CropManage: Online Irrigation and Nutrient Management Tool

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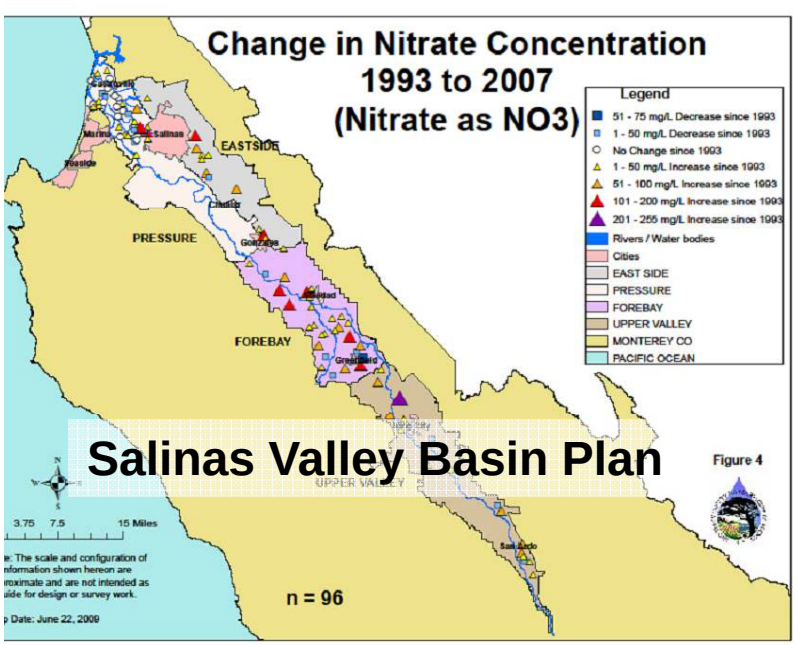
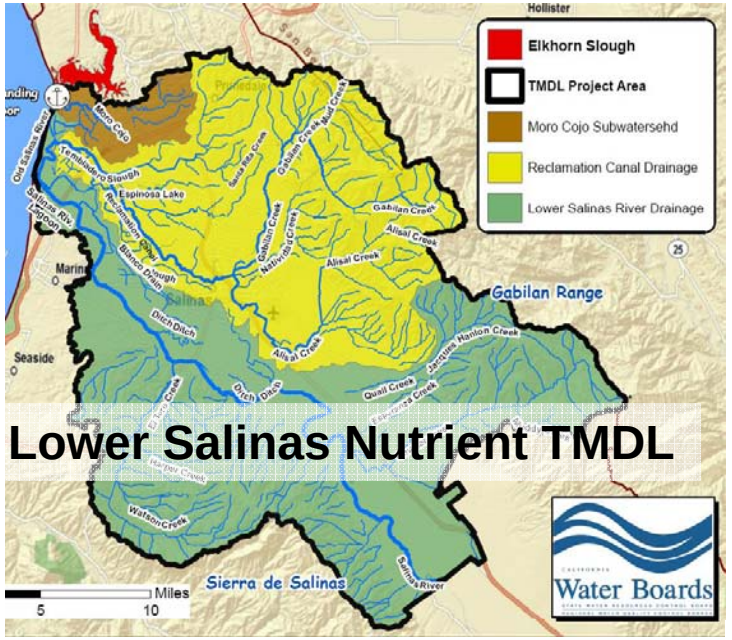
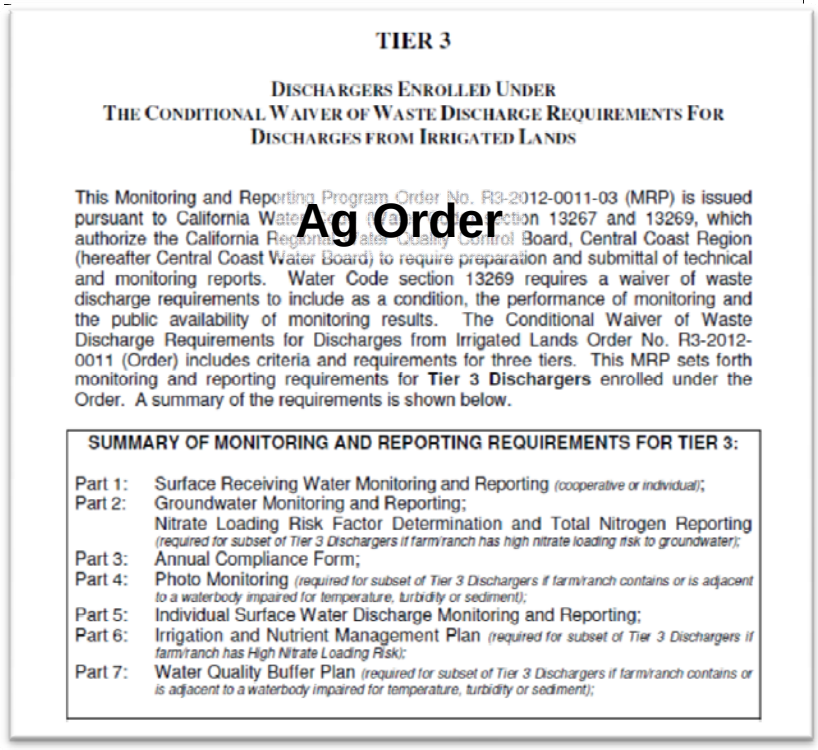






TIER 3

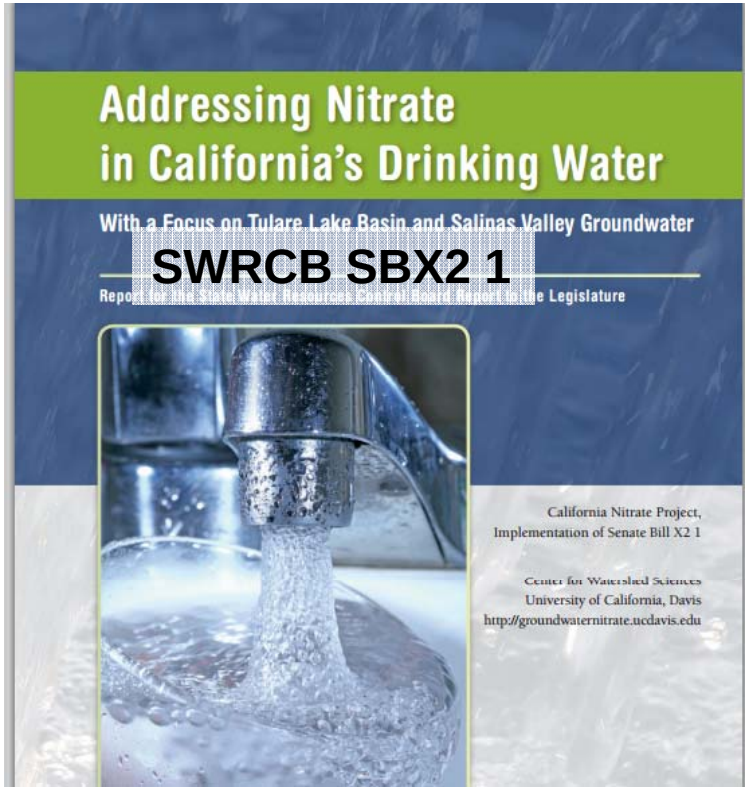
DISCHARGERS ENROLLED UNDER
THE CONDITIONAL WAIVER OF WASTE DISCHARGE REQUIREMENTS FOR
DISCHARGES FROM IRRIGATED LANDS

