CropManage: An Online Decision Support Tool for Irrigation and Nutrient Management

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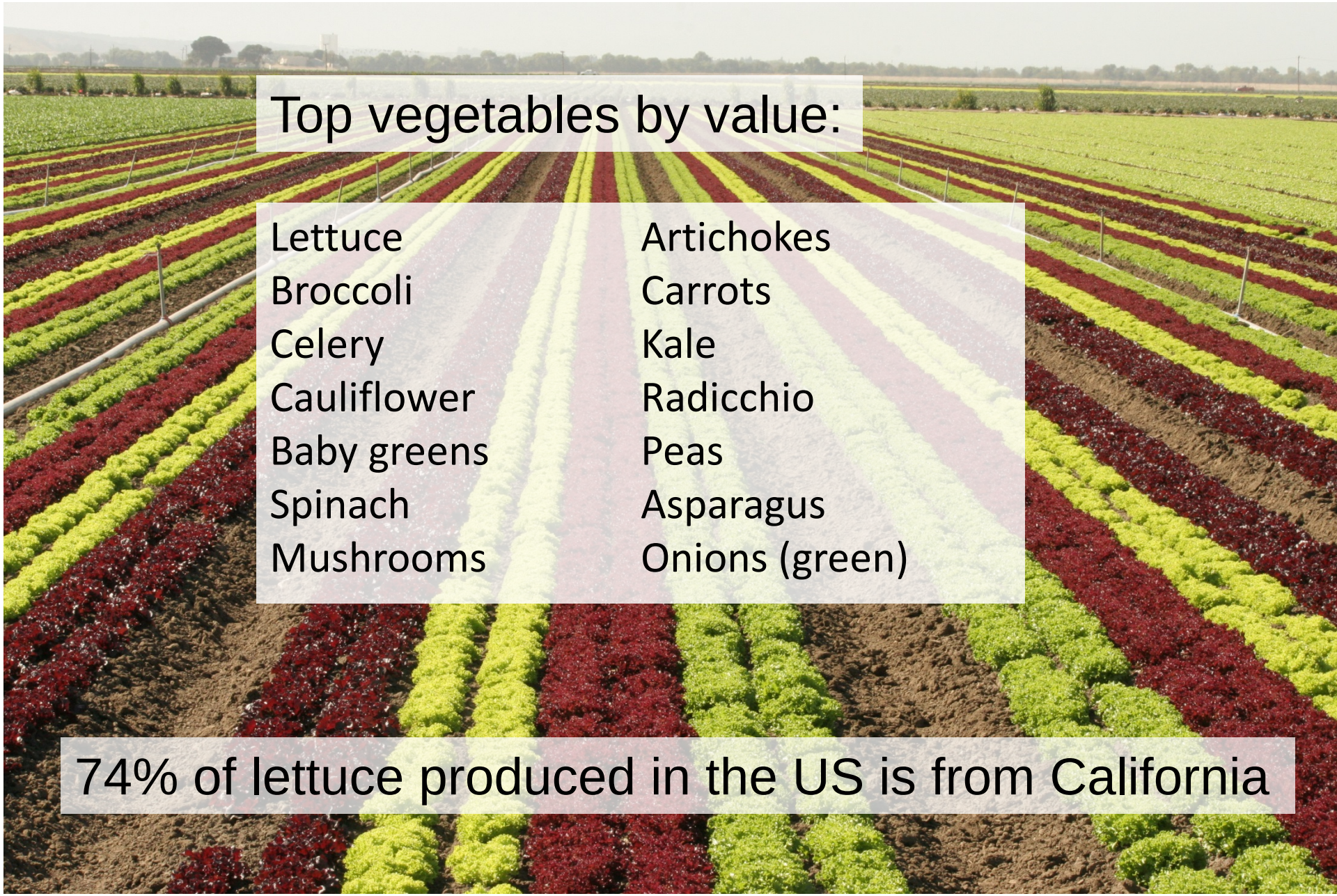
- ✓ Central Coast UCCE Farm Advisors
- ✓ Grower and shipping industry participants

The Central Coast is the Salad Bowl Capital of the US

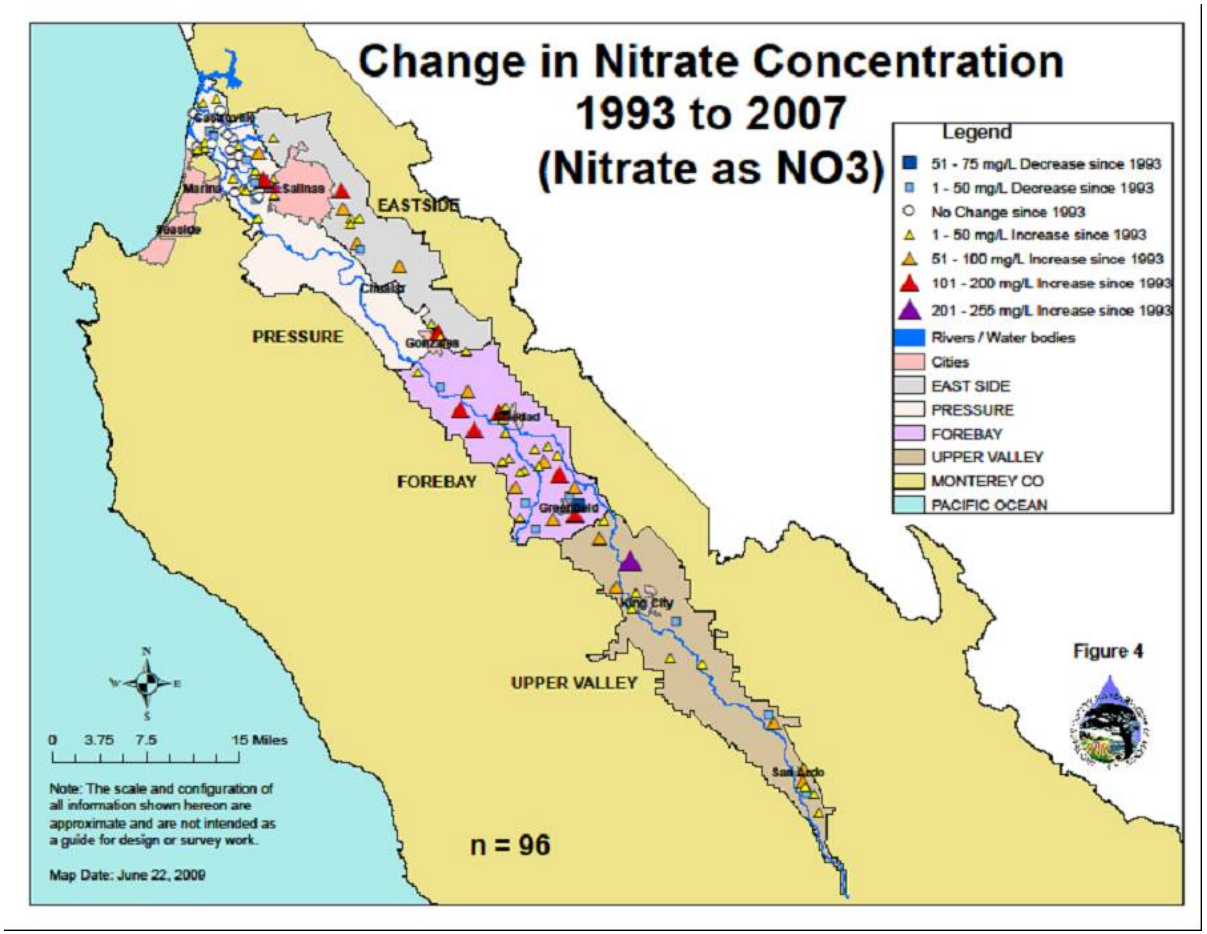


Top vegetables by value:

