CropManage: On-line Decision Support Tool for Managing Water and Nitrogen of Vegetables

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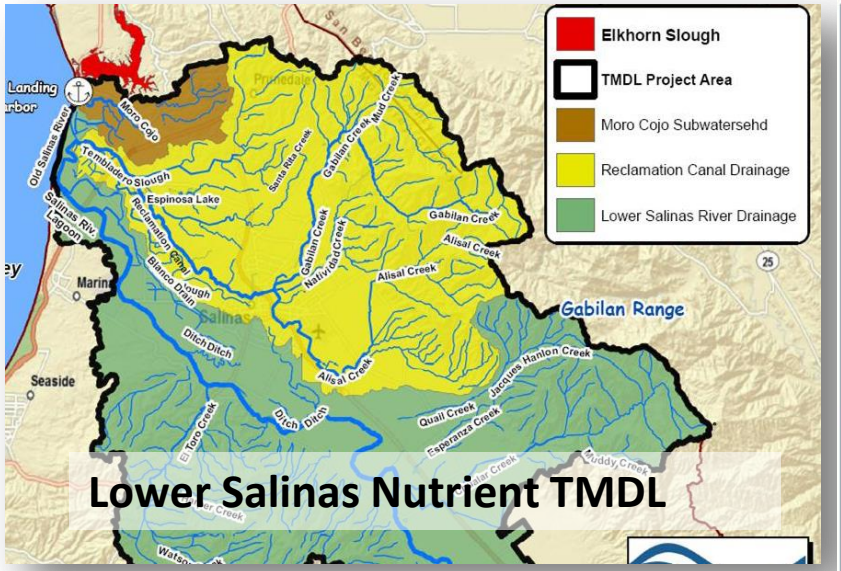
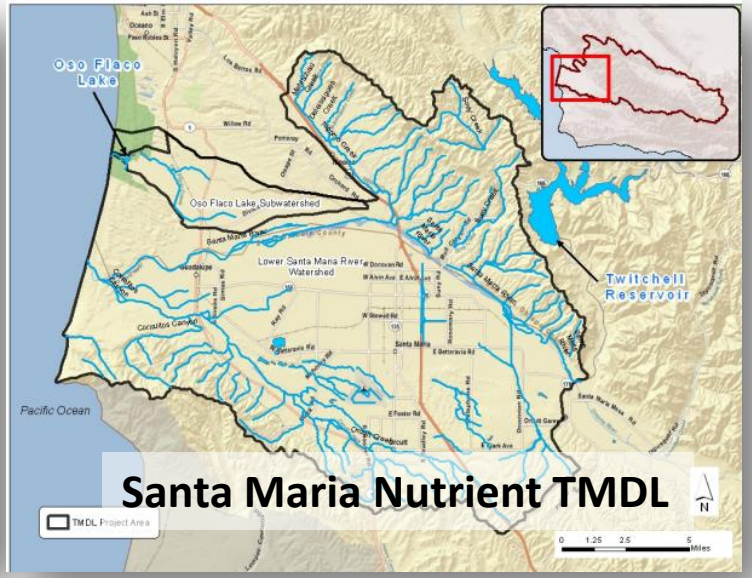




TIER 3

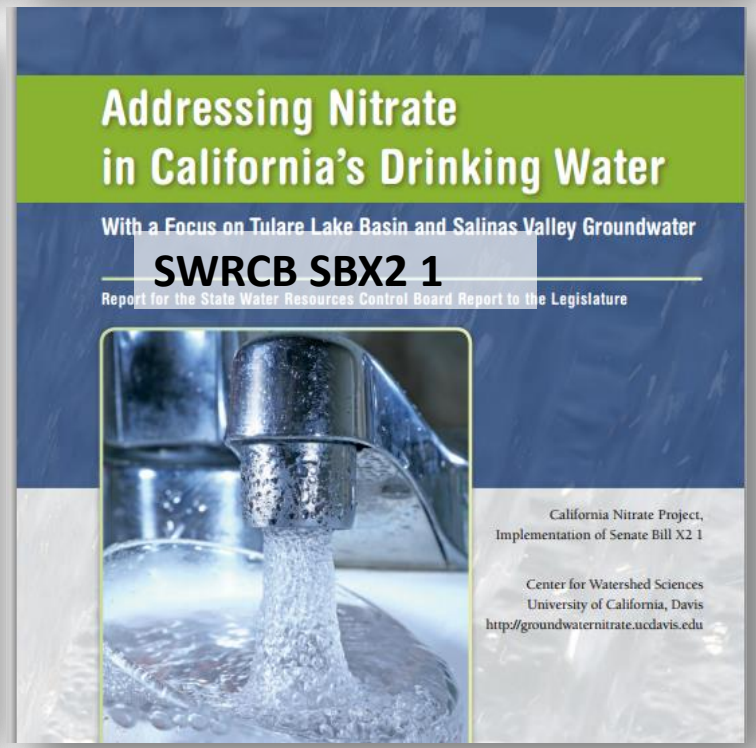
DISCHARGERS ENROLLED UNDER THE CONDITIONAL WAIVER OF WASTE DISCHARGE REQUIREMENTS FOR DISCHARGES FROM IRRIGATED LANDS

This Monitoring and Reporting Program Order No. R3-2012-0011-03 (MRP) is issued pursuant to California Water Code (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);*