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

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);*

Ag Order

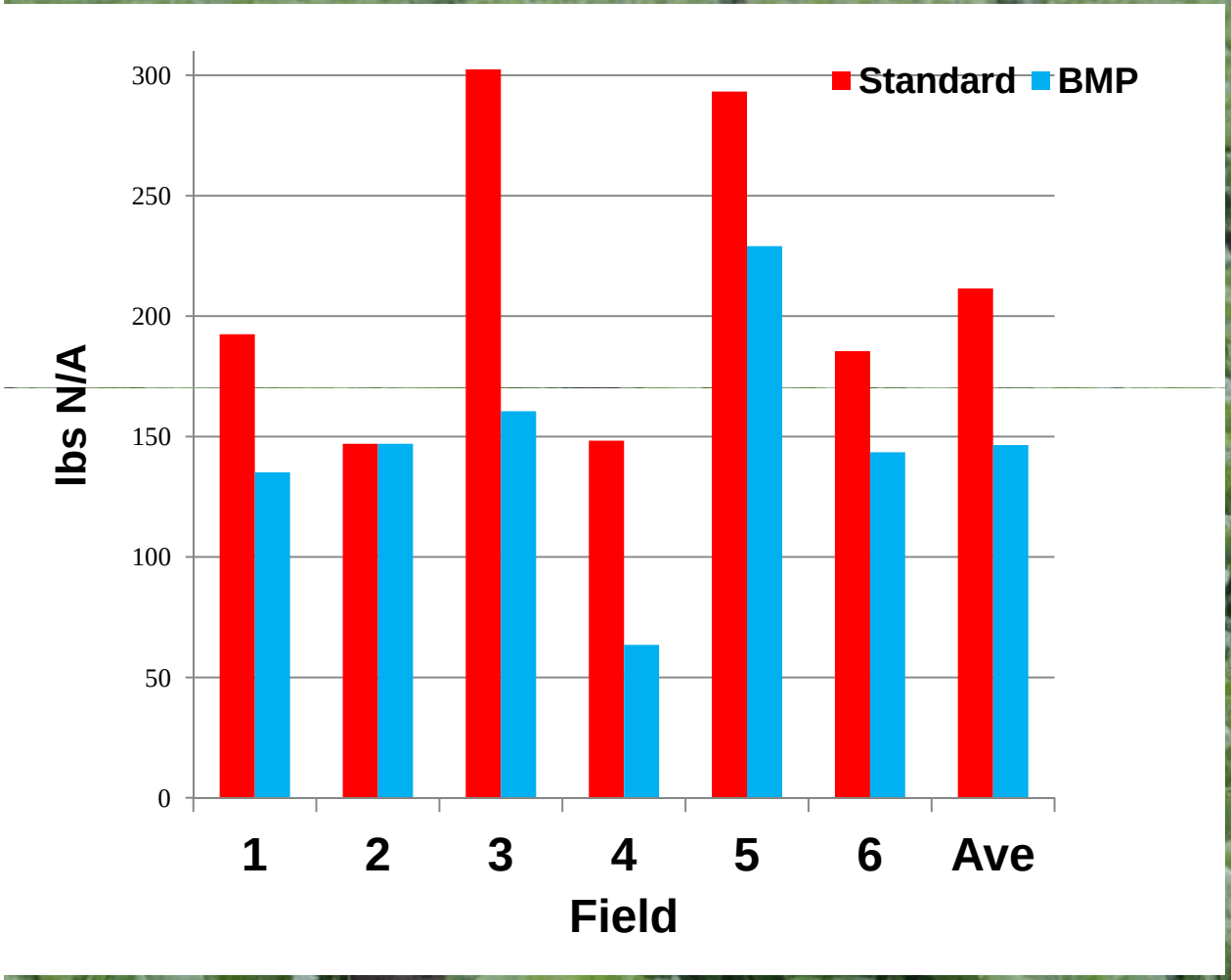


Tools for Managing Water and Nitrogen Fertilizer in Lettuce

- soil nitrate quick test

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

Commercial Lettuce Nitrogen Fertilizer Trials

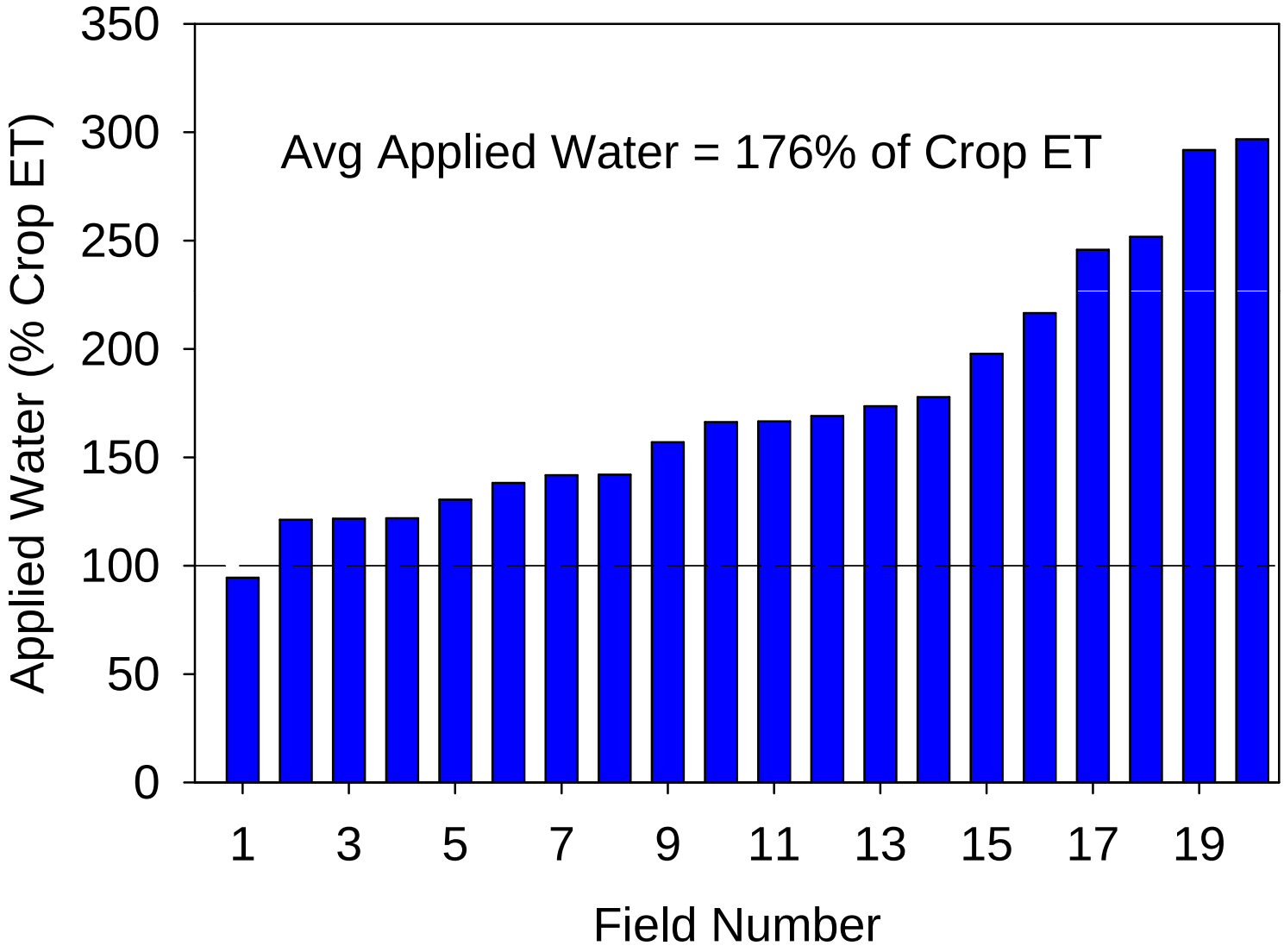