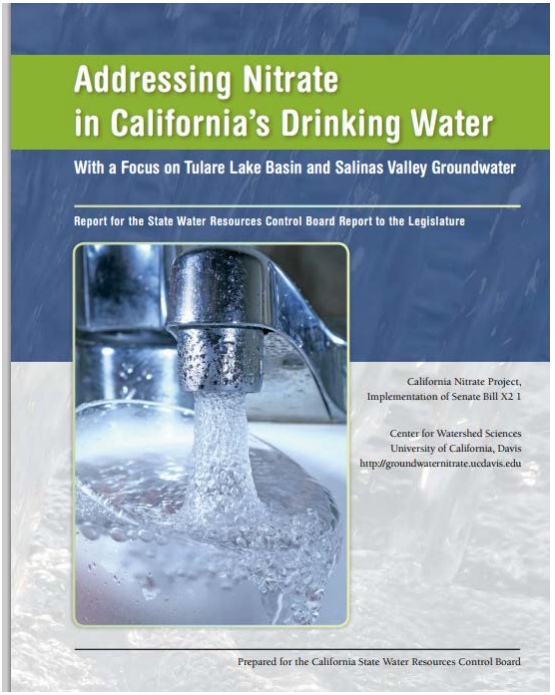
Lettuce	Artichokes
Broccoli	Carrots
Celery	Kale
Cauliflower	Radicchio
Baby greens	Peas
Spinach	Asparagus
Mushrooms	Onions (green)

74% of lettuce produced in the US is from California

Nitrate contamination of Ground Water



MCWRA



Harter and Lund, 2012

TIER 2/TIER 3 FARMS WITH HIGH NITRATE LOADING RISK
TOTAL NITROGEN APPLIED REPORT - RANCH / RISK UNIT

Page 1 of 1 - June 5, 2014 Version

SUBMIT ELECTRONIC FORM: Click on "Submit Form" to send completed form directly to the Water Board

EMAIL FORM AS AN ATTACHMENT: Attach completed and saved form to an email and send to AgNOI@waterboards.ca.gov

CONDITIONAL WAIVER OF WASTE DISCHARGE REQUIREMENTS FOR DISCHARGES FROM IRRIGATED LANDS - REGIONAL BOARD ORDER R3-2012-0011

By October 1, 2014 and October 1 annually thereafter, Tier 2 and Tier 3 dischargers with High Nitrate Loading Risk must report total nitrogen applied and present in the soil. *Refer to instructions on reverse.*

SECTION I: GENERAL RANCH INFORMATION

AW#: Ranch Global ID: Ranch Name:

High Risk Determination Name(s):

SECTION II: RECORDKEEPING AND REPORTING INFORMATION

High Risk

Reporting Year: *(select one)* ☐ 2014 ☐ 2015 ☐ 2016 ☐ 2017

Have nitrogen records been maintained for the required reporting period *(September 1 - August 30)*? ☐ YES ☐ NO

If NO, state the reporting period for which records have been maintained: MM/DD/YYYY to MM/DD/YYYY

SECTION III: TOTAL NITROGEN APPLIED REPORTING

Ranch / Risk Unit Reporting Name: Ranch / Risk Unit Acres:

	Crop Type(s) Grown and Harvested During Reporting Period	Crop Type Acres	Total Nitrogen Present in the Soil *(lbs/acre)*	Total N Applied in Fertilizers & Amendments *(lbs/acre)*	O / C
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					

Average Nitrogen Concentration in Irrigation Water *(mg/L as NO3 -N)*:

Total Nitrogen Applied with Irrigation Water *(lbs/acre)*:

Identify the Basis for the Amount of Total Nitrogen that was Applied *(select all that apply)*

- ☐ University Research Data
- ☐ Yield Projection
- ☐ Grower Experience
- ☐ UCCE Information
- ☐ Commodity or Industry Group
- ☐ Laboratory Recommendation
- ☐ UC Farm Advisor Consultation
- ☐ Private Research Trials
- ☐ Site Analysis Dry Biomass
- ☐ Water Coalition
- ☐ On-Farm Research Trials
- ☐ Scientific Literature
- ☐ Consultant (PCA, CCA, etc.)
- ☐ Trade Publication
- ☐ Local Info/Neighbor
- ☐ Fertilizer Distributor/Dealer

SECTION IV: AUTHORIZATION AND CERTIFICATION

By submitting this Total Nitrogen Applied Report, in compliance with Water Code § 13267, I certify under penalty of perjury that this document was prepared by me, or under my direction or supervision, following a system designed to ensure that qualified personnel properly gathered and evaluated the information submitted. To the best of my knowledge and belief, this document is true, accurate, and complete. I am aware that there are significant penalties for submitting false information.

Does this form contain information related to trade secrets or secret processes? ☐ YES ☐ NO

Preparer Nam

Preparer Title:

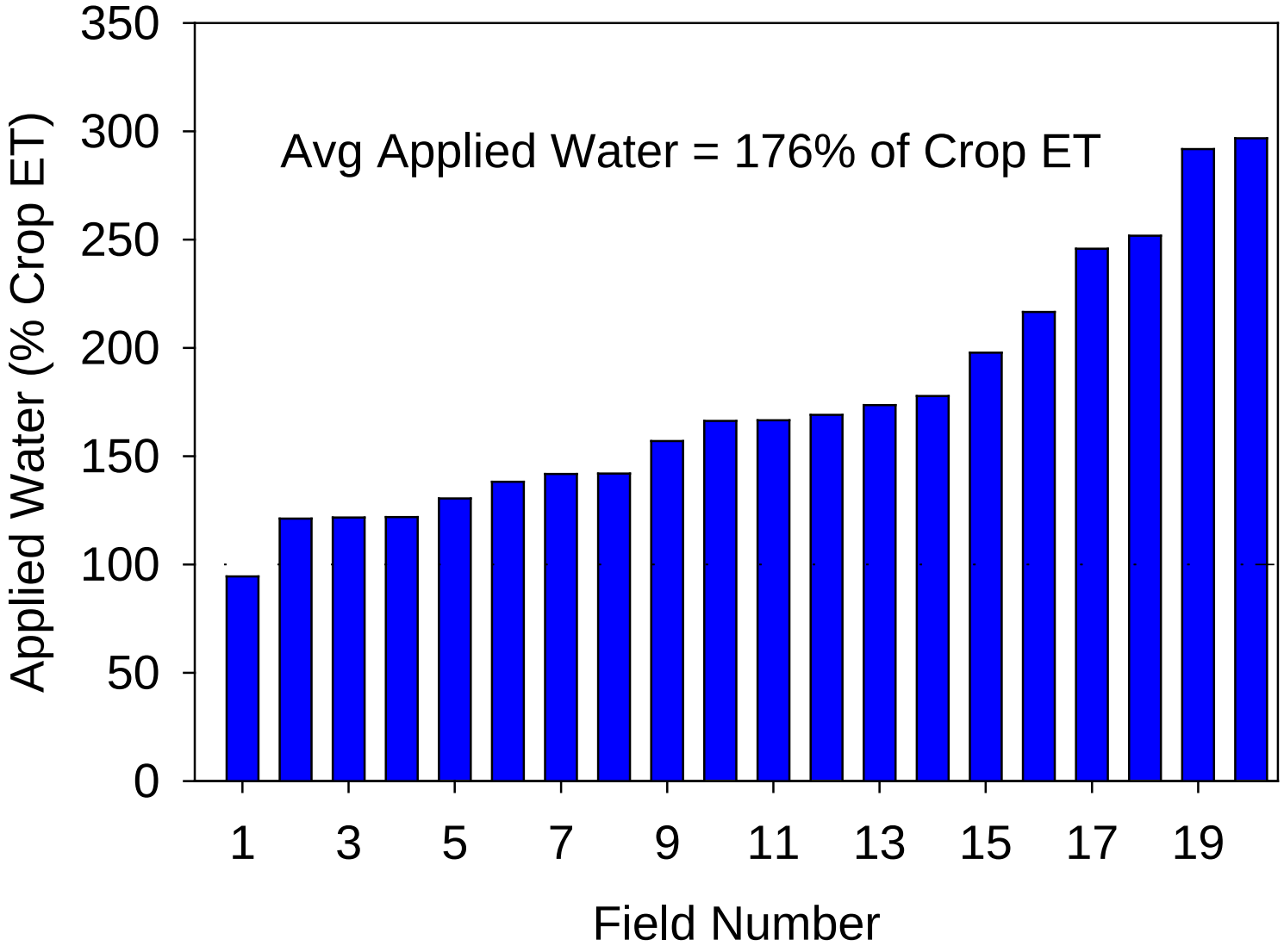
Preparer Contact Info:

Operator/RP Contact Info:

Nitrogen use reporting started October, 2014

- **Approximately half of the above ground biomass is removed at harvest**
- **70 to 80 kg of N/ha remains as residue**

Applied Water as Percentage of Crop ET (Lettuce)



