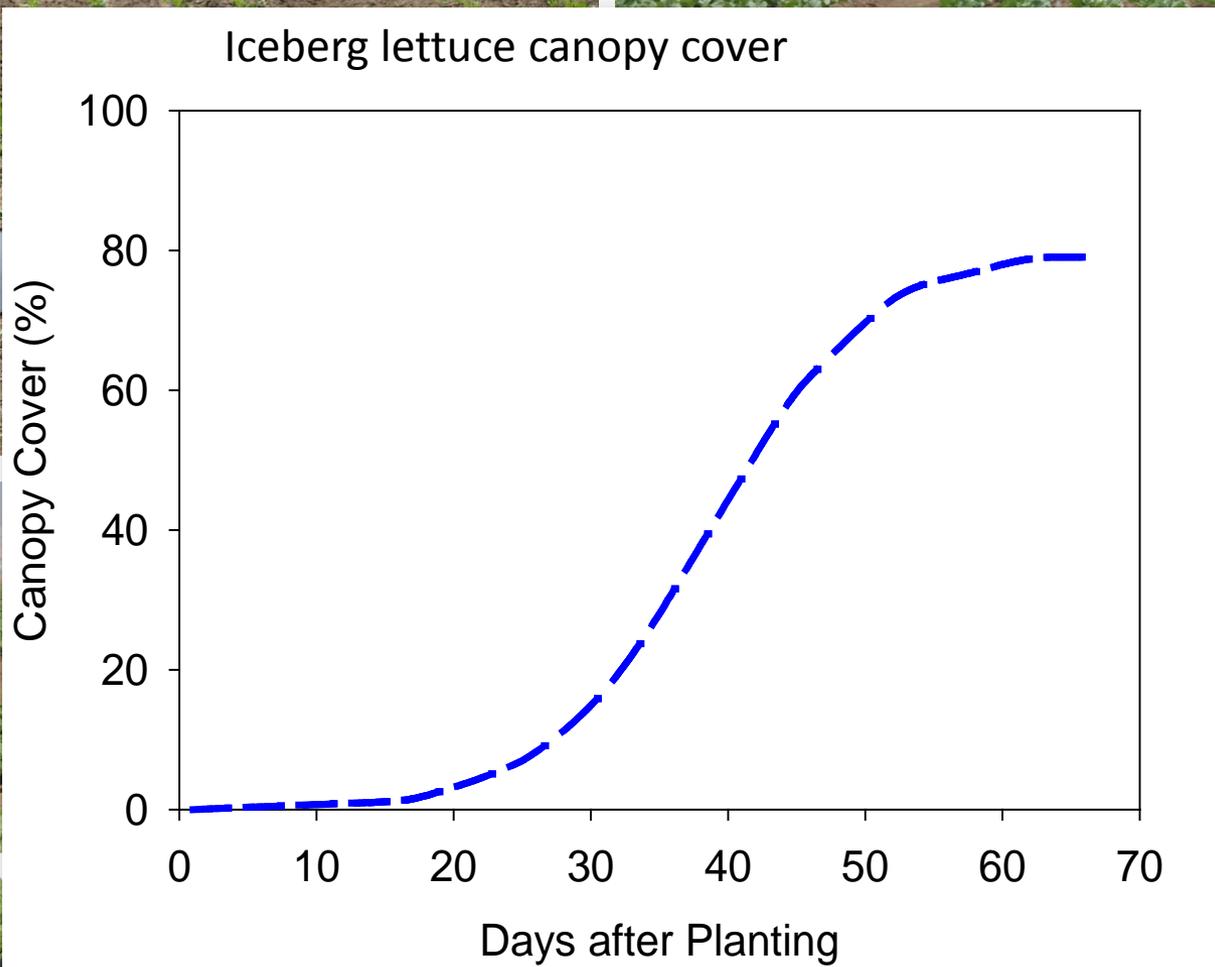
29 DAP



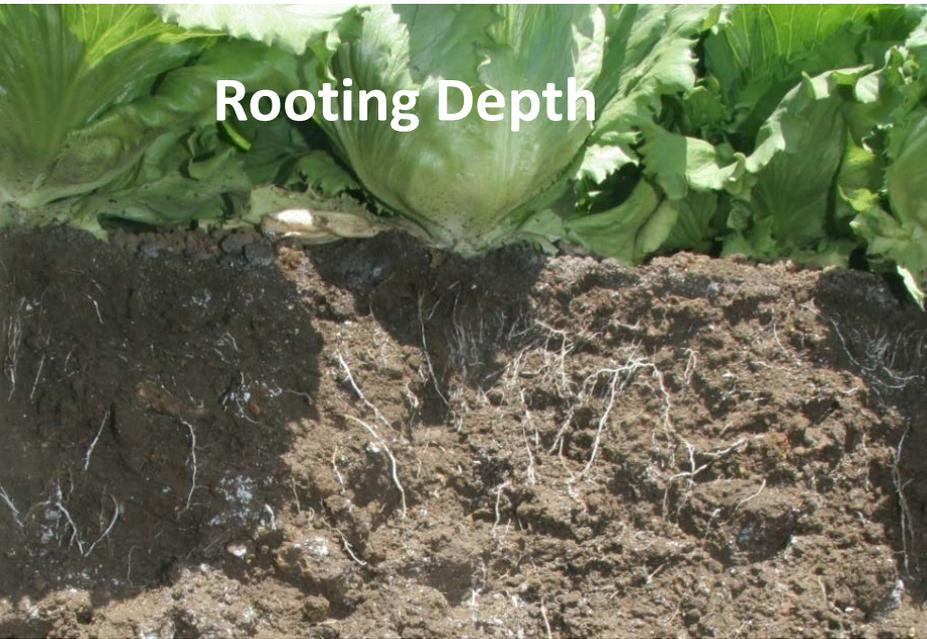
41 DAP



47 DAP



# Other information needs to be considered



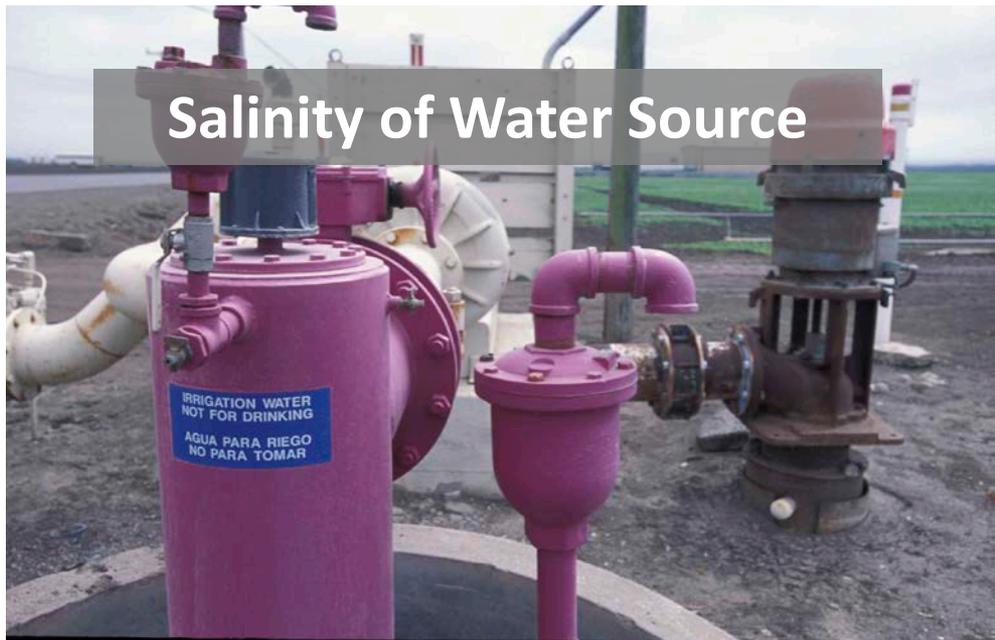
Rooting Depth



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>

## CropManage

About CropManage

### Login

To login enter your e-mail and password below.