Std: 212 lbs N/Acre
BMP: 146 lbs N/Acre

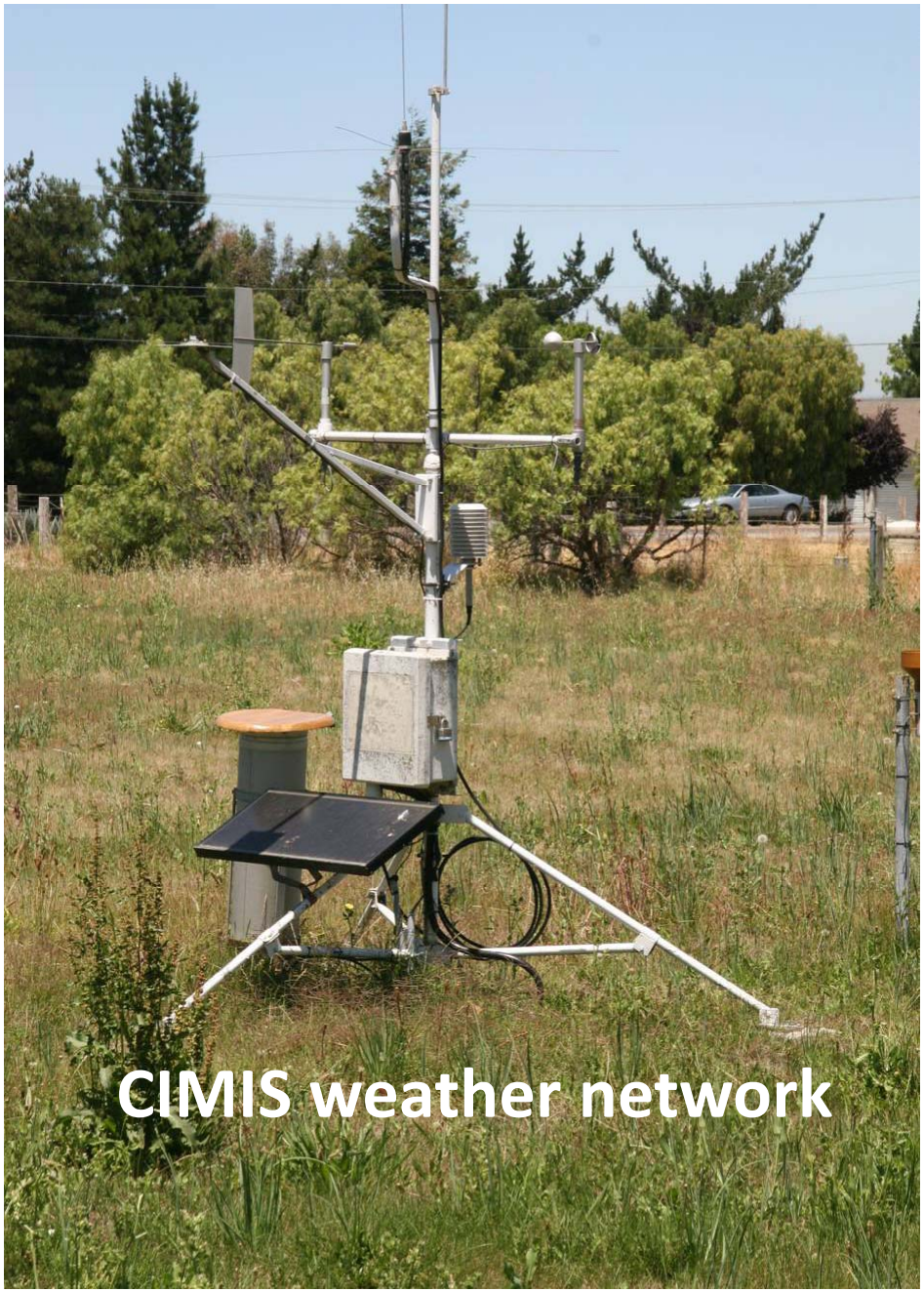
Difference
66 lbs/A

30% reduction in N fertilizer

Applied Water as Percentage of Crop ET (Lettuce)



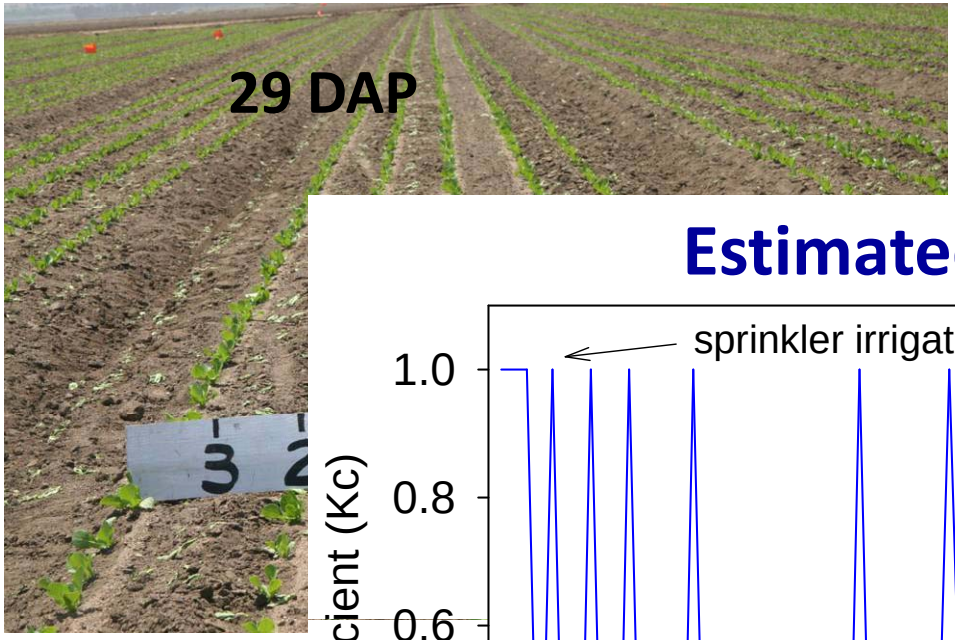
Weather-based Irrigation Scheduling

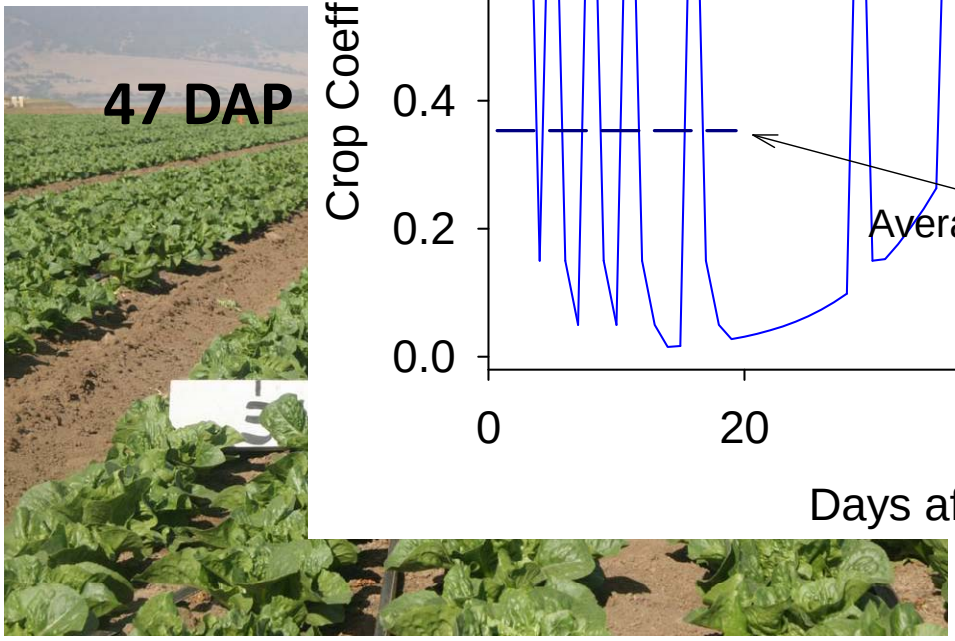


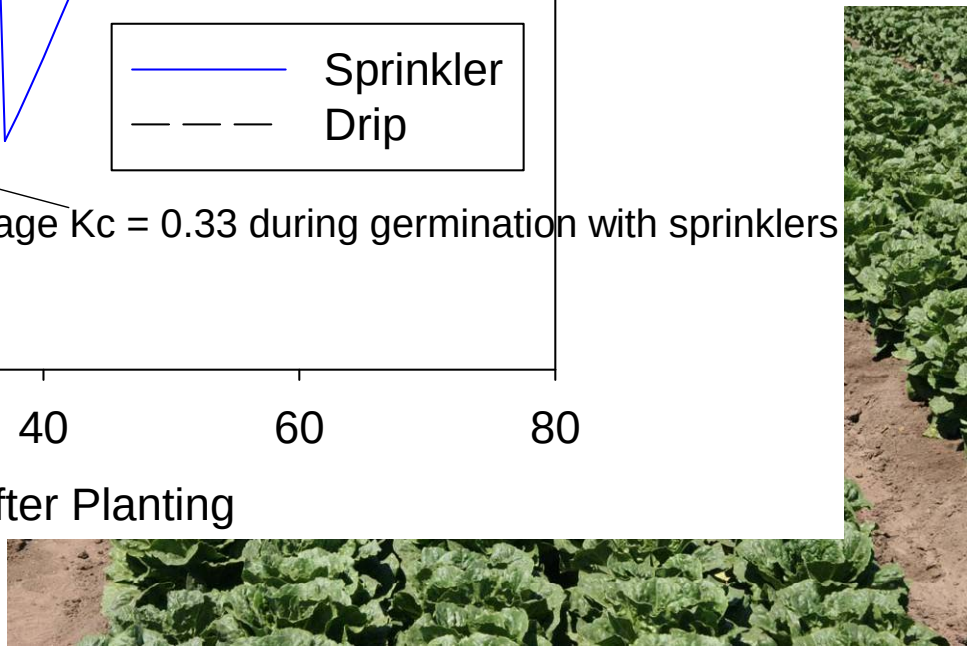
Converting Reference ET to Crop ET:

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

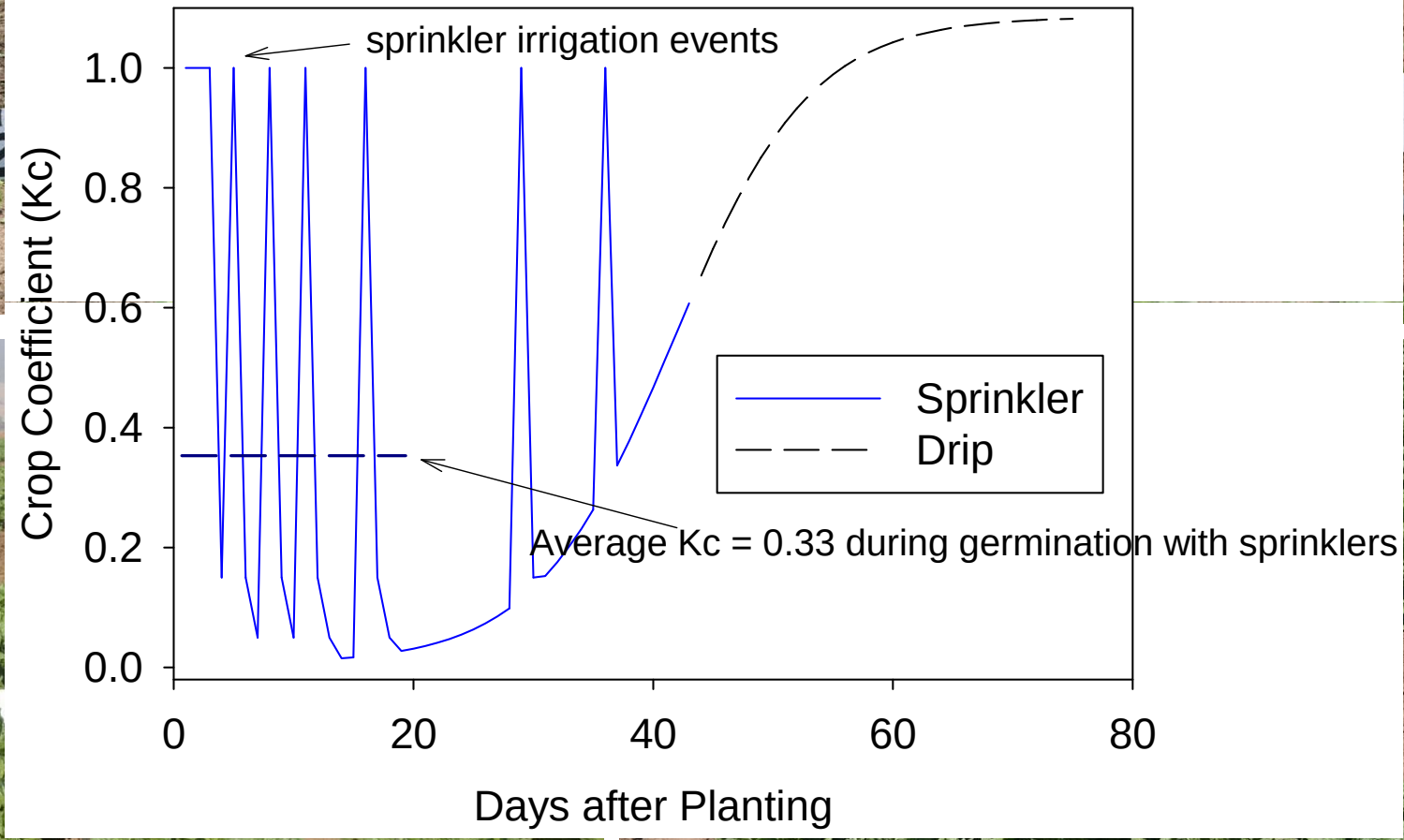
K_c can vary from 0.1 to 1.2



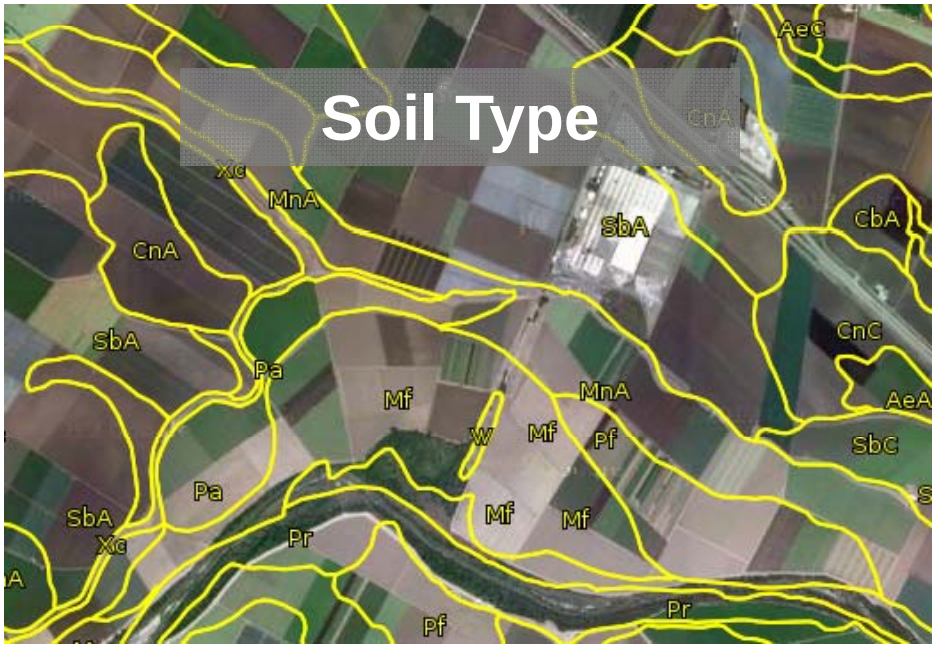




Estimated Kc of Lettuce



Other information needs to be considered

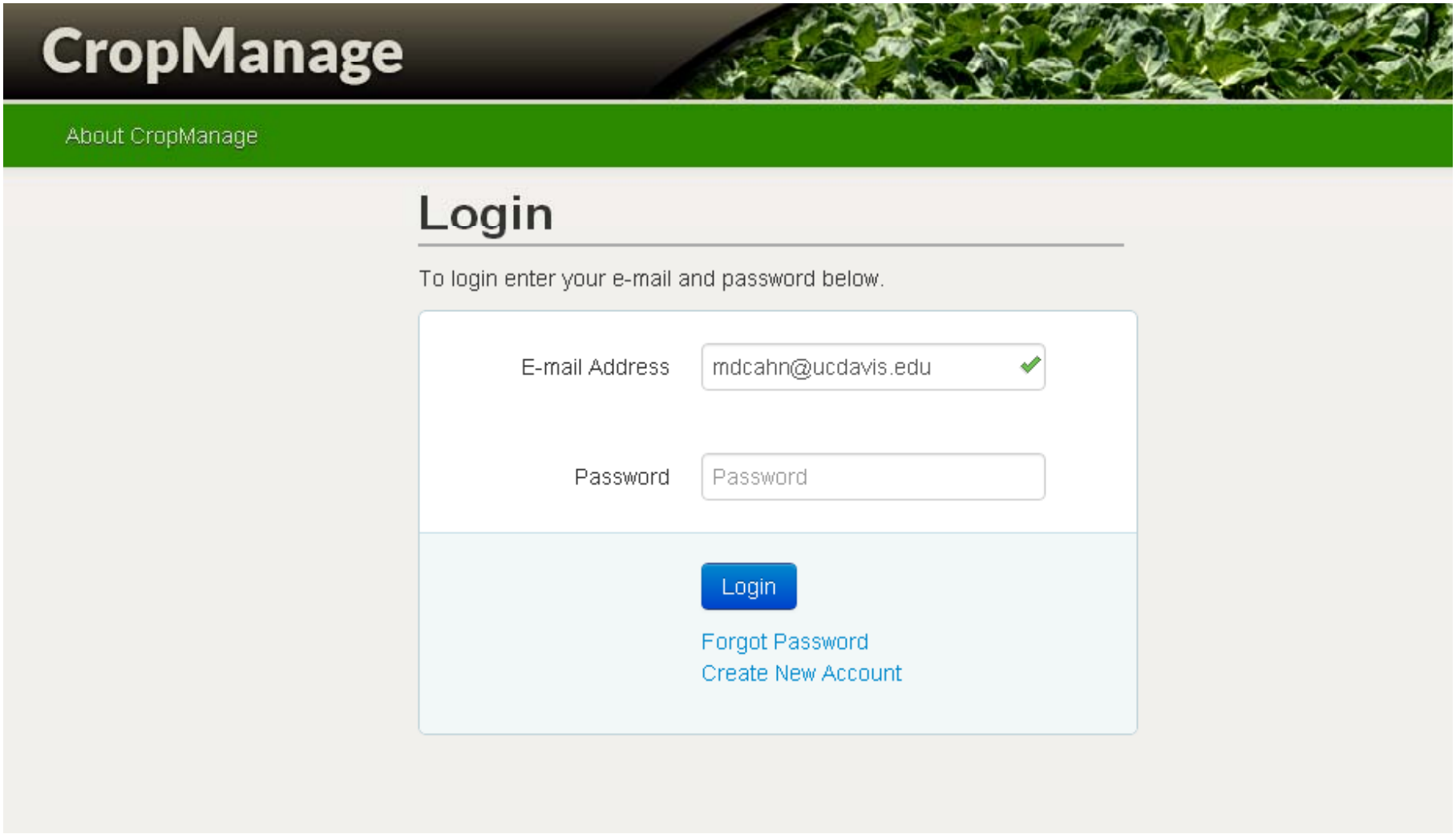


How can water and N management tools be useful for large vegetable growing operations?

- Large growing operations have multiple decision makers
- One farm manager may be responsible for >200 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.