San Antonio Reservoir

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:

$$ET_{crop} = ET_0 \times K_{crop}$$

K_c can vary from 0.1 to 1.2

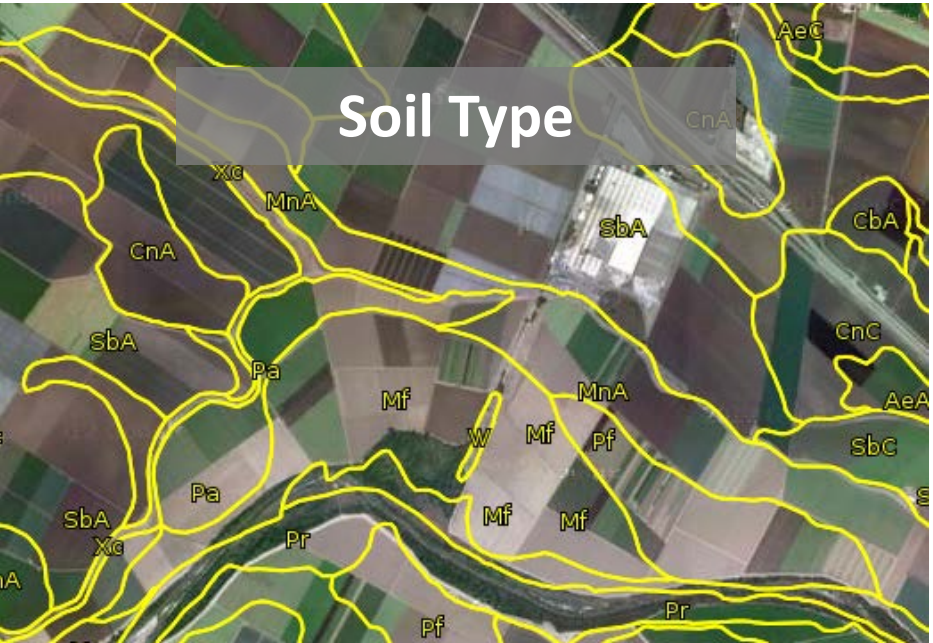

29 Days after planting


41 Days after planting


47 Days after planting


65 Days after planting

Other information needs to be considered

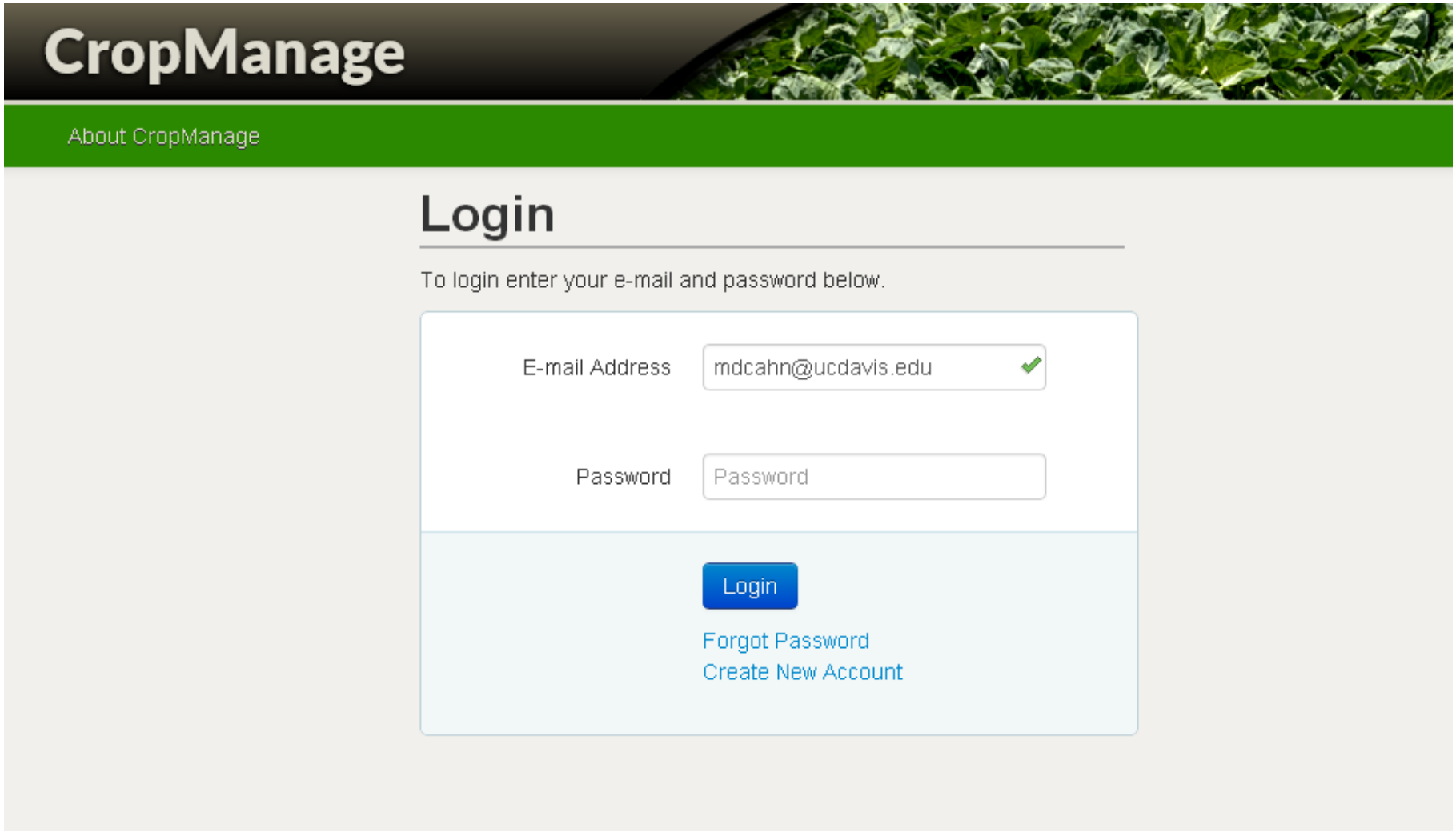


How can water and N management tools be useful for large vegetable growing operations?

- 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 tool

https://ucanr.edu/cropmanage



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. Add ranch and fields
3. Add plantings to fields
4. Enter soil tests, fertilizer, and irrigation events

Current crops supported

Vegetables:

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

Berries:

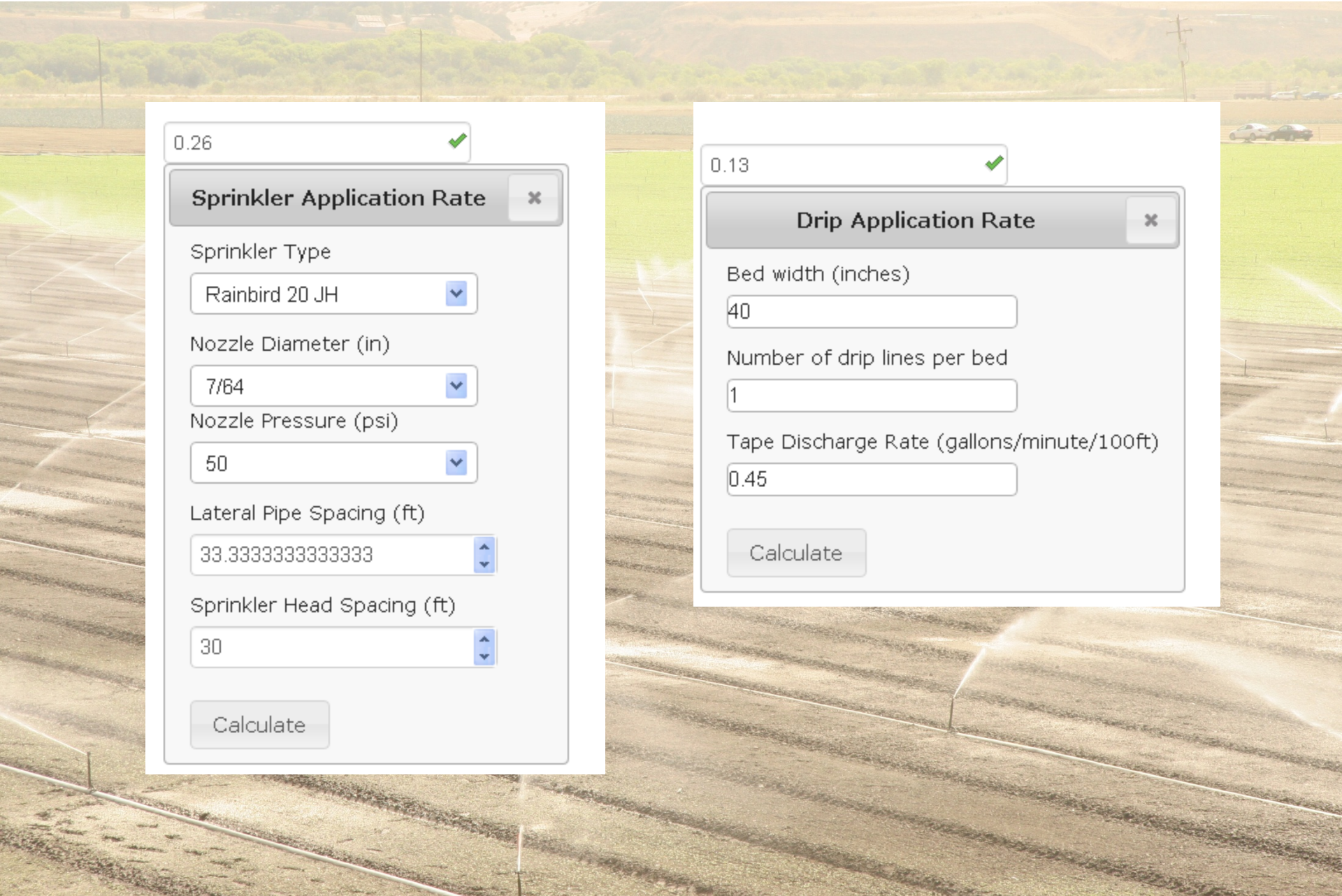
- Strawberry
- Raspberry*
- Blackberry*

Interface with UCD SoilWeb Tool

Soil Type | Select Soil Type | Find Soil Type

Soil Depth	Silt (%)	Sand (%)	Clay (%)	Organic (%)	Density (g/cm^3)	Soil Tension (cbar)	Mineralization Rate (lb N/acre/day)
1 ft	19.6%	67.4%	13%	2.5%	1.6	7	0.2
2 ft	19.6%	67.4%	13%	2.5%	1.6	5.8	0.2

Irrigation System Application Rate (mm/hr)



Evapotranspiration Calculation

Gallardo et. al. (1996)

Interval since last irrigation + irrigation method

↓

$K_{evaporation}$

Canopy cover model

↓

$K_{transpiration}$

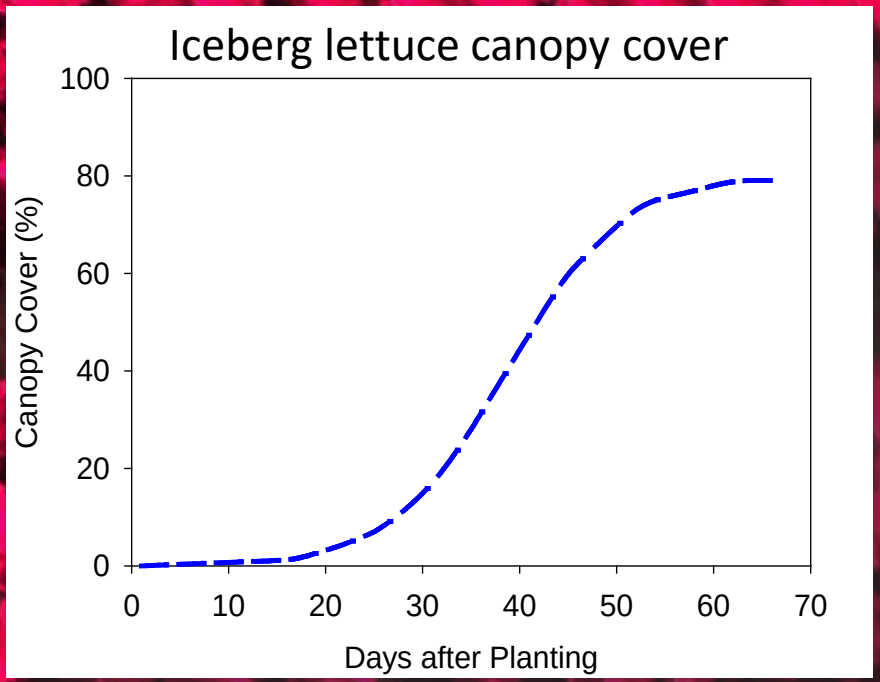
Which is >?

↓

Kc x ETo

↓

ETc


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

Fertilizer Summary

< Back | Go to:

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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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