E-mail Address

mdcahn@ucdavis.edu



Password

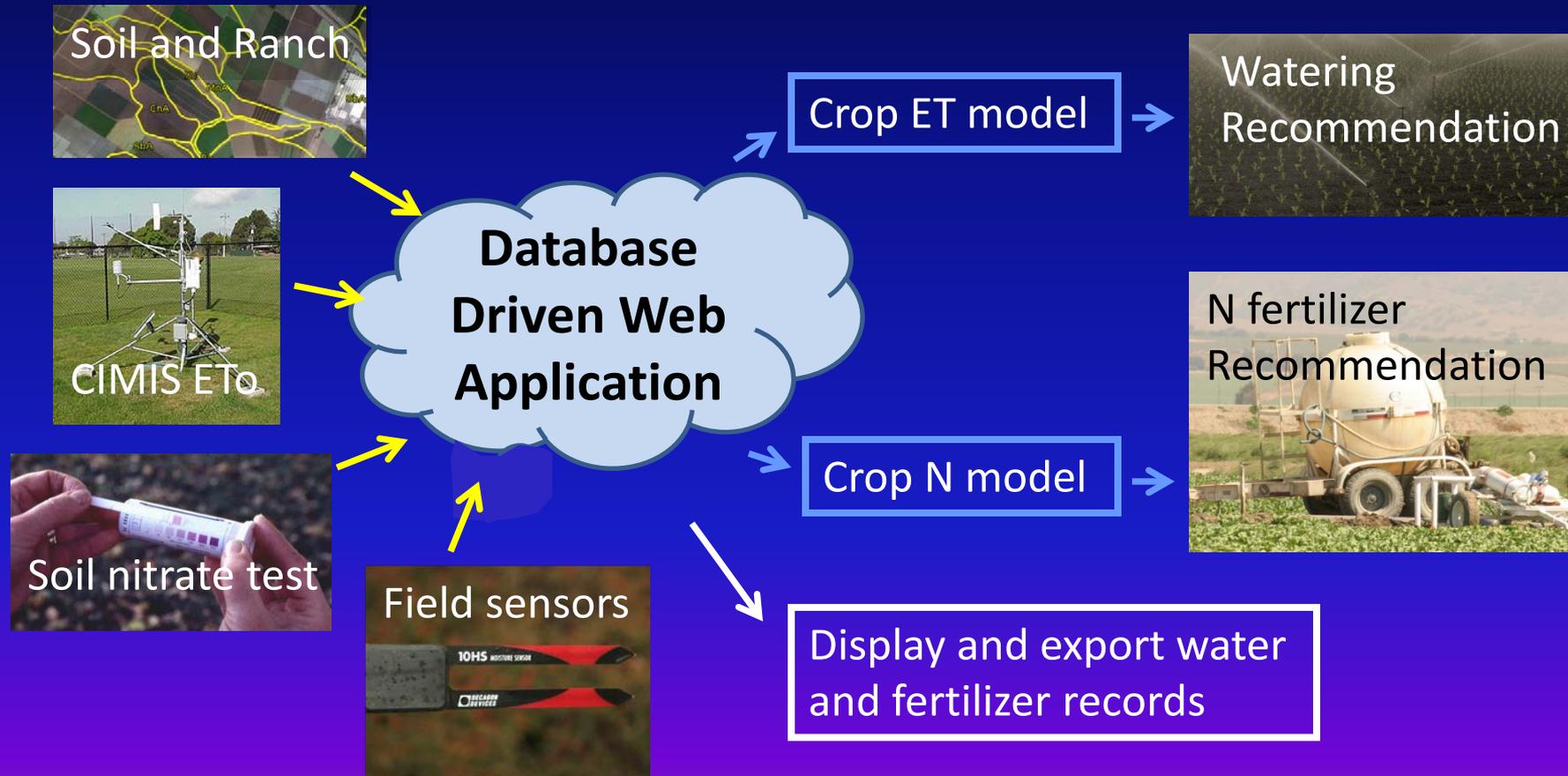
Password

Login

[Forgot Password](#)

[Create New Account](#)

## Integrate information from multiple sources



**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  $\text{NO}_3\text{-N}$ )

– Soil mineralization N

– Plant residue N

- N in irrigation water

# Fertilizer Summary

[< Back](#)[Go to: ▾](#)[Show / Hide Columns](#)