CropManage

Integrate information from multiple sources

Database driven web application

Crop ET model

Crop N model

Record display and data export

Decision support using crop models

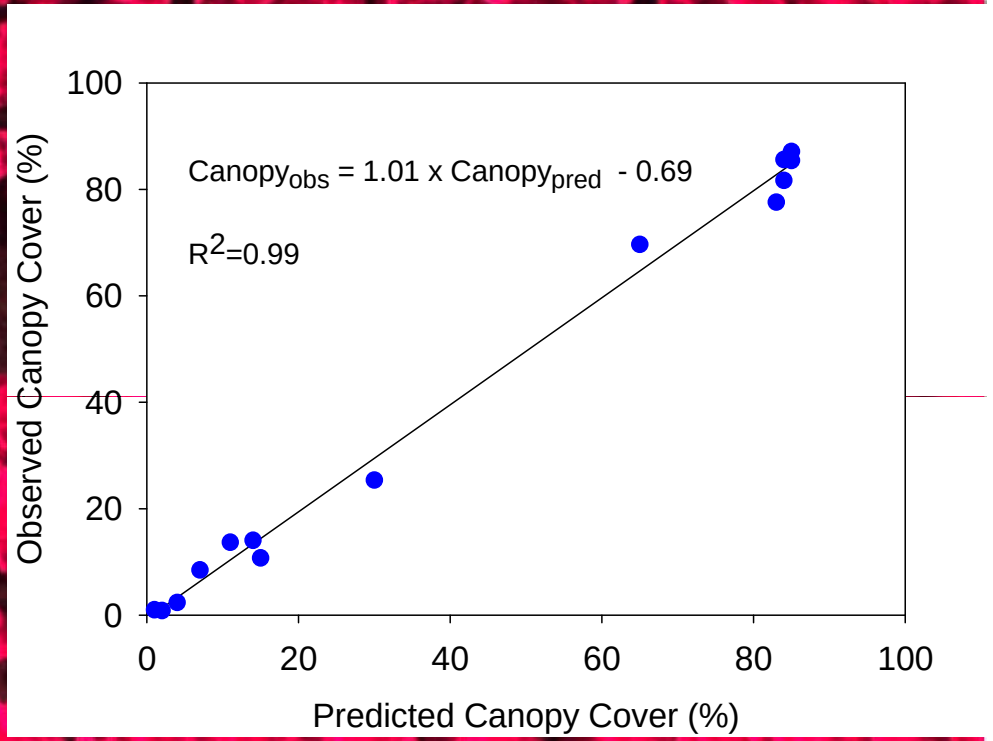
How is N fertilizer rate determined from the quick nitrate test?

Fertilizer N = Future Crop N uptake

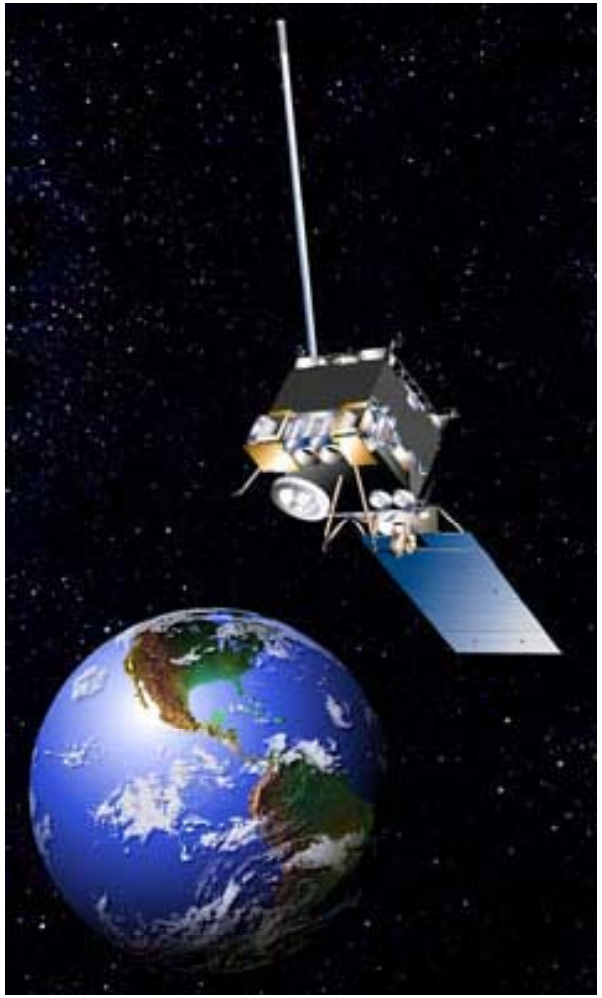
– (Quick Test N - threshold NO_3-N)

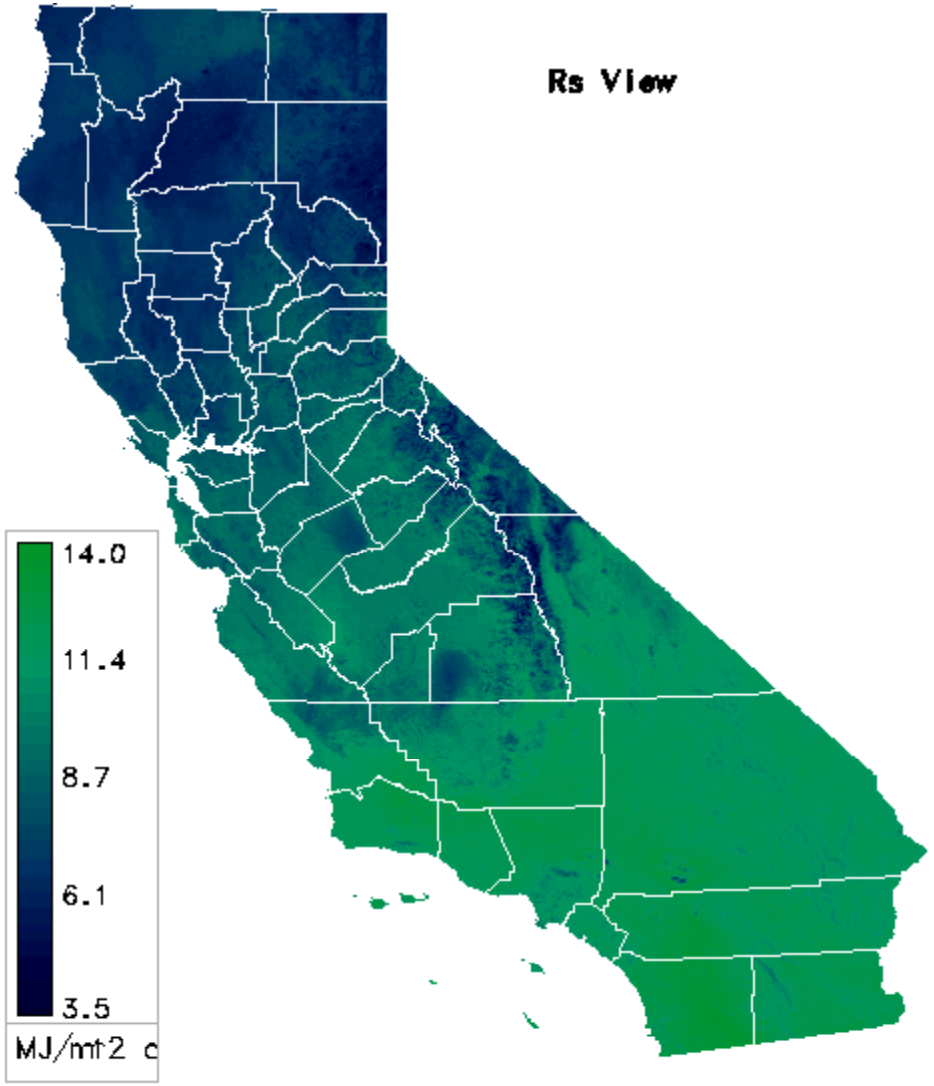
– Soil mineralization N

– Plant residue N


Canopy$_{obs}$ = 1.01 x Canopy$_{pred}$ - 0.69
R^2=0.99
Observed Canopy Cover (%)
Predicted Canopy Cover (%)
0
20
40
60
80
100