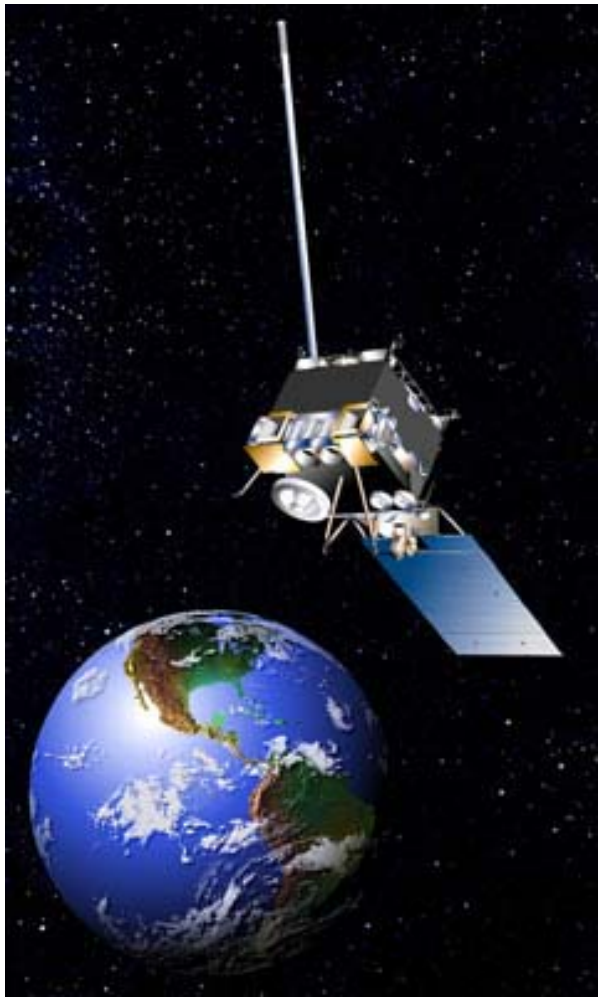
New Watering | View Rainfall Data

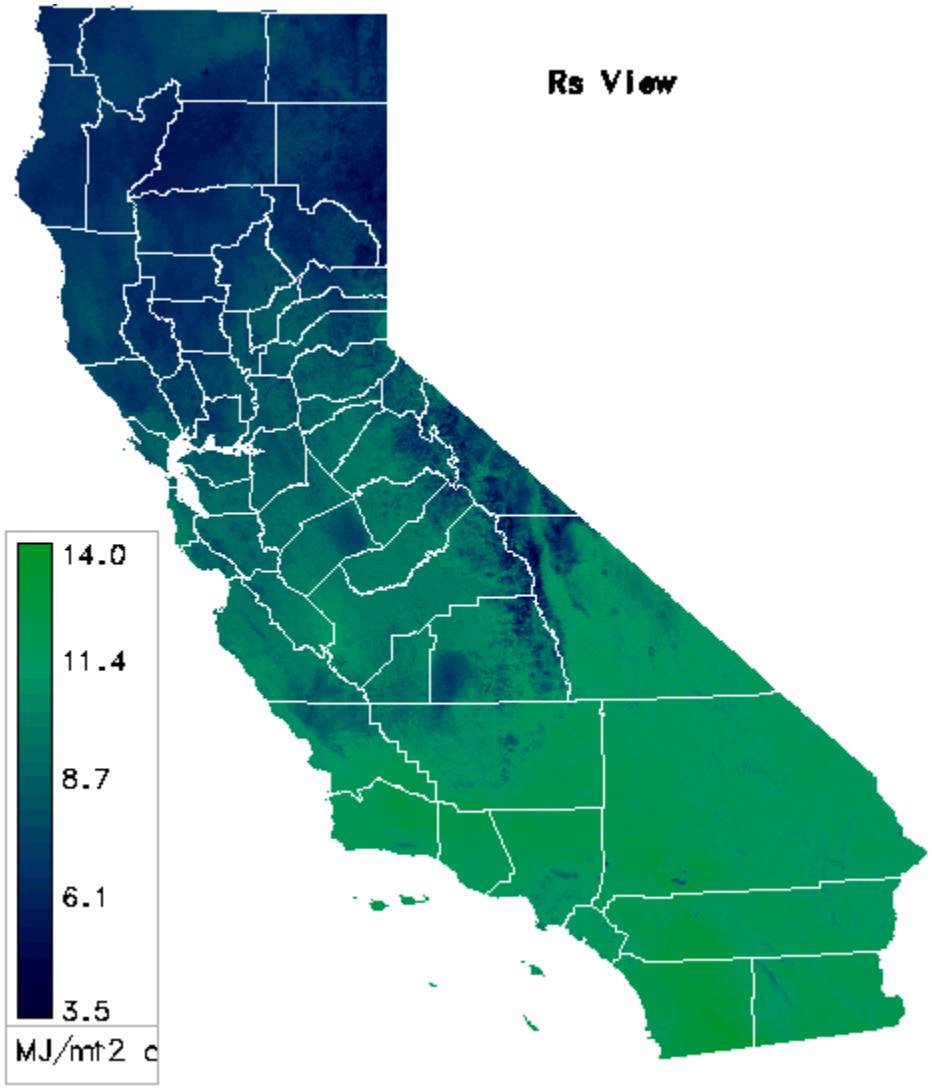
First Previous 1 2 Next Last

Show 10 Rows

Show / Hide Table

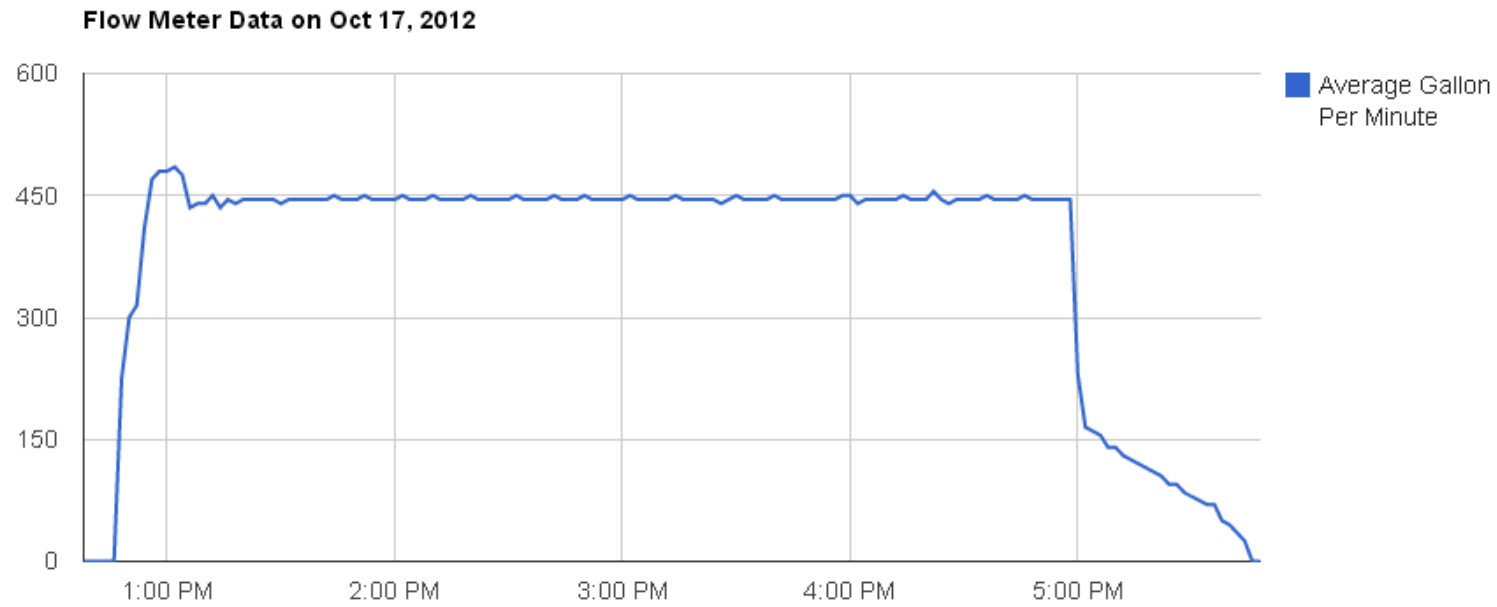
Spatial CIMIS ETo Reporting



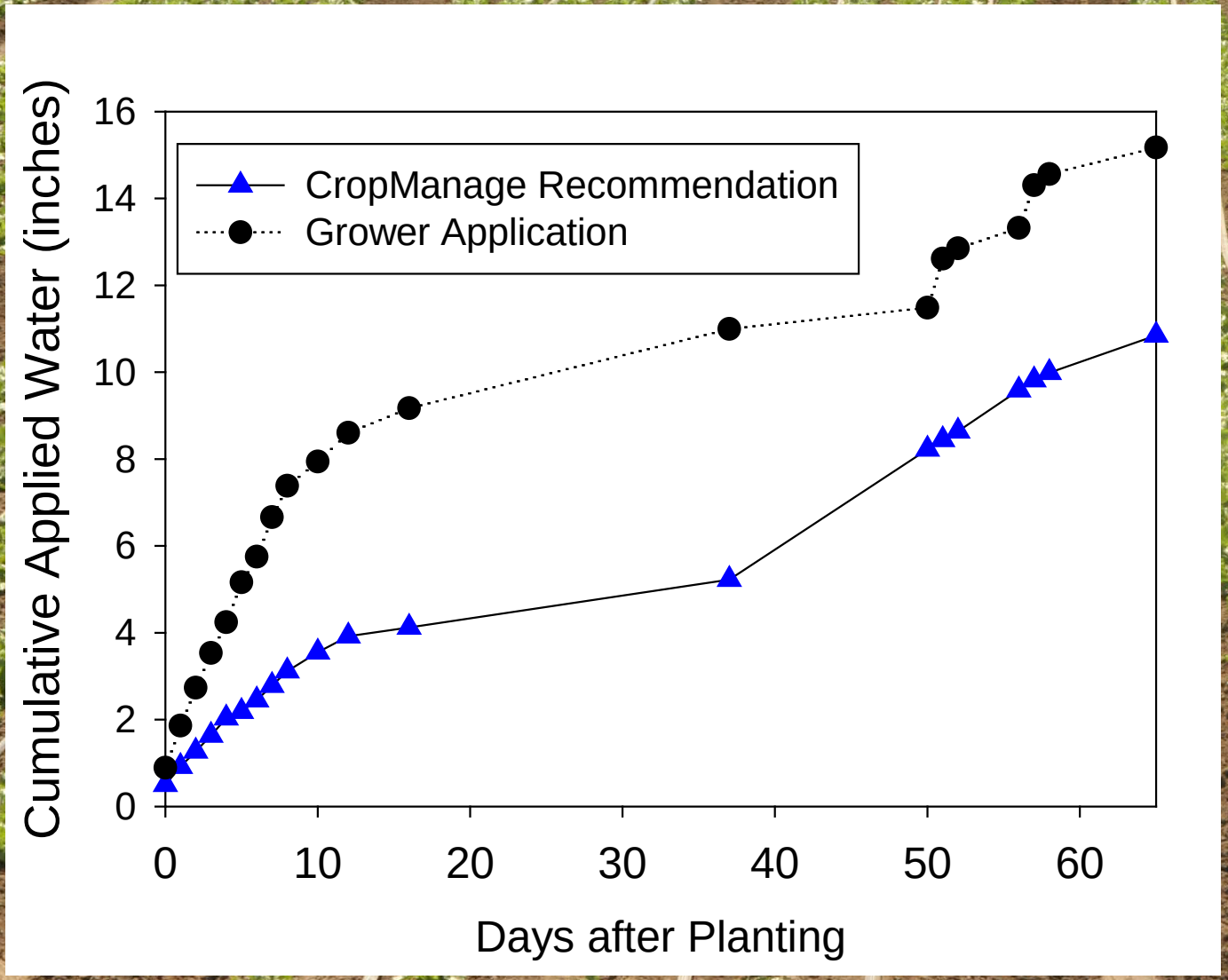


How much water was applied?