Fertilizer Date	Soil NO <sub>3</sub> -N (ppm)	Crop Stage	Fertilizer N Recommended (lb N/acre)	Cumulative N Uptake	Fertilizer	Applied N (lb N/acre)	Applied Fertilizer
<a href="#">7/1/12</a>	12.50	Planting	0.0	0.23	3.5-12-14	15.0	36.9 gal/acre
<a href="#">7/24/12</a>	15.00	1st drip fertigation	31.2	4.32	28-0-0-5	24.8	8.0 gal/acre
<a href="#">8/10/12</a>	15.00	2nd drip fertigation	55.8	31.90	UAN28	56.7	19.0 gal/acre
Totals			86.9			96.5	

[New Fertilizing](#)[First](#) [Previous](#) **1** [Next](#) [Last](#)Show  [▾](#) Rows[Show / Hide Table](#) [▲](#)

# Irrigation Summary

Show / Hide Columns

Reset Column Order

Show Previous Columns

Show Next Columns

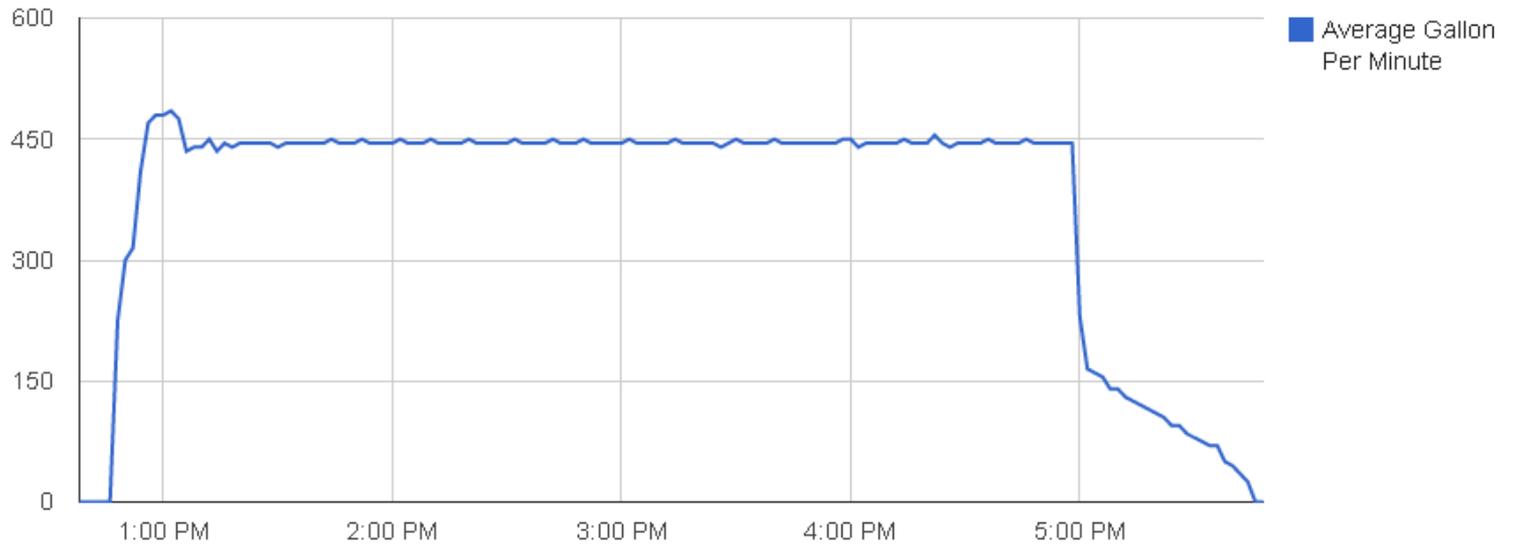
Water Date	Irrigation Method	Recommended Irrigation Interval (days)	Recommended Irrigation Amount (inches)	Recommended Irrigation Time (hours)	Irrigation Water Applied (inches)	Kc	Canopy Cover (%)	Average Reference ET (inches/day)	Total Crop ET (inches)
7/8/12	Sprinkler	1.6	0.48 in	1.59 hrs	0.60 in	0.48	0	0.25	0.36
7/13/12	Sprinkler	2.8	0.47 in	1.57 hrs	0.51 in	0.30	1	0.24	0.35
7/20/12	Drip	6.3	0.41 in	2.70 hrs	0.45 in	0.23	3	0.22	0.34
7/24/12	Drip	9.4	0.19 in	1.25 hrs	0.22 in	0.16	5	0.25	0.16
7/29/12	Drip	11.2	0.23 in	1.56 hrs	0.15 in	0.18	11	0.22	0.20
8/4/12	Drip	8.2	0.46 in	3.03 hrs	0.60 in	0.27	24	0.24	0.39
8/7/12	Drip	7.6	0.26 in	1.76 hrs	0.30 in	0.40	33	0.19	0.22
8/10/12	Drip	4.9	0.44 in	2.95 hrs	0.30 in	0.50	43	0.25	0.38
8/14/12	Drip	4.3	0.73 in	4.90 hrs	0.80 in	0.64	56	0.25	0.62
8/18/12	Drip	4.1	0.82 in	5.49 hrs	0.00 in	0.77	67	0.23	0.70
Totals			5.36 in	29.70 hrs	6.03 in				4.38 in