Spatial CIMIS ETo Reporting

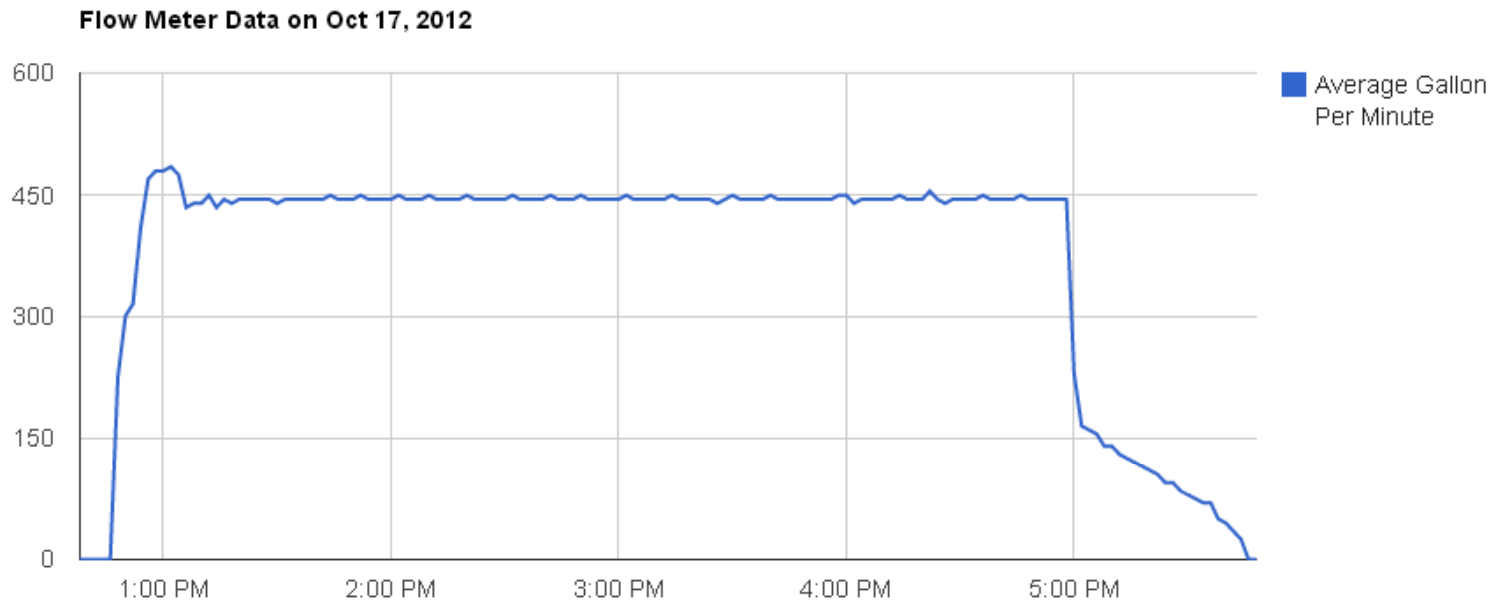




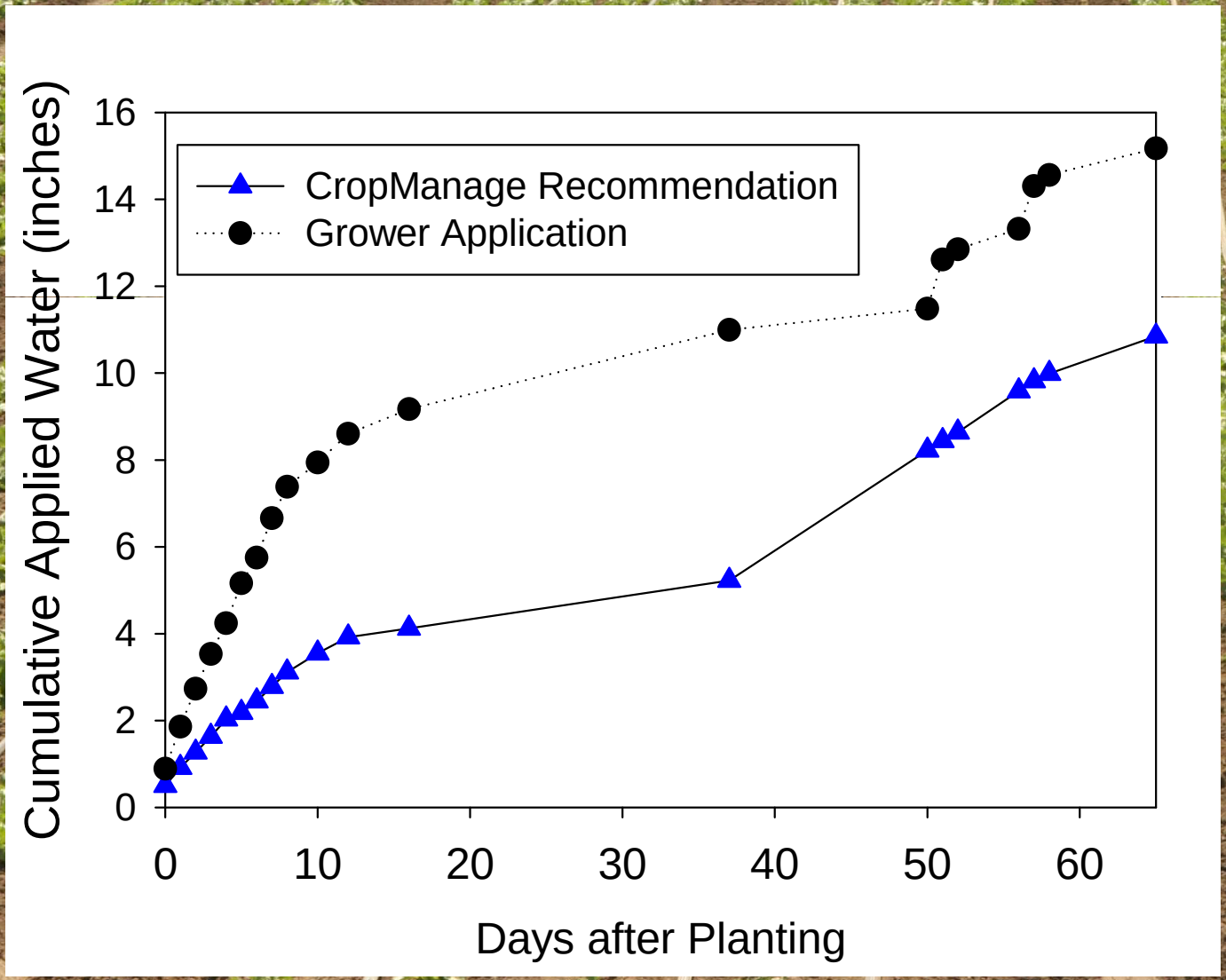
Interface with UCD SoilWeb Tool

How much water was applied?