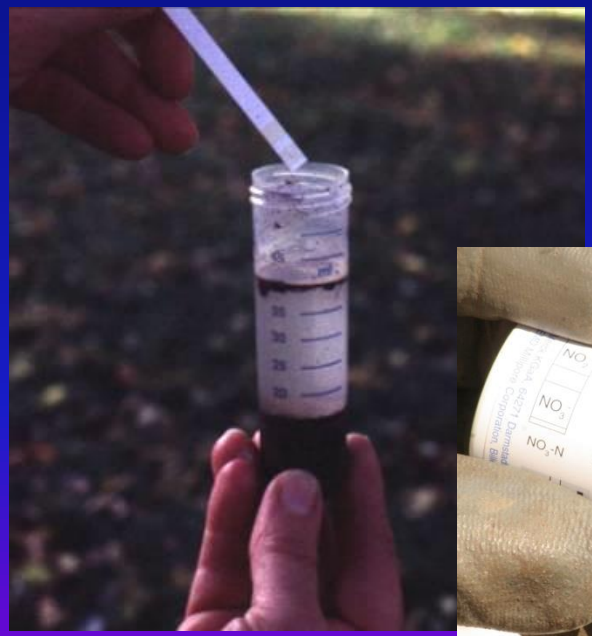


Tools for Managing Water and Nitrogen Fertilizer in Lettuce

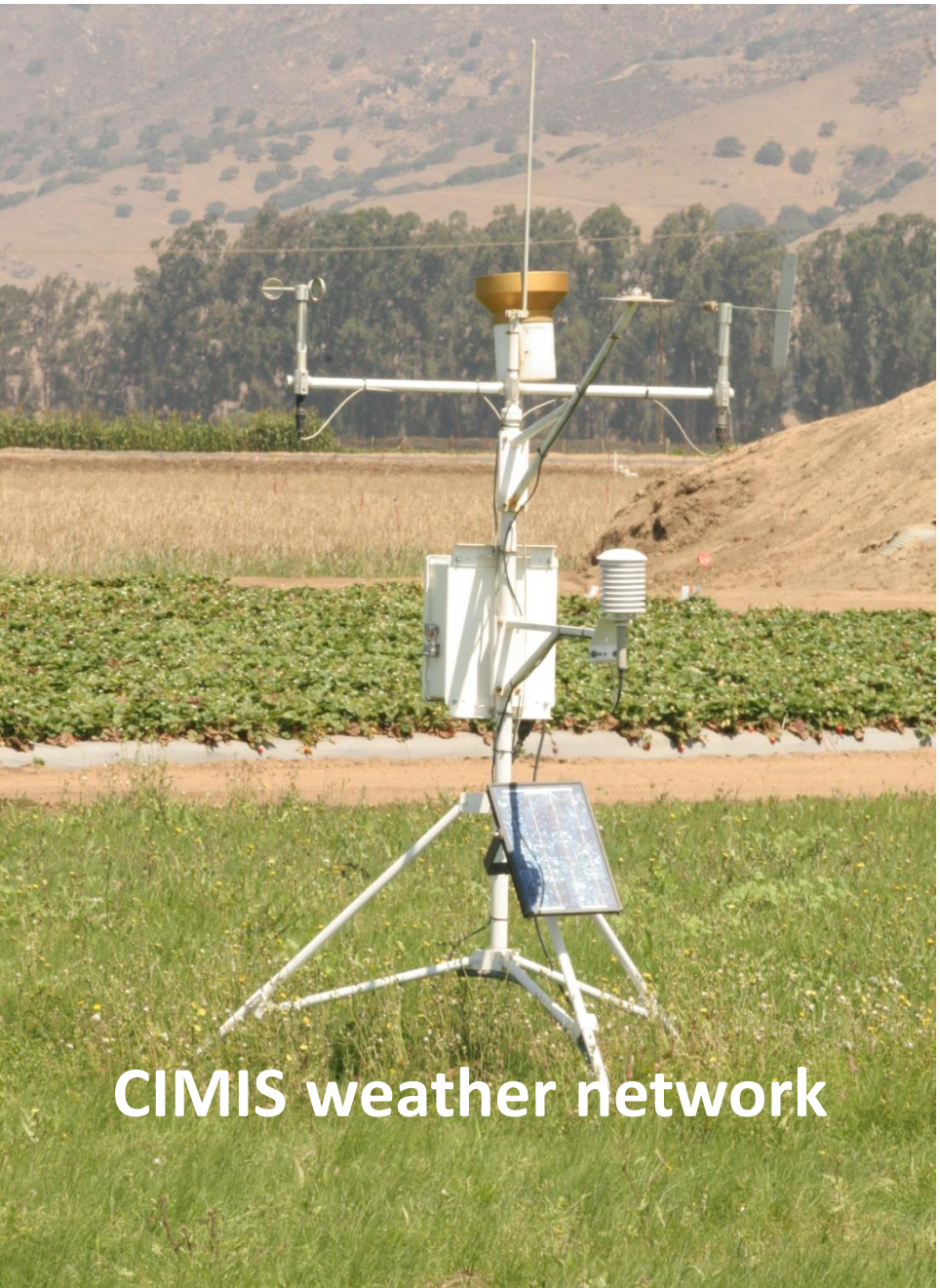
- Soil nitrate quick test

  (20 ppm NO_3-N = 70 to 80 lbs of N/acre/ft)

- Weather-based irrigation scheduling



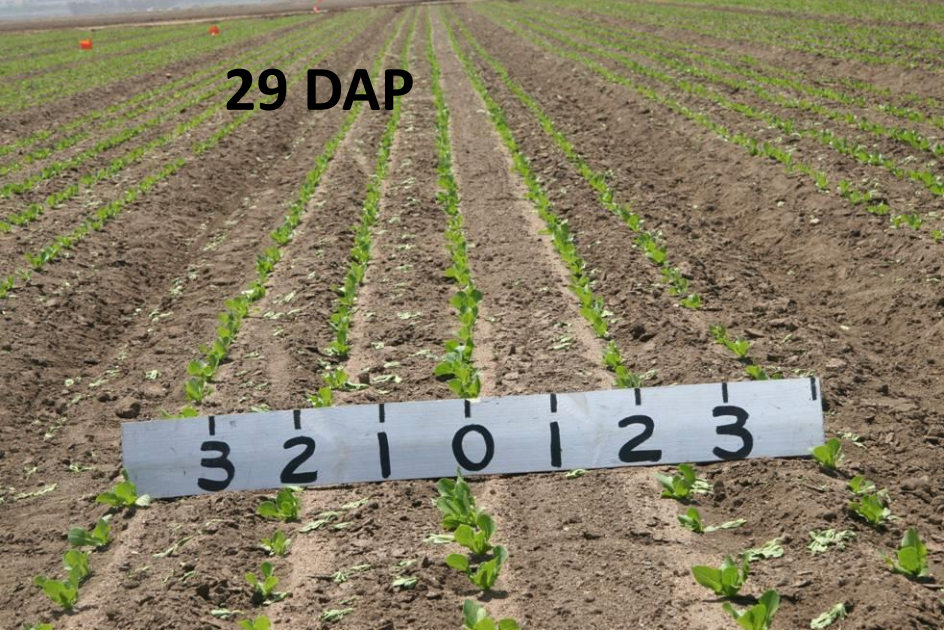
Weather-based Irrigation Scheduling



Converting Reference ET to Crop ET:

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

K_c can vary from 0.1 to 1.2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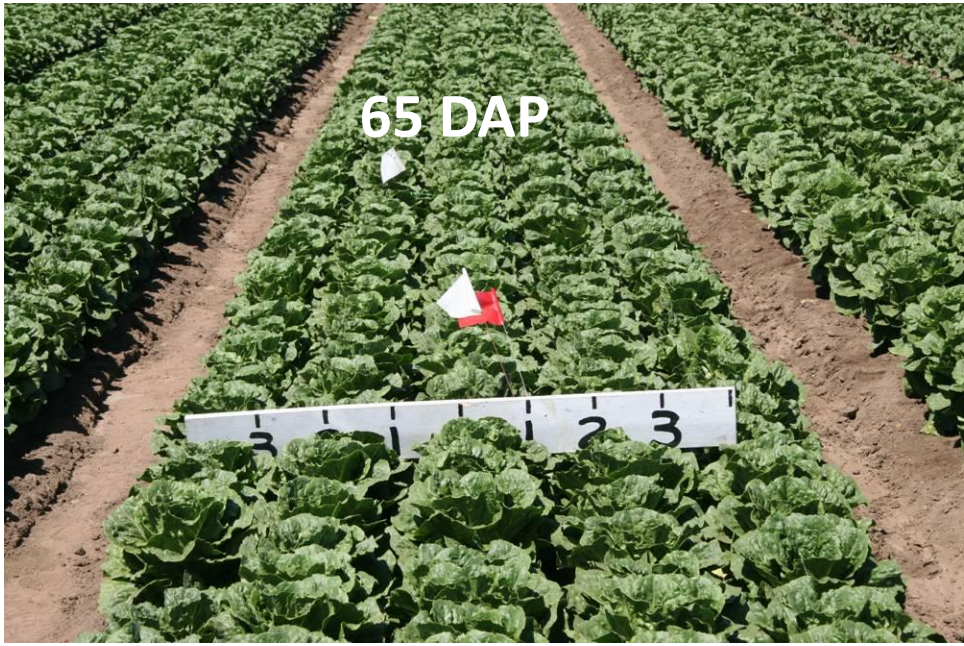
3 2 1 0 1 2 3