New Watering    View Rainfall Data

# How much water was applied?

## Flow Meter Data

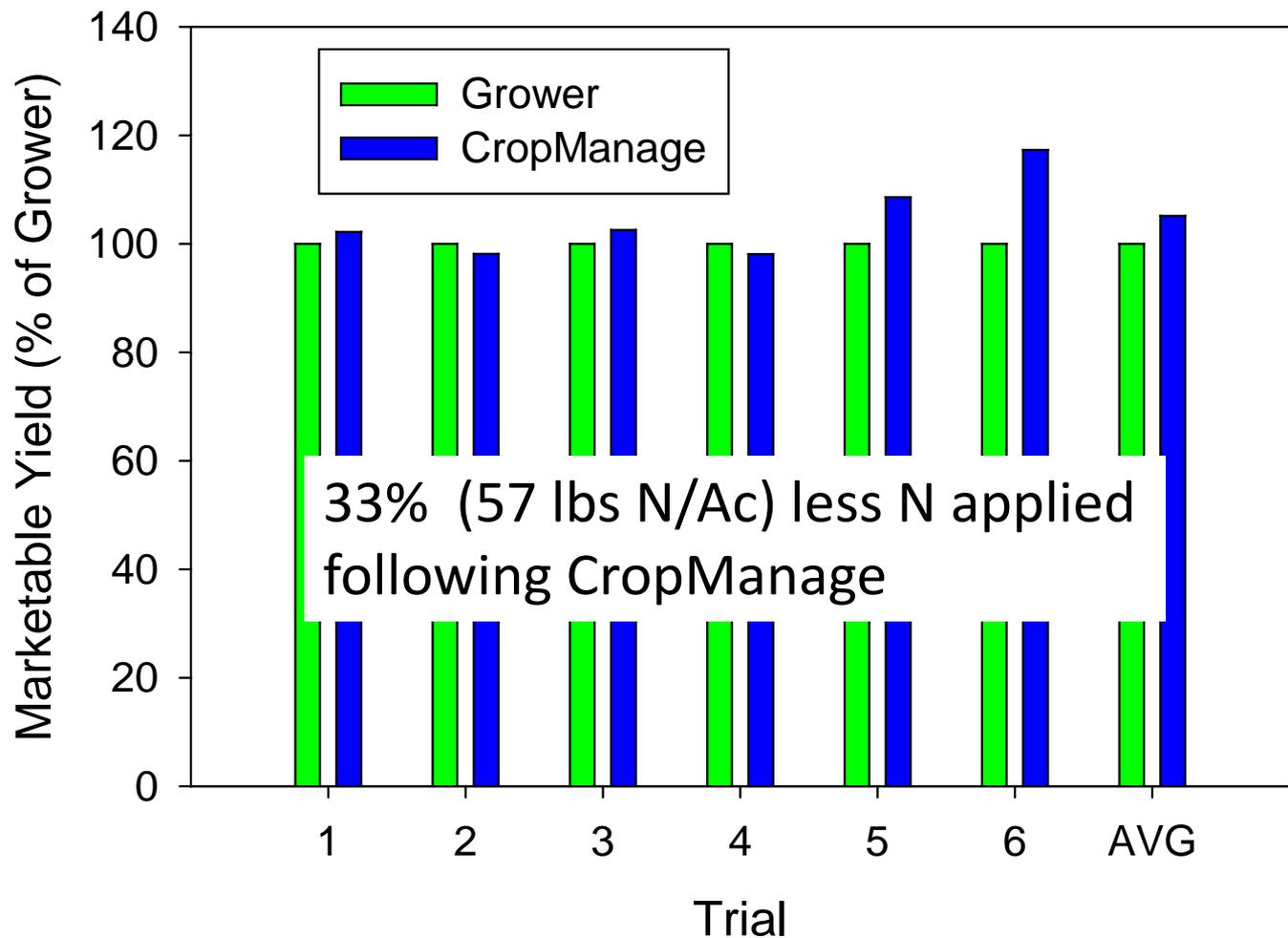
Flow Meter Data on Oct 17, 2012



# Using weather based irrigation scheduling for broccoli

Irrigation Treatment	Applied water inches	Marketable Yield		
		Crown ----- lbs/acre -----	Bunch	Total
Grower Standard (150% ET)	20.4	6797	8289	15086
CropManage (100% ET)	14.2	6747	9522	16269
LSD <sub>0.05</sub>		NS	1052	1061

# Summary of Commercial Lettuce Strip Trials (2012-2013)



# Clientele interest

- 