Flow Meter Data



Evaluate and Document Water Management



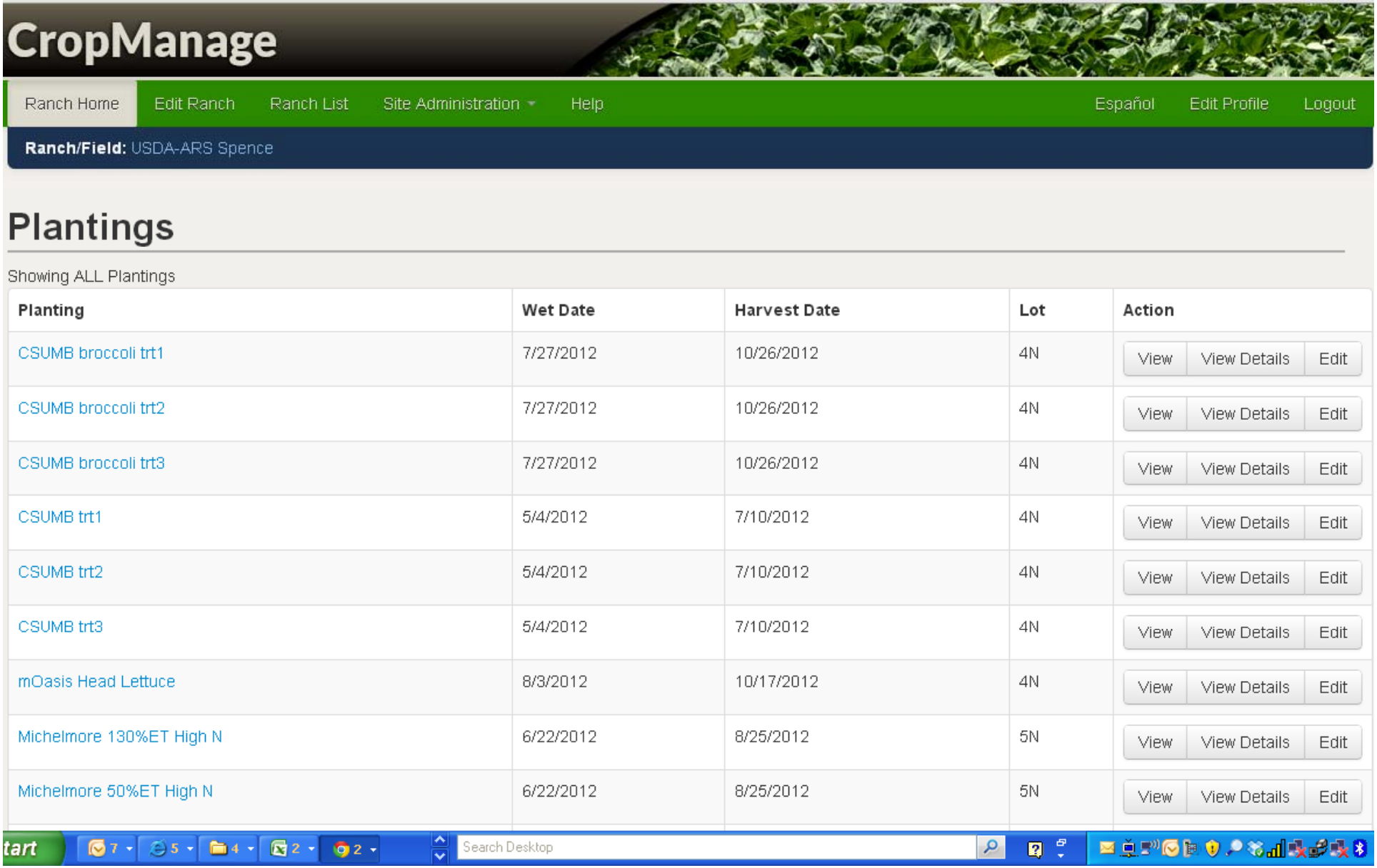
Steps to Using CropManage

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

UC Security and Privacy Policy

1. CropManage is designed to protect the privacy of grower data.
2. Current industry security standards are used (backed up to 2 other servers, encryption, secure security socket layer).
3. UC does not give out/sell grower data and is not obligated to give out data.
4. UC will not analyze grower data without first asking for permission.

Ranch Summary



Soil Summary

Sample Date	Sample Reading (ppm)	Crop Stage	Sample Depth (ft)	Sample Analysis	Soil Nitrate-N (ppm)	Soil Mineral N (lb/acre)
9/4/12	25	1st drip fertigation	1	Quick Strip	11.90	45.23
9/17/12	50	2nd drip fertigation	1	Quick Strip	23.81	90.46
9/21/12	50	3rd drip fertigation	1	Quick Strip	23.81	90.46
10/4/12	25	4th drip fertigation	1	Quick Strip	11.90	45.23
10/4/12	25	4th drip fertigation	2	Quick Strip	11.90	45.23
10/9/12	20	4th drip fertigation	1	Quick Strip	9.52	36.18
10/9/12	15	4th drip fertigation	2	Quick Strip	7.14	27.14

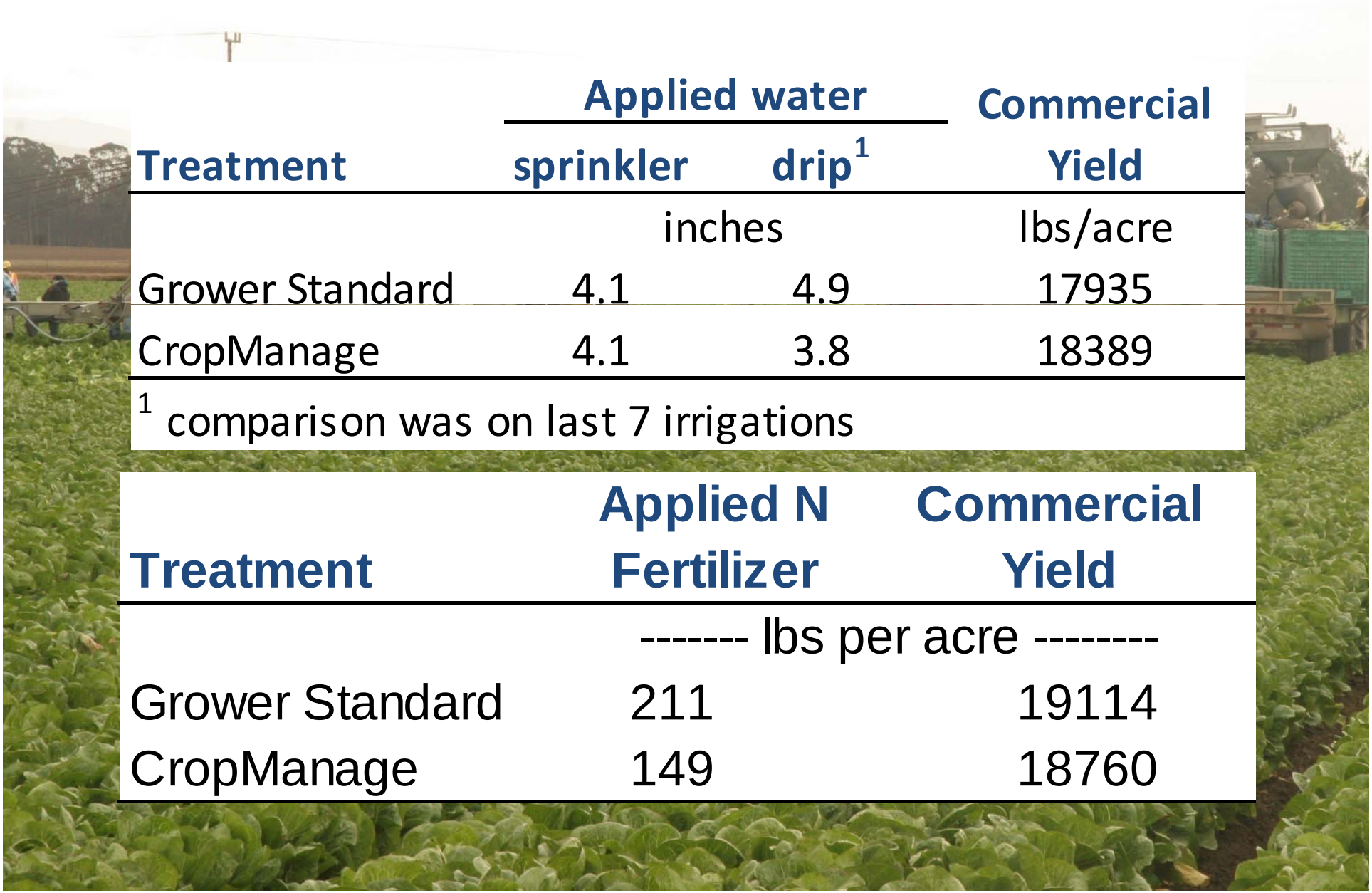
Fertilizer Summary

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
7/24/12	N/A	Bed listing	N/A	0.00	6-20-20	18.0	300.0 lbs/acre
8/20/12	N/A	Post-thinning	N/A	5.31	Ammonium Sulfate	63.0	300.0 lbs/acre
9/7/12	11.90	1st drip fertigation	47.8	15.15	UAN32	40.0	11.3 gallons/acre
9/18/12	23.81	2nd drip fertigation	0.0	26.27	UAN32	40.0	11.3 gallons/acre
9/24/12	N/A	3rd drip	N/A	34.99	KTS	0.0	10.7 gallons/acre

Water Summary Table

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)
7/27/12	sprinkler	N/A	N/A	N/A	1.52 in	0.00	0	0.00
7/29/12	Sprinkler	1.0	0.35 in	1.18 hrs	0.77 in	0.70	1	0.19
7/31/12	Sprinkler	1.0	0.37 in	1.23 hrs	0.95 in	0.70	1	0.20
8/2/12	Sprinkler	1.0	0.36 in	1.20 hrs	0.29 in	0.70	1	0.19
8/6/12	Sprinkler	2.2	0.34 in	1.14 hrs	0.35 in	0.37	2	0.17
8/10/12	Sprinkler	1.8	0.41 in	1.38 hrs	0.45 in	0.37	3	0.21
8/14/12	Sprinkler	2.8	0.41 in	1.37 hrs	0.56 in	0.38	5	0.20
8/24/12	Drip	6.5	0.53 in	3.80 hrs	0.54 in	0.25	15	0.18
8/28/12	Drip	14.4	0.16 in	1.13 hrs	0.15 in	0.28	23	0.12
8/31/12	Drip	8.1	0.24 in	1.71 hrs	0.22 in	0.37	31	0.19
9/4/12	Drip	7.6	0.37 in	2.63 hrs	0.39 in	0.49	43	0.16
9/7/12	Drip	6.8	0.34 in	2.43 hrs	0.55 in	0.62	53	0.16