41 DAP


47 DAP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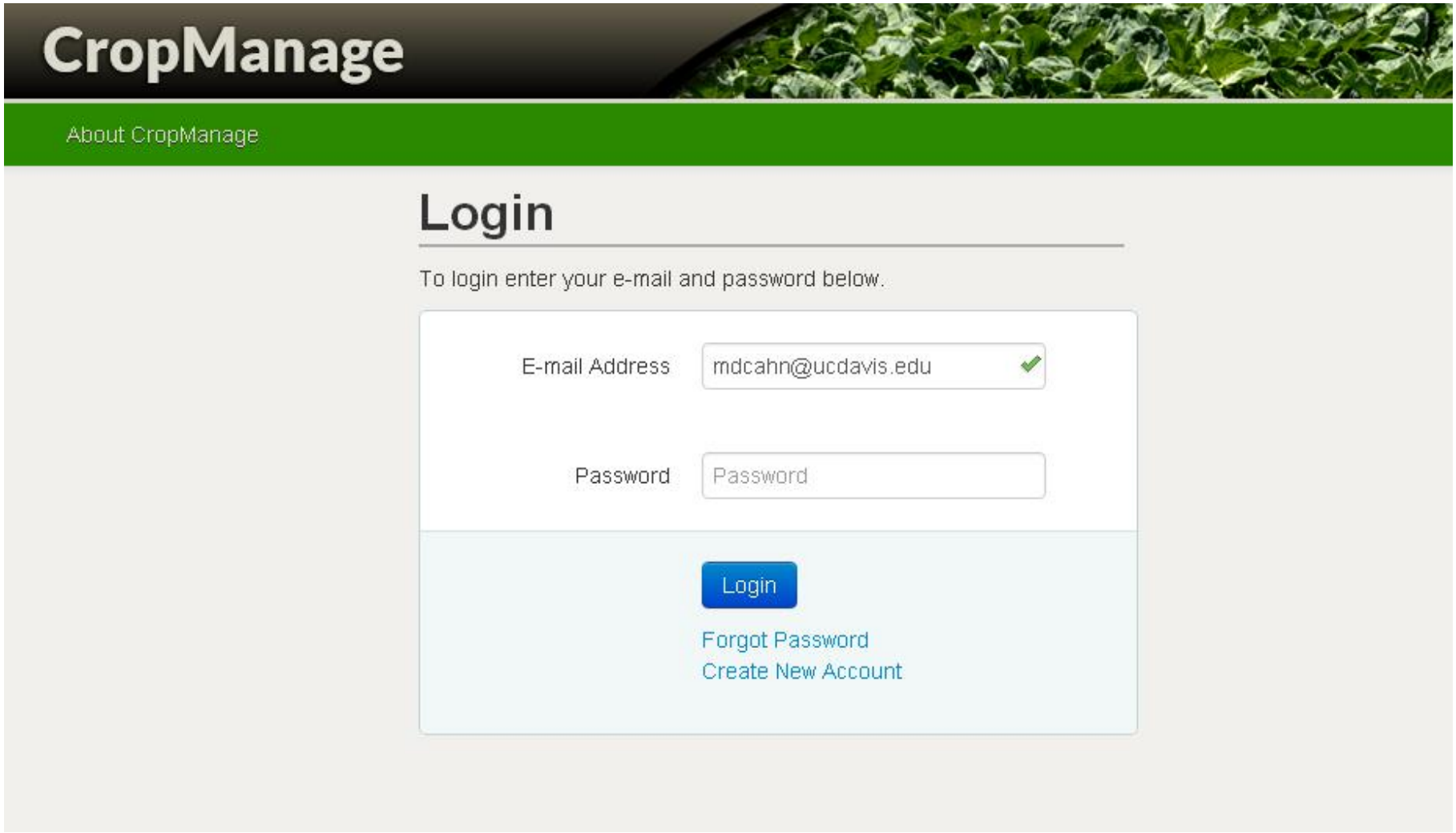
Other information needs to be considered

How can water and N management tools be useful for large vegetable growing operations?

- Large growing operations have multiple decision makers
- One farm manager may be responsible for >100 fields during a season
- Other responsibilities besides water and fertilizer N management

Web-based Irrigation and N management software for lettuce

https://ucanr.edu/cropmanage



CropManage Web-based Tool:

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.
- ✓ Maintain and share irrigation, fertilizer, and soil test records for multiple fields and farms.

Integrate information from multiple sources

Database Driven Web Application

Crop ET model

Crop N model

Display and export water and fertilizer records

Decision support using crop models

Steps to Using CropManage

1. Establish user login
2. Set up a ranch or request access to existing ranch
3. Add new plantings to ranch or view existing plantings
4. Enter or view soil tests, fertilizer, or irrigation events for plantings

Current crops supported

Romaine, 40-inch wide beds (2 plant rows)
Romaine, 80-inch wide beds (5/6 plant rows)
Iceberg, 40-inch wide beds (2 plant rows)
Iceberg, 80-inch wide beds (5/6 plant rows)

How is N fertilizer rate determined from the quick nitrate test?

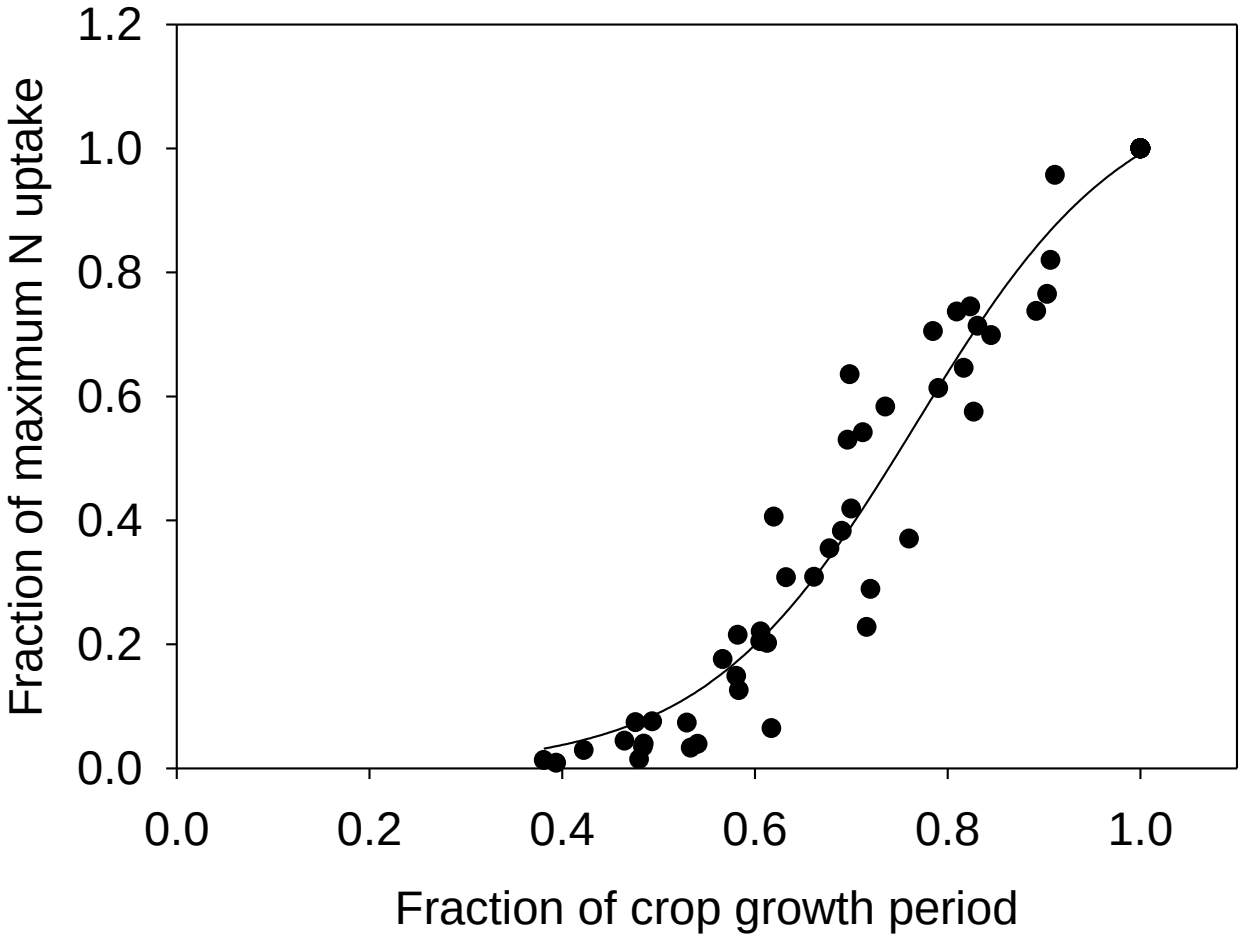
Recommended
Fertilizer N = Future Crop N uptake

– (Quick Test N - threshold NO_3-N)