- A man wearing a blue short-sleeved button-down shirt, a dark cap, and sunglasses is working in a field. He is holding a surveying instrument, possibly a level or a similar tool, and appears to be measuring or marking the ground. In the background, there is a white truck, another person, and a vast green field under a clear blue sky.
- > 550 users
  - > 250 Ranches
  - > 6700 visits to CM blog since Dec 2013

# The road ahead...



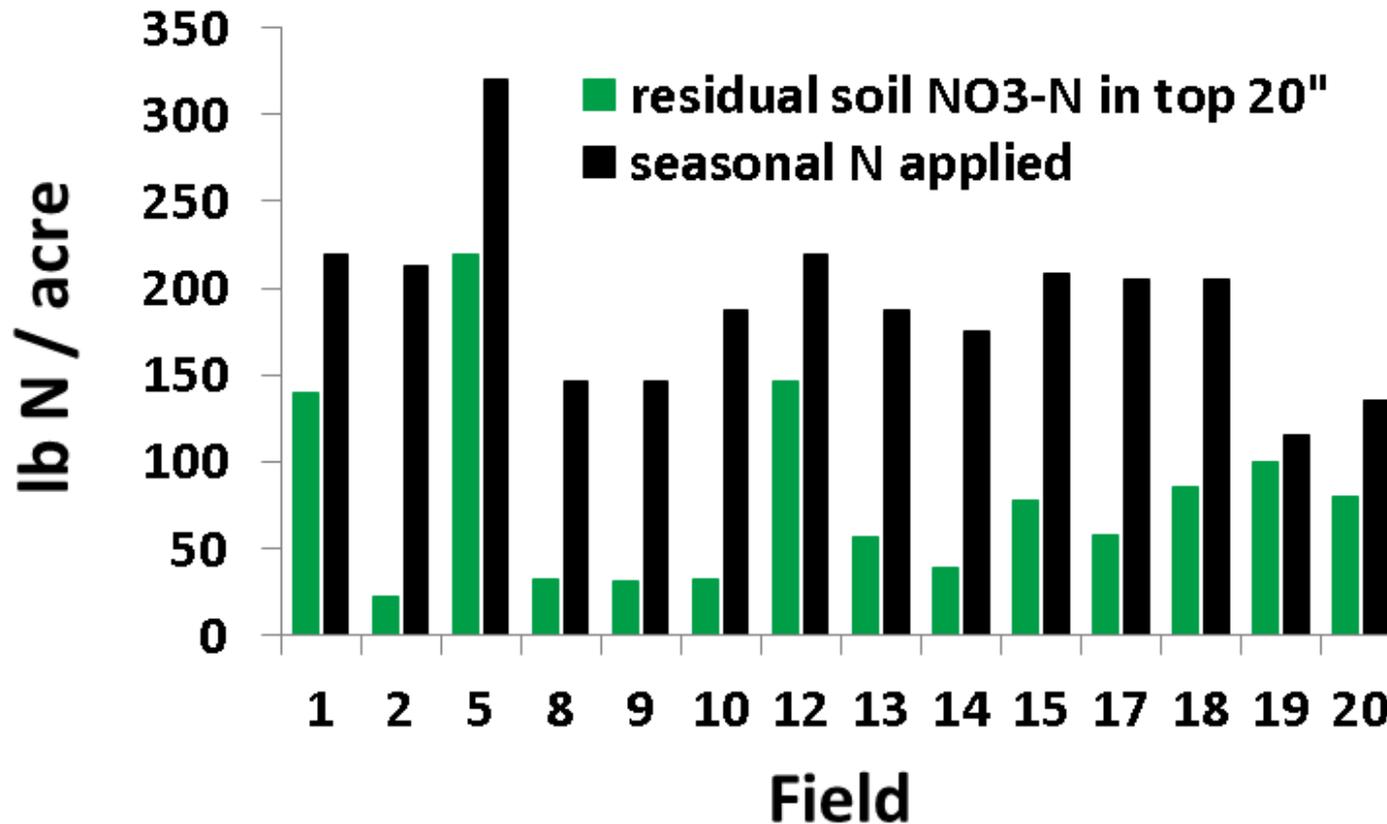
# Would a “cropmanage” approach be helpful for growing processing tomatoes?