Flow Meter Data



Evaluate and Document Water Management



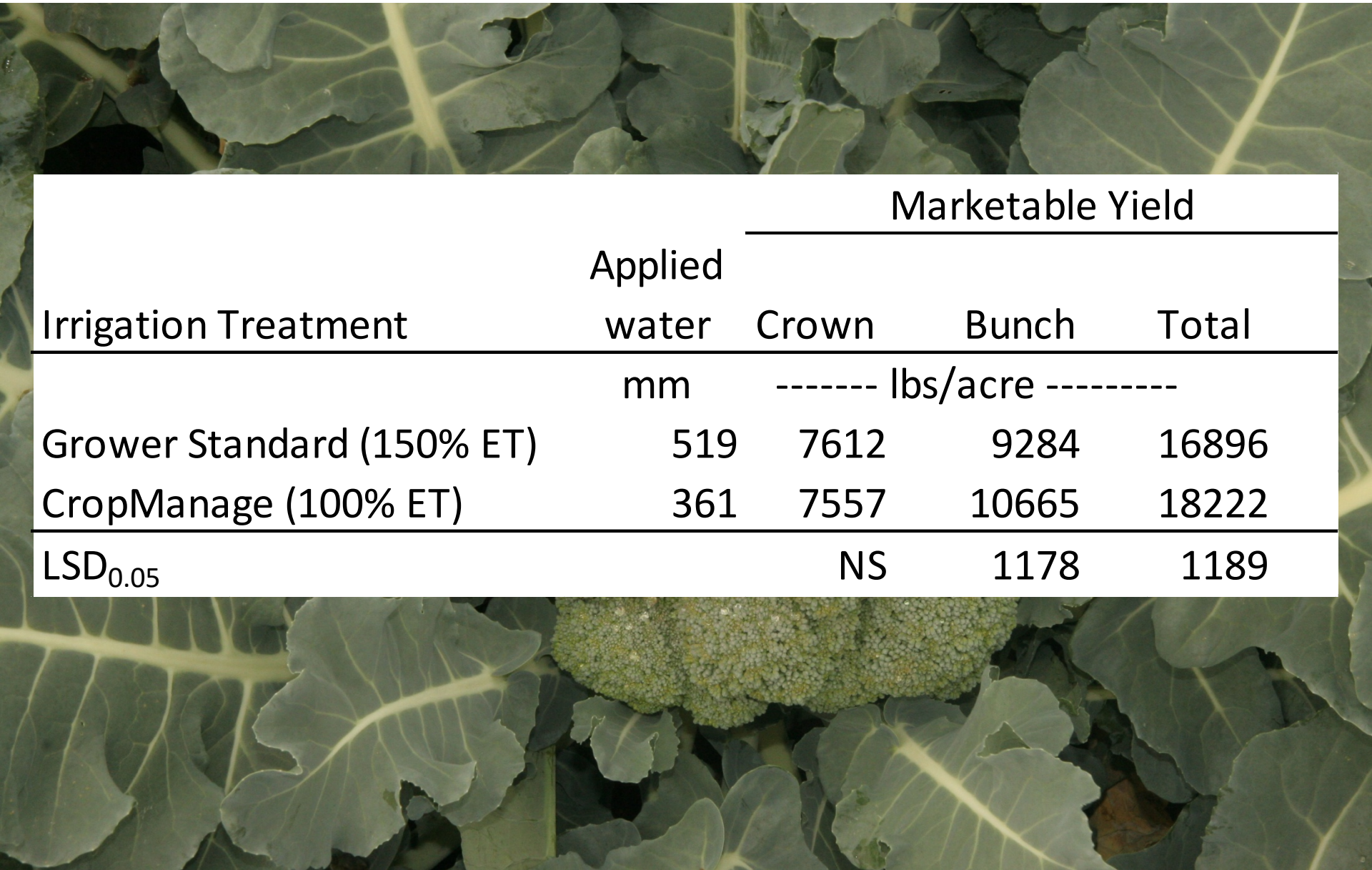
Soil moisture monitoring

Replicated Irrigation Trial for Iceberg Lettuce

Treatment	applied water	head wt		carton yield		CFR[1]
	drip	untrimmed	trimmed	untrimmed	trimmed	yield
	mm	kg/head		--------- kg/ha ----------		
Grower standard (150% ETc)	254	1.24	0.73	82771	48408	45999
CropManage (100% ETc)	170	1.25	0.73	84697	49402	44329
$LSD_{0.05}$		ns	ns	ns	ns	ns