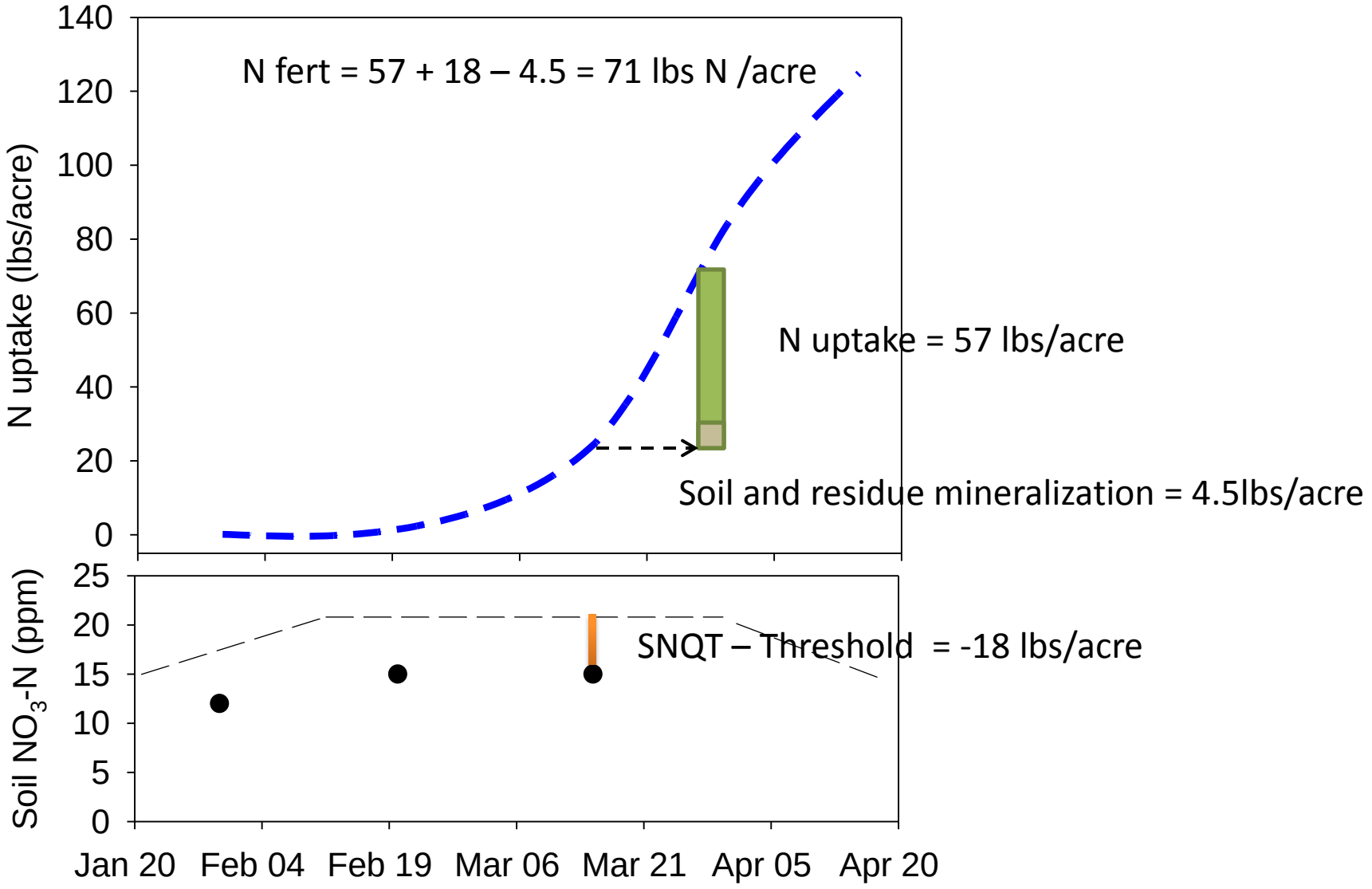
– Soil mineralization N

– Plant residue N

N uptake rate by head lettuce (40 inch-wide beds)



Nitrogen Fertilizer Recommendation



Fertilizer Summary

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Show / Hide Columns

Fertilizer Date	Soil NO_3-N (ppm)	Crop Stage	Fertilizer N Recommended (lb N/acre)	Cumulative N Uptake	Fertilizer	Applied N (lb N/acre)	Applied Fertilizer
7/1/12	12.50	Planting	0.0	0.23	3.5-12-14	15.0	36.9 gal/acre
7/24/12	15.00	1st drip fertigation	31.2	4.32	28-0-0-5	24.8	8.0 gal/acre
8/10/12	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 5 Rows

Show / Hide Table

Irrigation Summary

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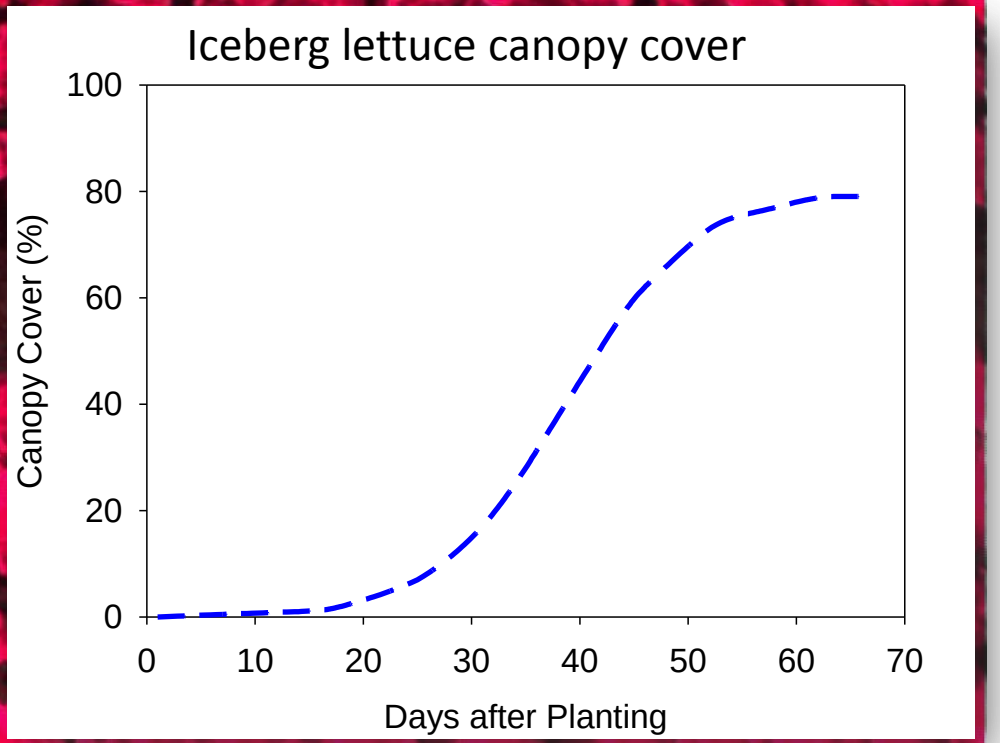
Water Date	Irrigation Method	Recommended Irrigation Interval (days)	Recommended Irrigation Amount (inches)	Recommended Irrigation Time (hours)	Irrigation Water Applied (inches)	Kc	Canopy Cover (%)	Average Reference ET (inches/day)	Total Crop ET (inches)
7/8/12	Sprinkler	1.6	0.48 in	1.59 hrs	0.60 in	0.48	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