## **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  $\text{NO}_3\text{-N}$  early in the season, and modify the template to reflect the residual, primarily by delaying / reducing fertigation on the front end
- If irrigation water  $\text{NO}_3\text{-N}$  is high, adjust for N content



## Fertilizer application vs. preplant soil residual NO<sub>3</sub>-N

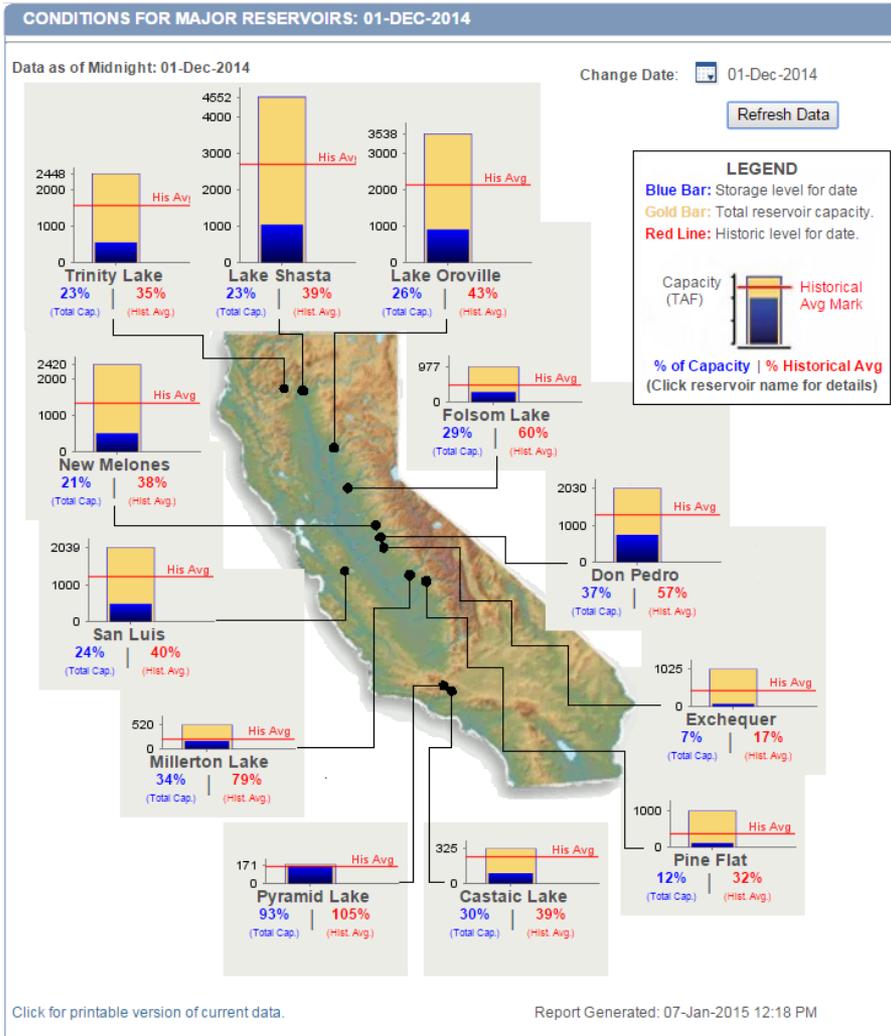