Field Validation of CropManage



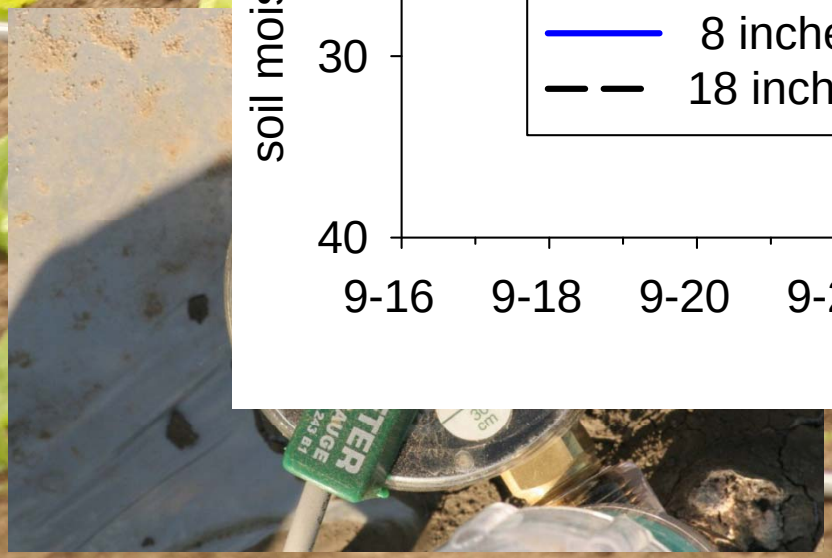
Treatment	Applied water		Commercial Yield
	sprinkler	drip[1]	
	inches		lbs/acre
Grower Standard	4.1	4.9	17935
CropManage	4.1	3.8	18389

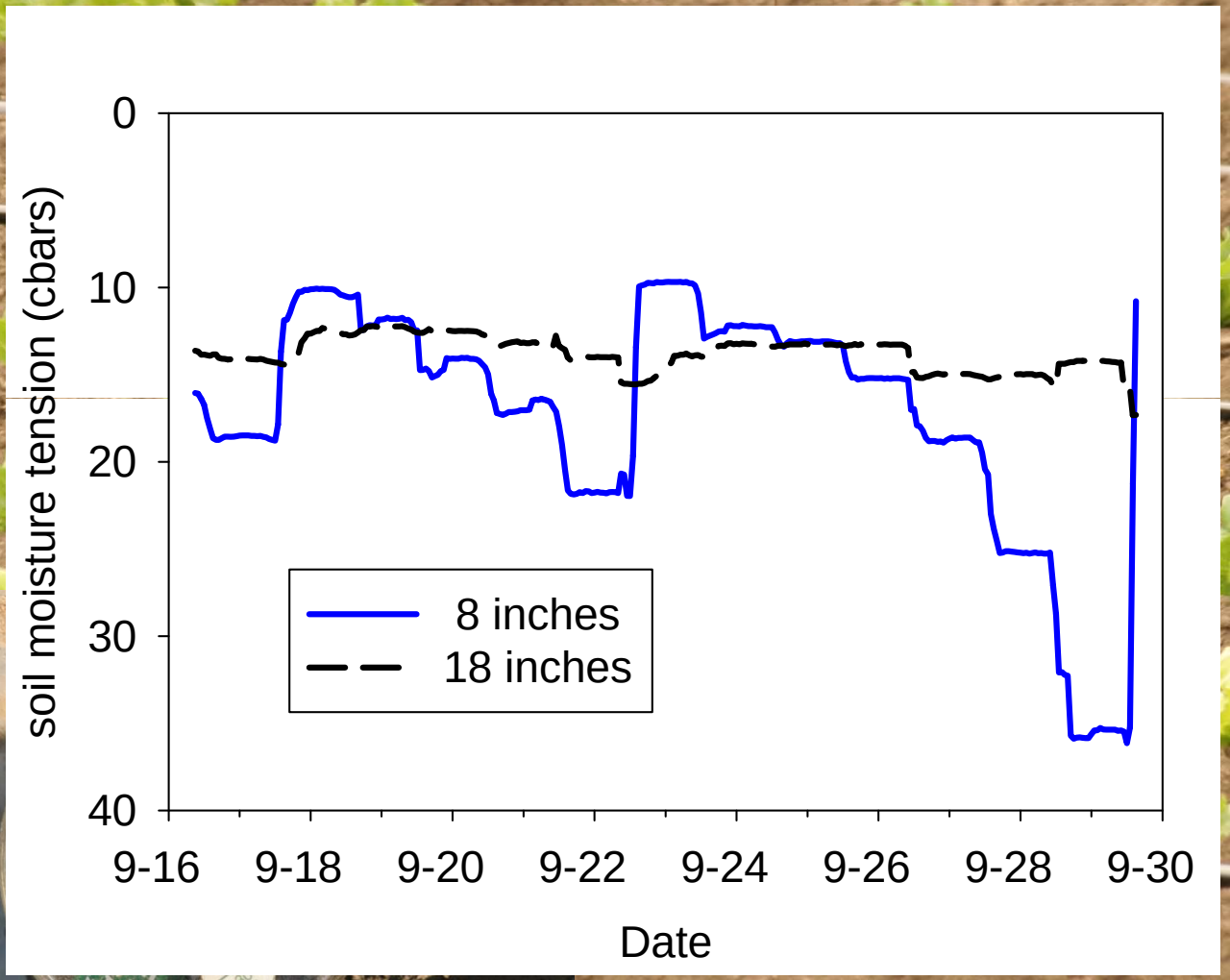
[1] comparison was on last 7 irrigations

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

The road ahead…

Soil moisture monitoring





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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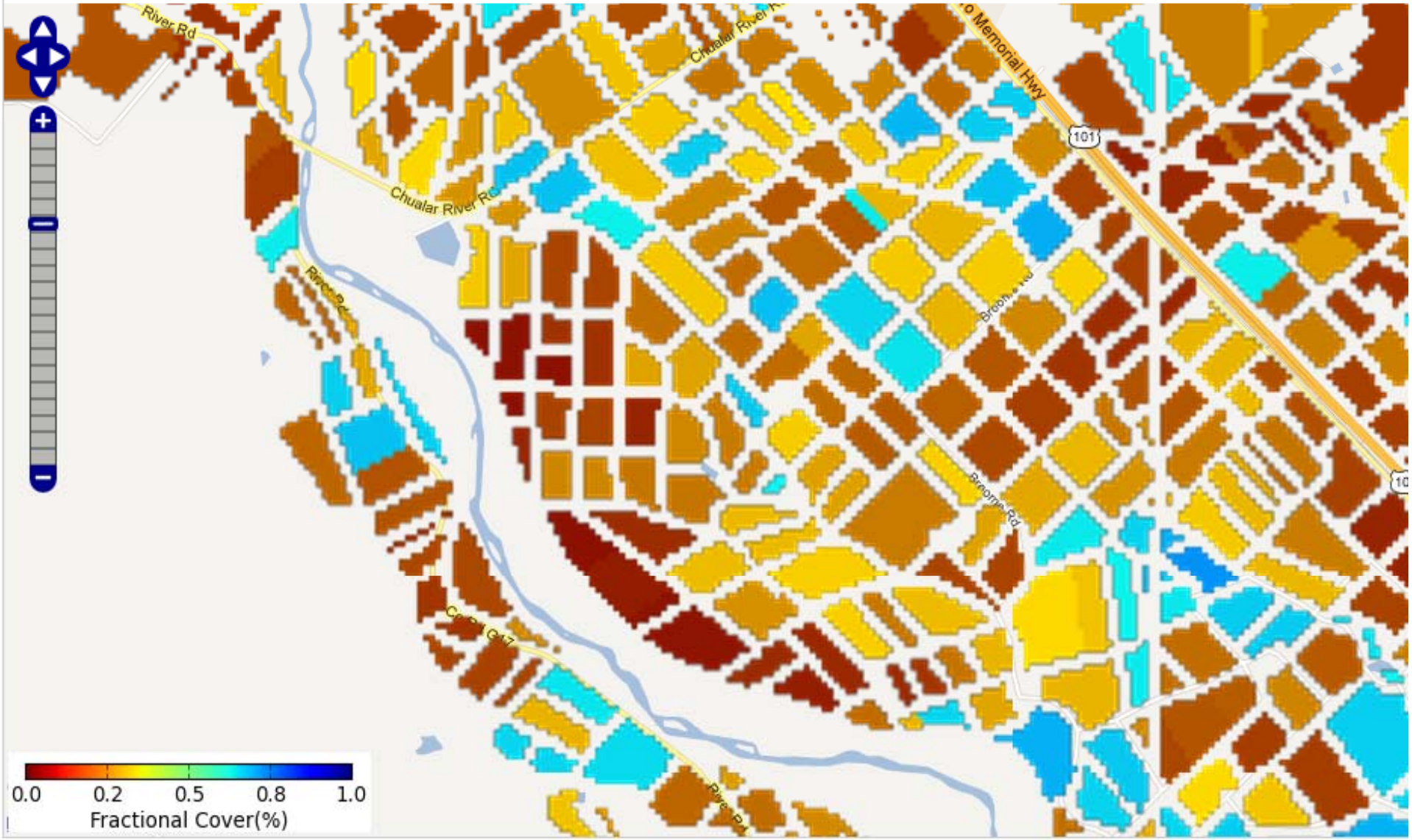

Final Thoughts

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

- *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.

- We will offer 2 hour training workshops on CropManage on March 13 and April 2, 2013.