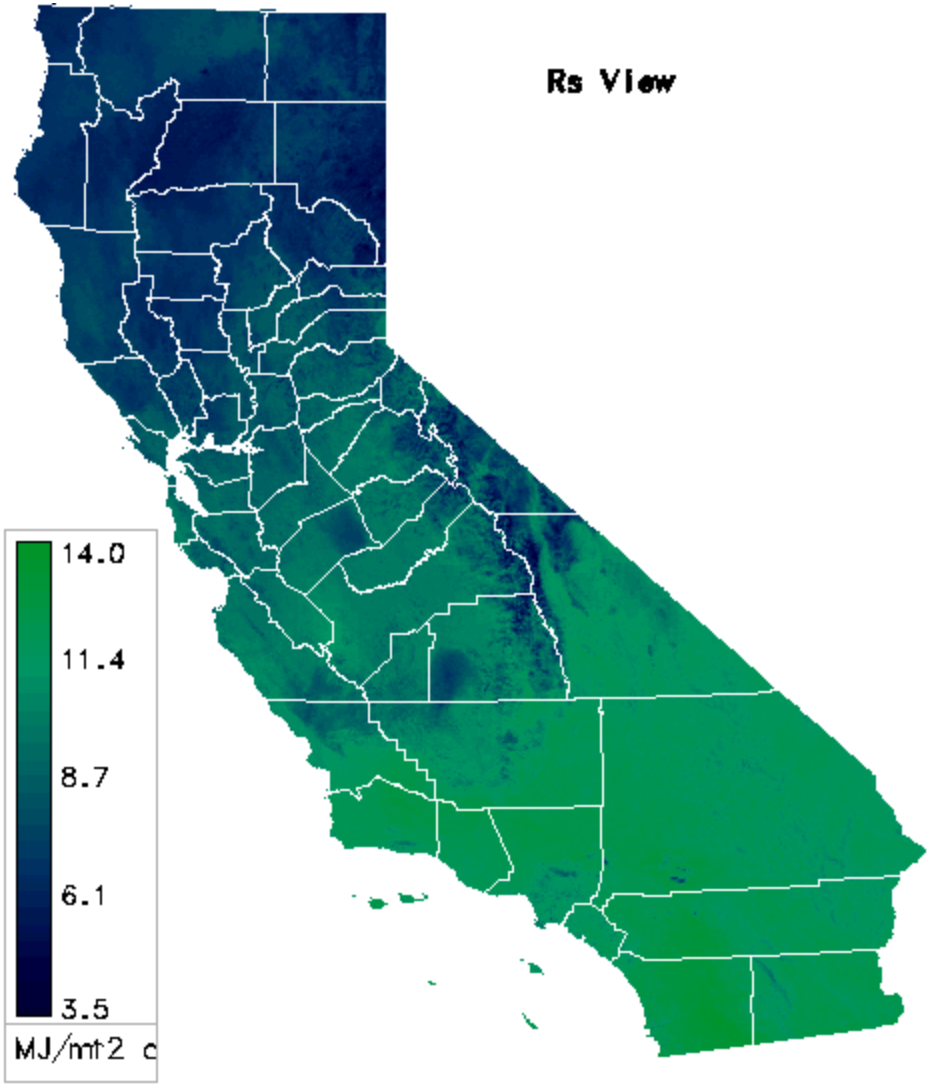
First Previous 1 2 Next Last

Show / Hide Table

Show 10 Rows


Iceberg lettuce canopy cover
Canopy Cover (%)
100
80
60
40
20
0
0
10
20
30
40
50
60
70
Days after Planting

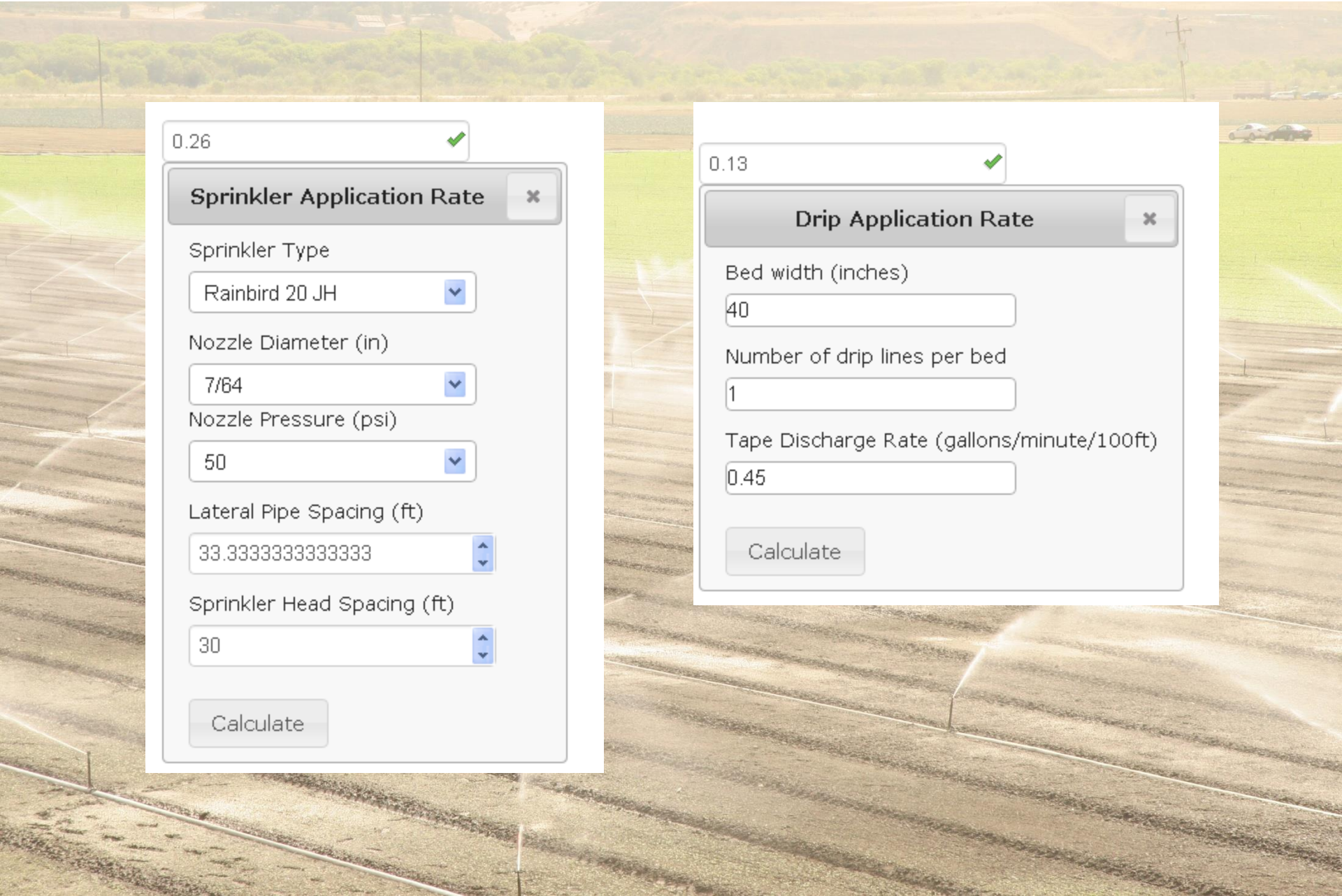
Spatial CIMIS ETo Reporting



Interface with UCD SoilWeb Tool

Soil Type | Select Soil Type | Find Soil Type

Irrigation System Application Rate (inches/hr)



User Support: CropManage Blog

CROPMANAGE

Help and User Instructions for Irrigation and N management tool

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CropManage Overview: A web application for managing water and nitrogen fertilizer in lettuce

Author: **Michael D Cahn** **October 15, 2012**

Cool season vegetable production requires significant inputs of water and nitrogen (N) fertilizer to maximize yield and quality. Proposed changes in water quality regulations on the Central Coast and higher fertilizer prices in recent years have prompted grower interest in increasing efficiency of nitrogen fertilizer use in lettuce. By improving water management and matching nitrogen applications to the uptake pattern of the crop, growers could potentially reduce fertilizer use and address water quality concerns.