- Soil residual NO<sub>3</sub>-N varied from 23-219 lb/acre, averaged 80 lb/acre
- Grower N application ranged from 115-320 lb/acre, averaged 190 lb/acre

Data from Horwath et al., 2013

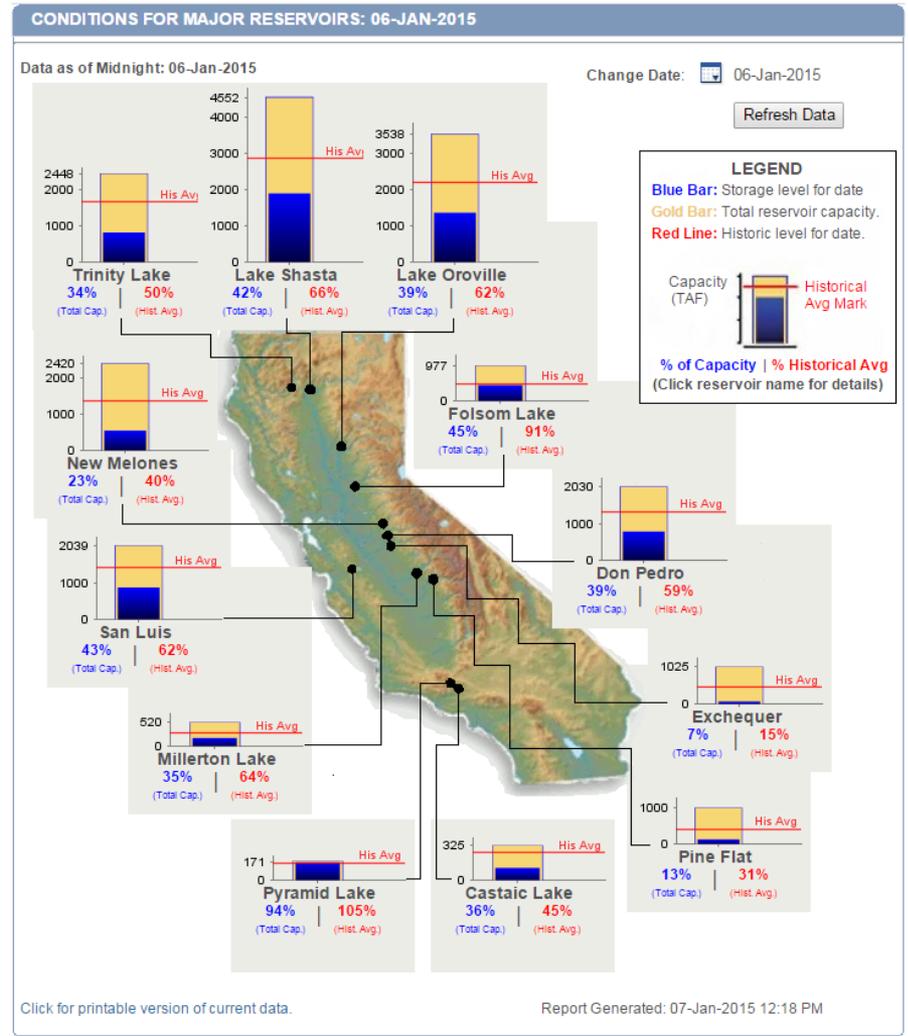
# Water is still in short supply

California Data Exchange Center - Reservoirs



**Dec 1, 2014**

California Data Exchange Center - Reservoirs



**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.