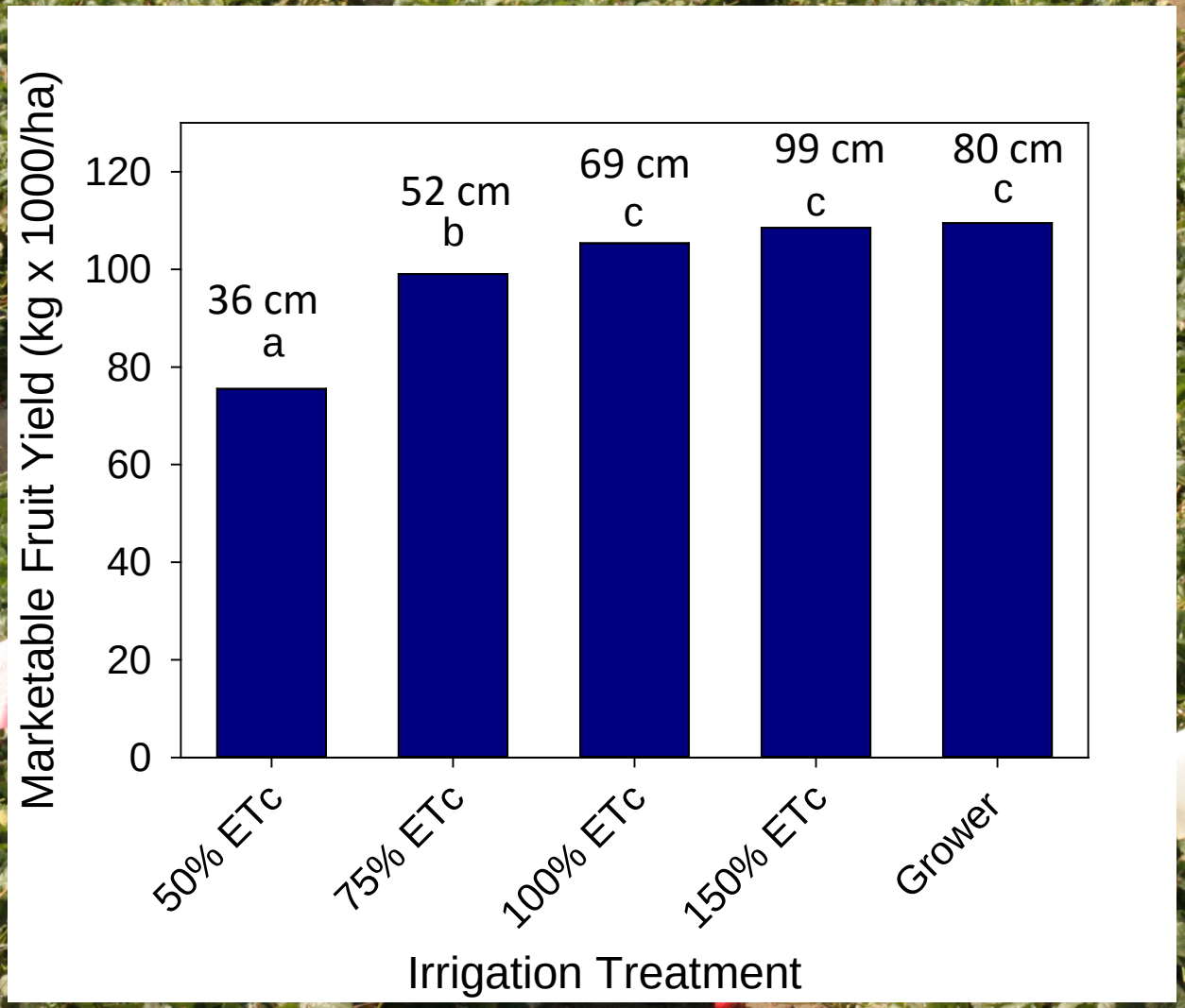
1. Cored for region

Using weather based irrigation scheduling for broccoli

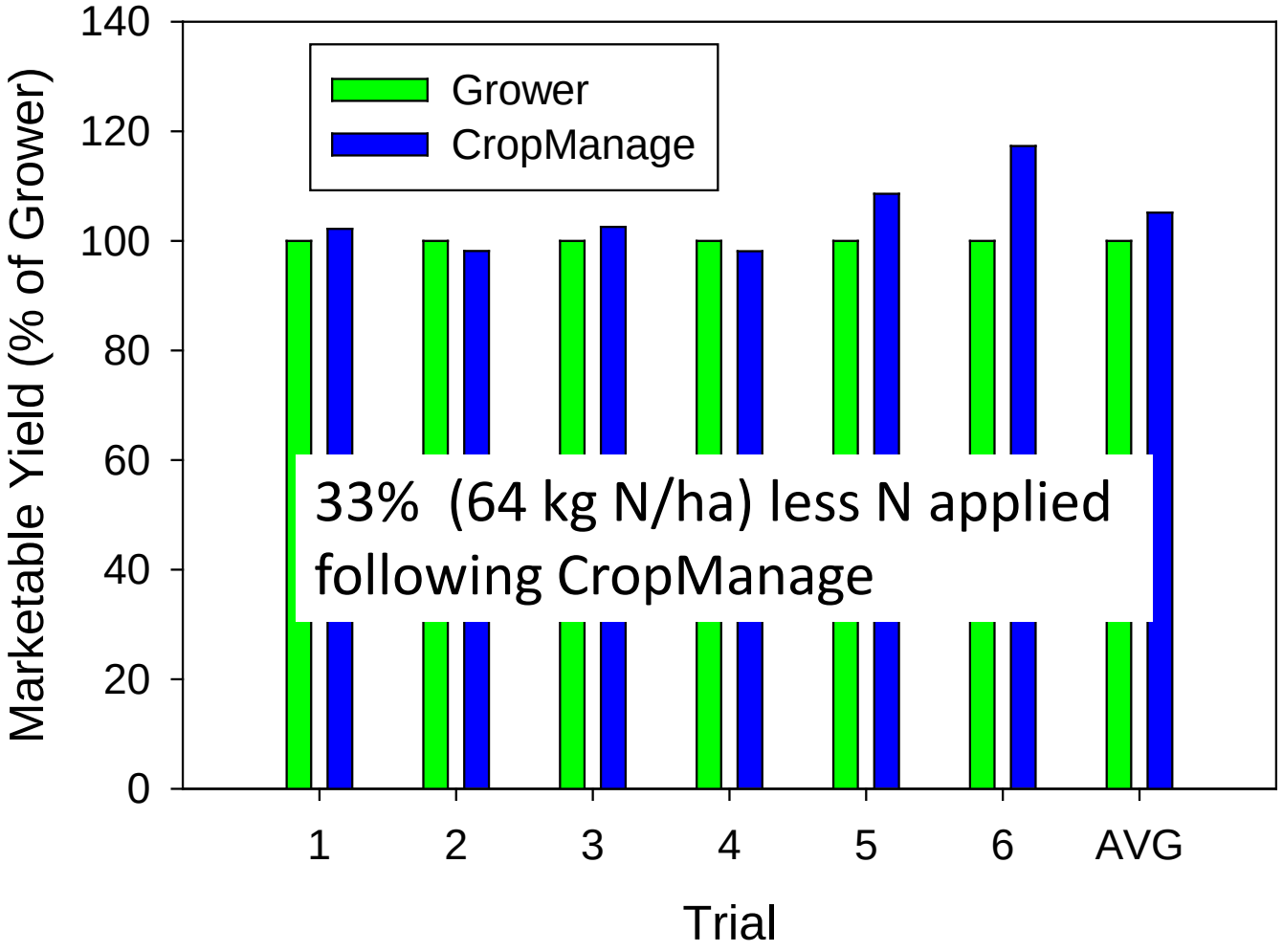


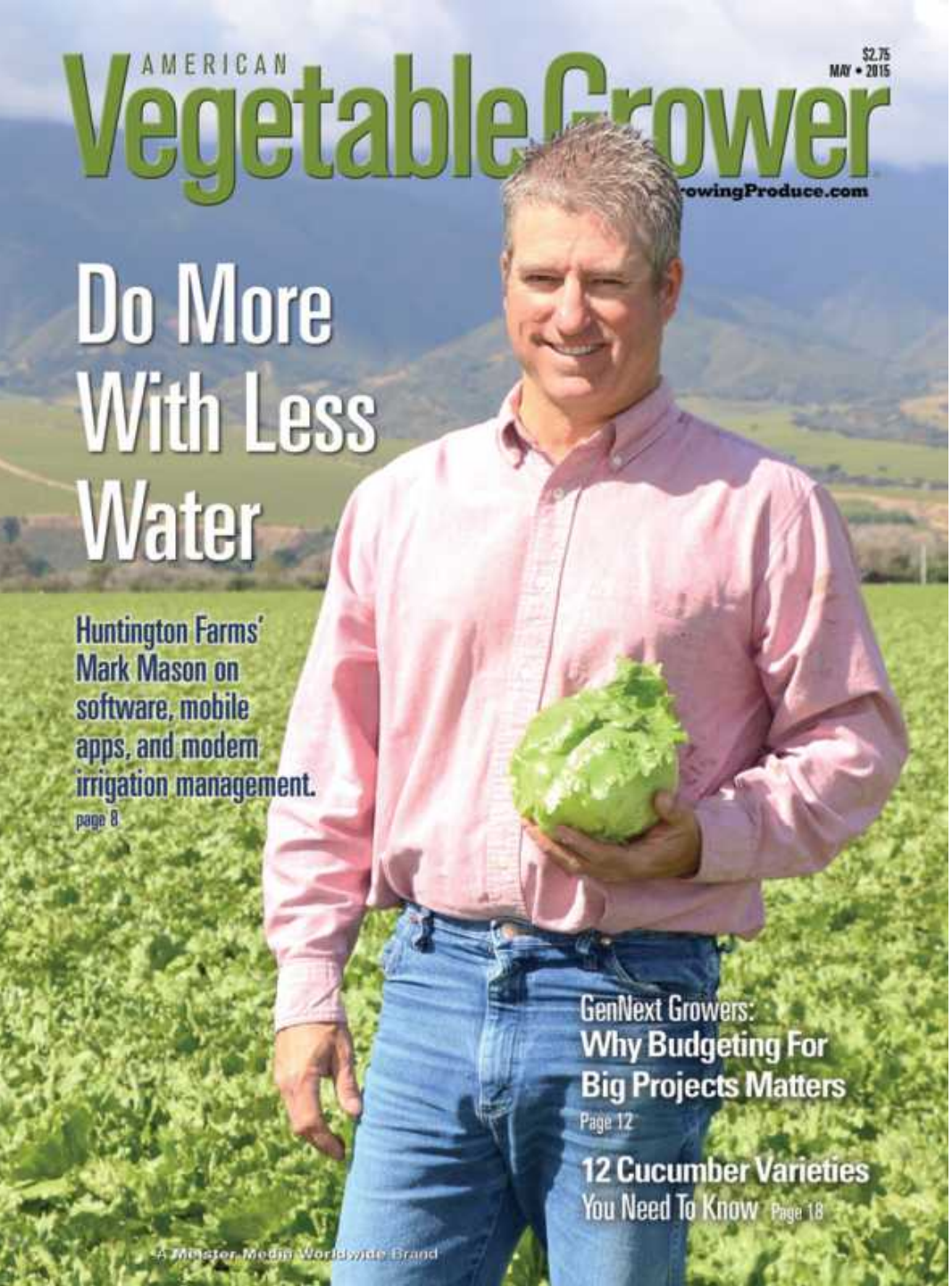
Irrigation Treatment	Applied water	Marketable Yield		
		Crown	Bunch	Total
	mm	------- lbs/acre ---------		
Grower Standard (150% ET)	519	7612	9284	16896
CropManage (100% ET)	361	7557	10665	18222
$LSD_{0.05}$		NS	1178	1189

Irrigation Effects on Marketable Strawberry Fruit Yields



Summary of Commercial Lettuce Strip Trials (2012-2013)





Grower interest

> 850 users

> 250 Ranches

> 15,000 visits to CM blog since Dec 2013

The road ahead…

New version of CropManage under development

Microsoft .NET Framework

- Dedicated programmer for CM
- Better user-interface
- Faster speed
- More flexibility to support different types of commodities
- Web-service for partnering
- Usage reporting

Opportunities to partner with commercial companies by developing CM into a web service (API):

EKO METRICS

Steinbeck Country Produce, Inc.