Two tools available, the quick nitrate soil test and weather-based irrigation scheduling, have been shown to help lettuce producers better manage water and fertilizer nitrogen. Trials we conducted in commercial fields have demonstrated that soil nitrate concentrations greater than 20 ppm NO_3-N,

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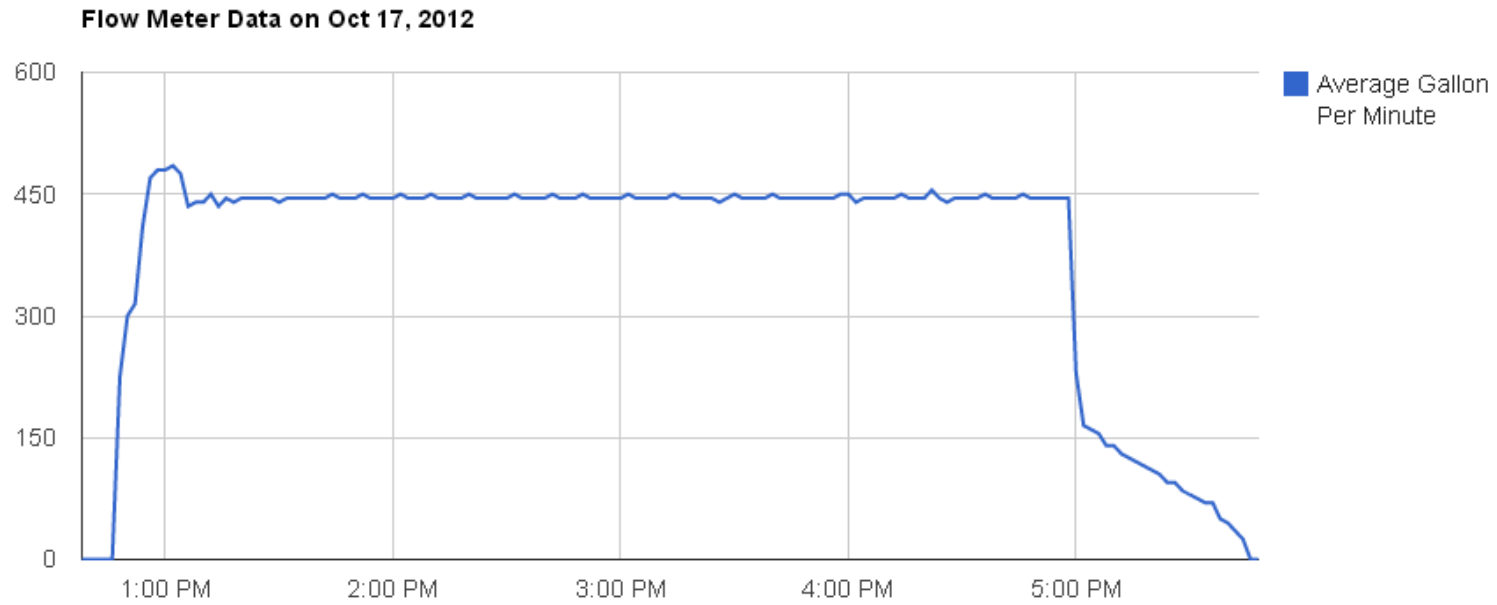
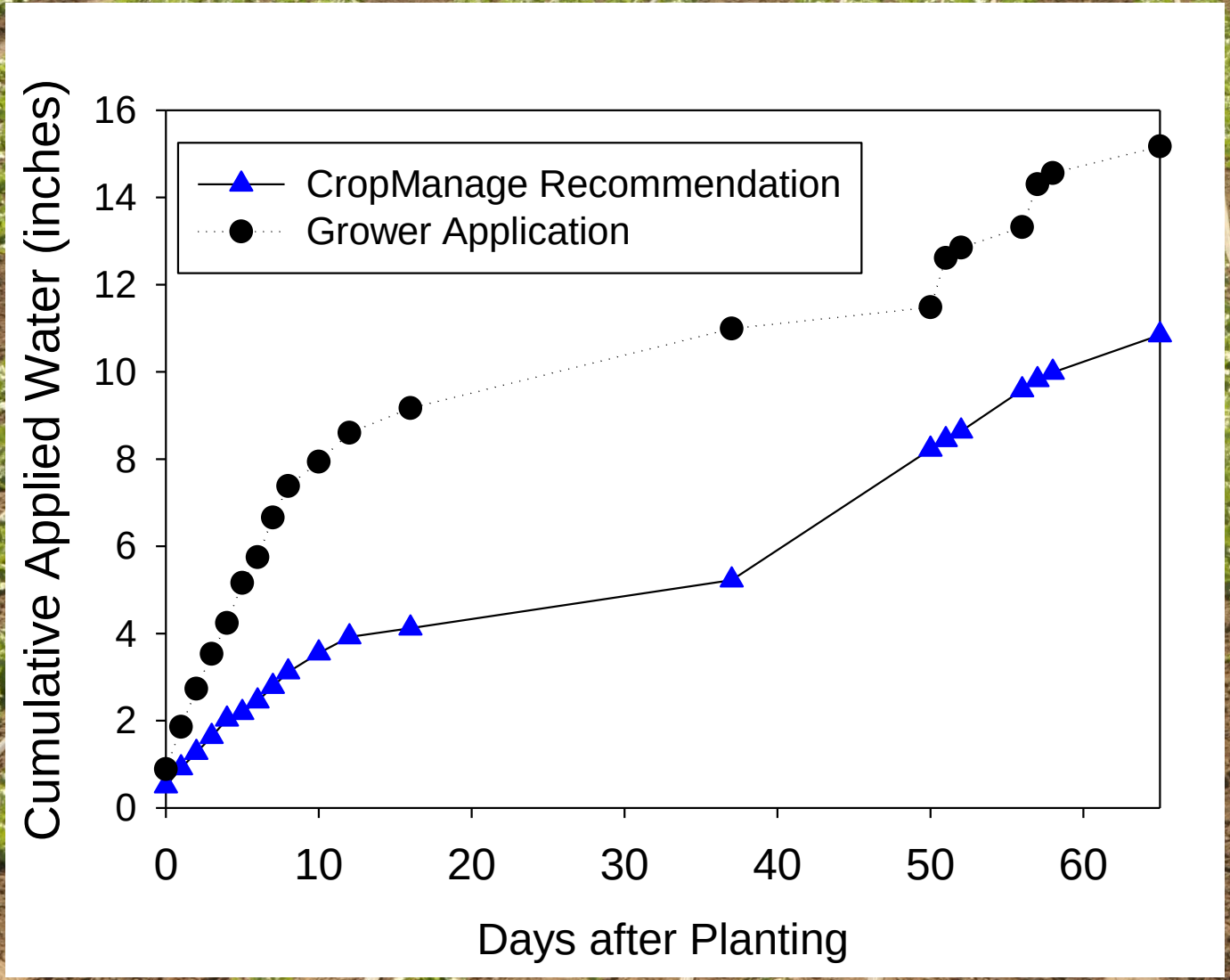
How much water was applied?

Flow Meter Data



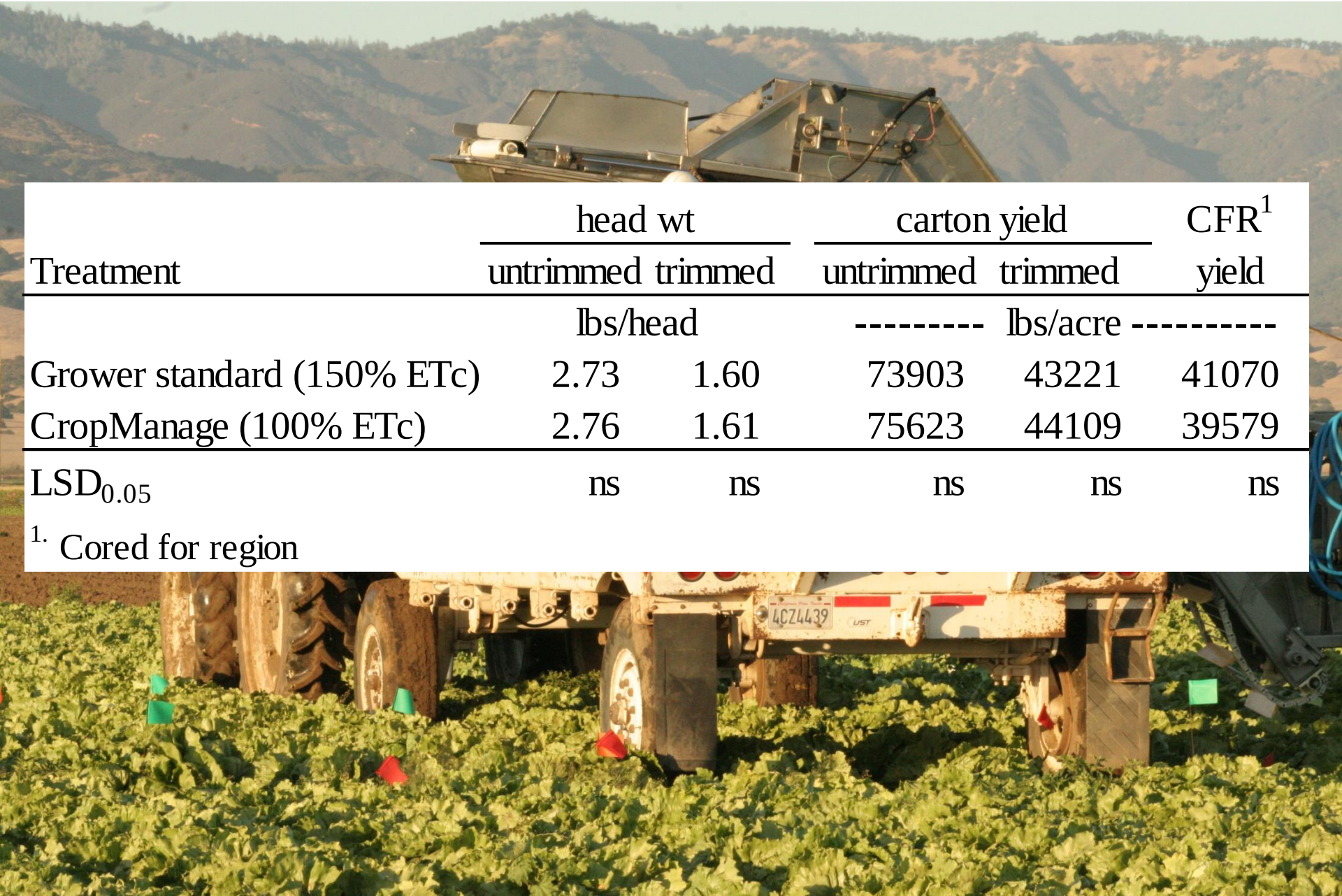
Evaluate and Document Water Management



Field Validation of CropManage

Treatment	Applied N Fertilizer	Commercial Yield
	------- lbs per acre --------	
Grower Standard	211	19114
CropManage	149	18760

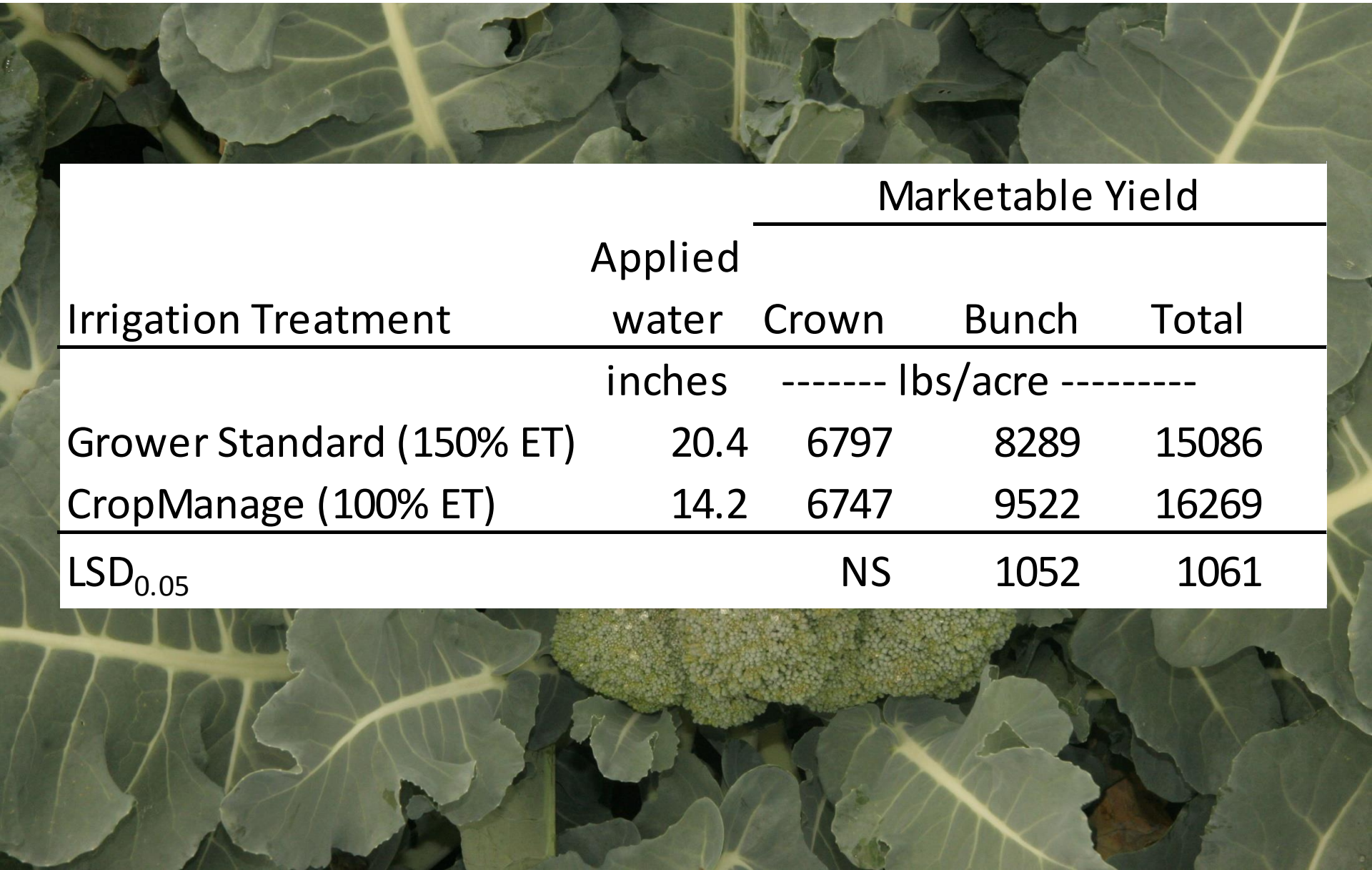
Replicated Irrigation Trial for Iceberg Lettuce



Treatment	head wt		carton yield		CFR[1]
	untrimmed	trimmed	untrimmed	trimmed	yield
	lbs/head		---------	lbs/acre	----------
Grower standard (150% ETc)	2.73	1.60	73903	43221	41070
CropManage (100% ETc)	2.76	1.61	75623	44109	39579
$LSD_{0.05}$	ns	ns	ns	ns	ns