Ranch Systems LLC

SureHarvest

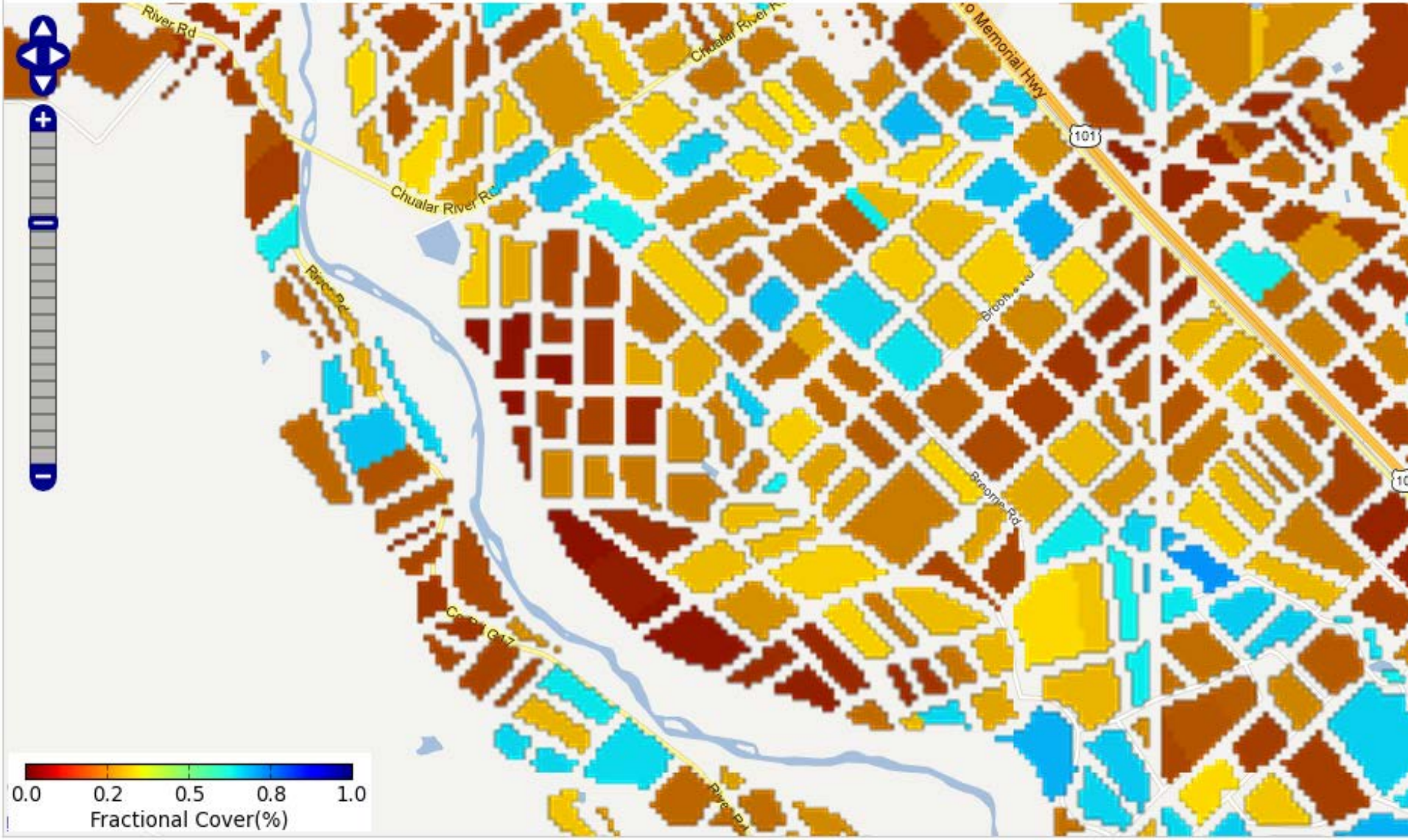
gThrive

TOPS Satellite Irrigation Management Support

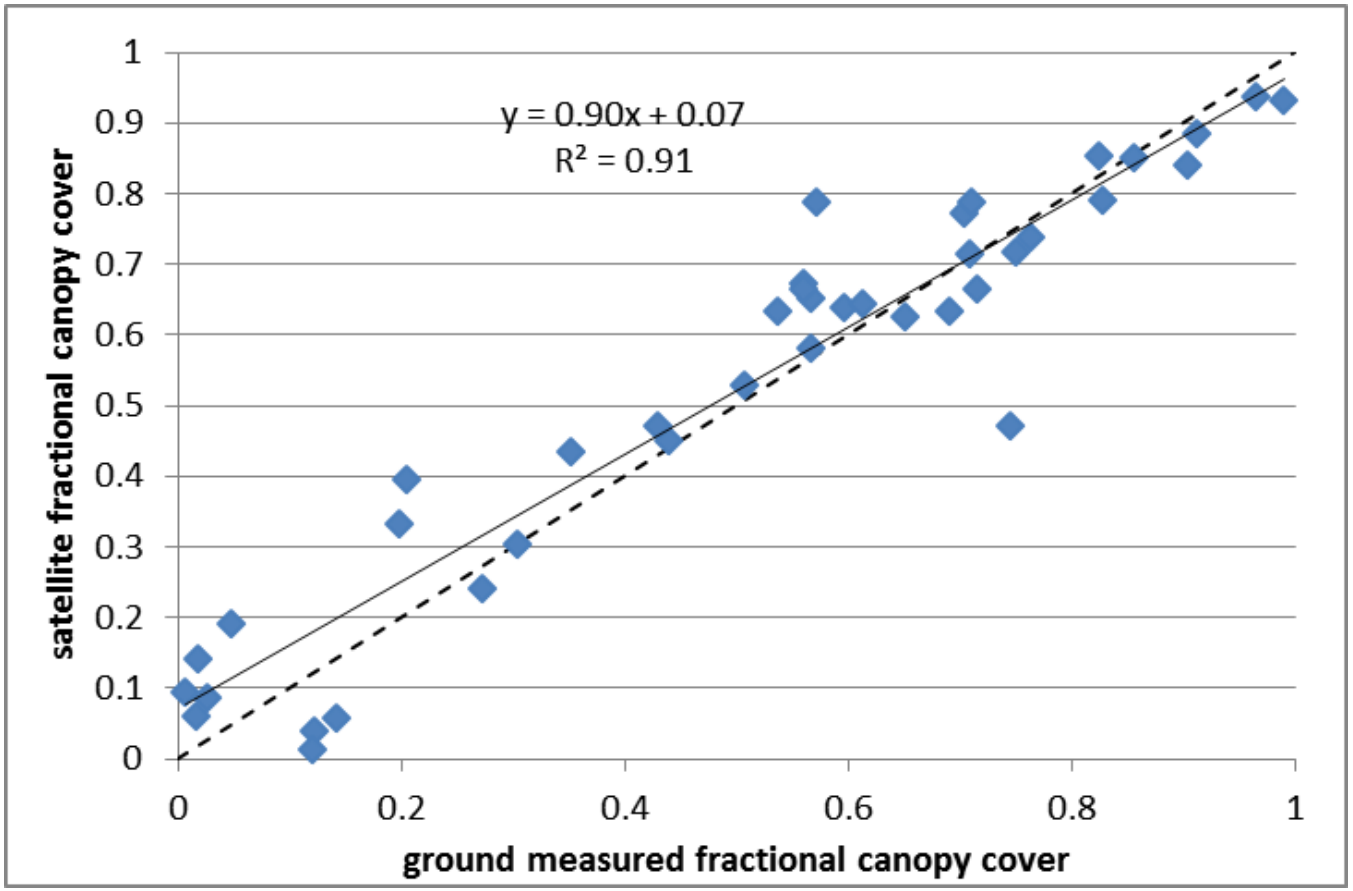
Username:

Go to: Search

About Help



SIMS *vs* ground measured canopy cover



Cheaper and better satellite imagery in the future

Skybox Imaging + Google

Final Thoughts

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

- ***CropManage* has been a useful tool for helping growers improve water and N management and for assisting with research/demonstration trials.**

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