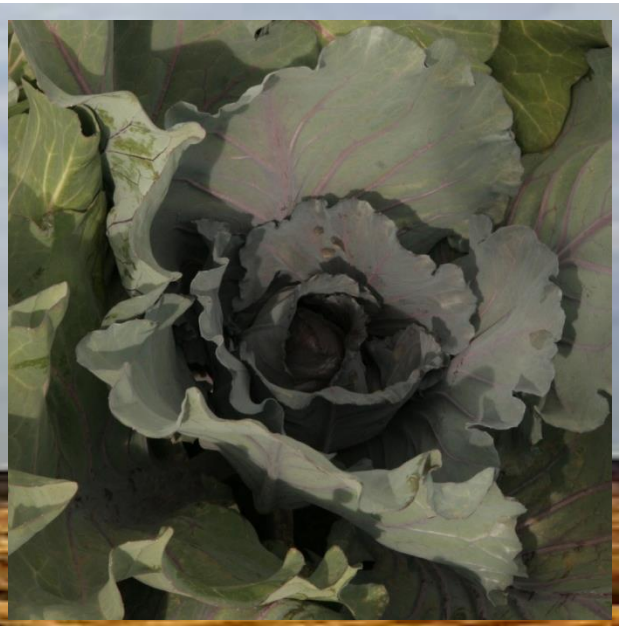
1. Cored for region

Using weather based irrigation scheduling for broccoli



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

The road ahead…



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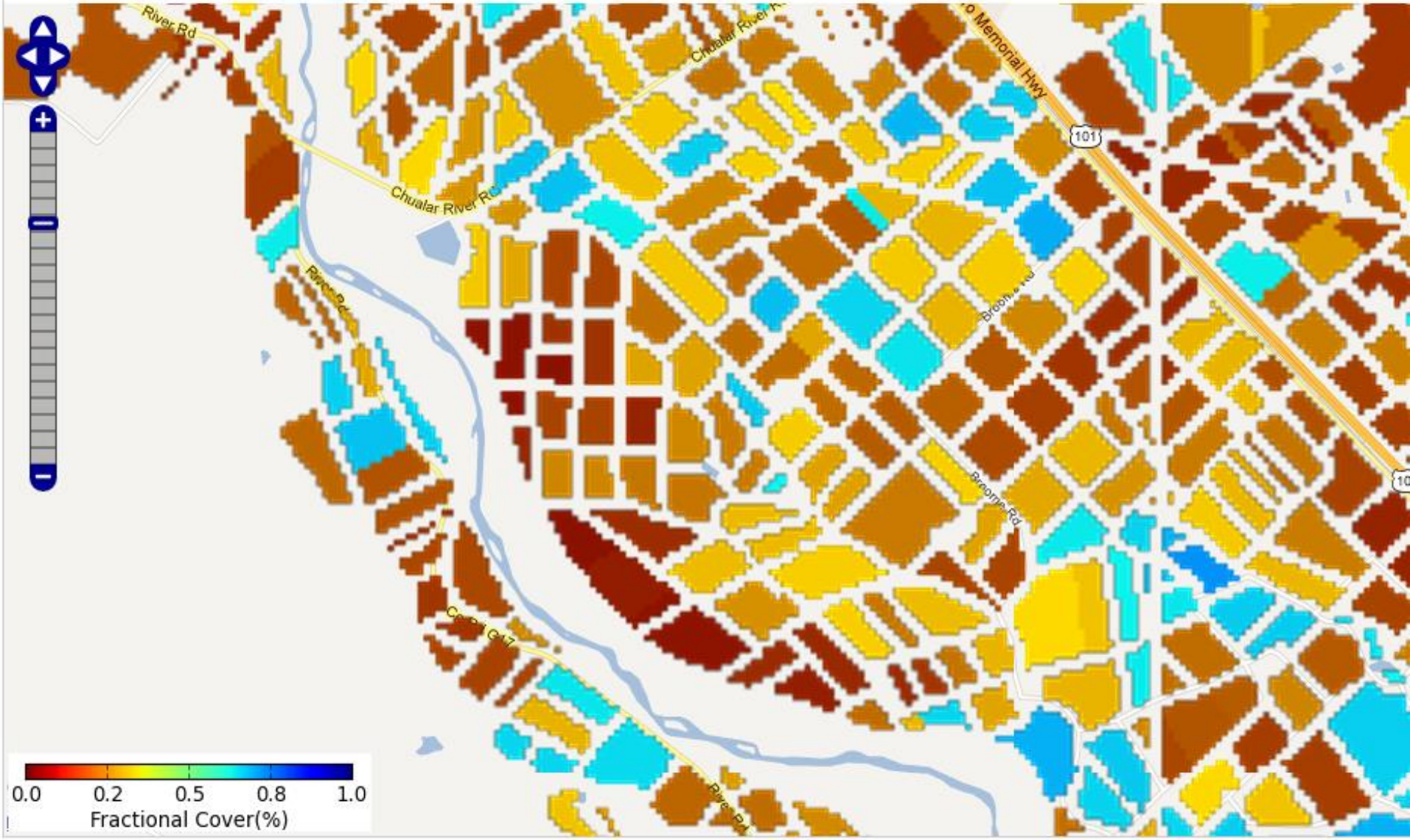


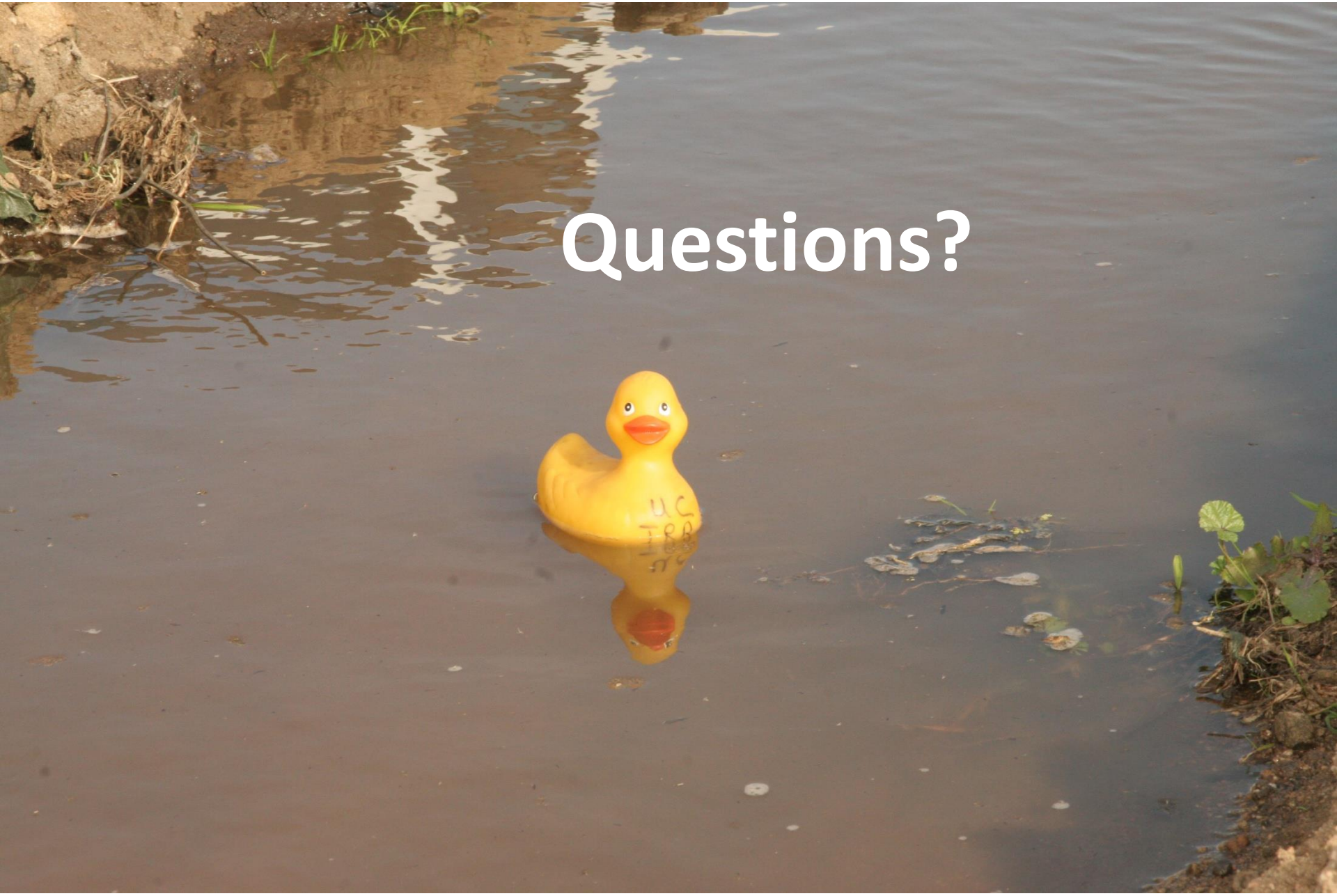
N contribution from irrigation water?

Final Thoughts

- Web applications can repackage complex data sets and mathematical models into simple to use decision support tools

- Web apps can also help growers track their practices and demonstrate that they are managing nutrients and water efficiently

- *CropManage* is not just for growers. It is a potential tool for crop consultants and advisers to use in assisting growers with water and N management decisions.


Questions?