Tools for Improving Irrigation Management of Vegetables

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Nitrate is part of the Agricultural Discharge Waiver

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL COAST REGION

ORDER NO. R3-2012-0011

CONDITIONAL WAIVER OF WASTE DISCHARGE REQUIREMENTS
FOR
DISCHARGES FROM IRRIGATED LANDS

The California Regional Water Quality Control Board, Central Coast Region finds that:

1. The Central Coast Region has approximately 435,000 acres of irrigated land and approximately 3000 agricultural operations, which may be that falls into the category of discharges of waste from irrigate

2. The Central Coast Region has more than 17,000 miles of streams/rivers) and approximately 4000 square miles of gr are, or may be, affected by discharges of waste from irrigated

3. The State Water Resources Control Board (State Water Boar Quality Control Boards (Regional Water Boards) are the p with primary responsibility for the coordination and control of to the Porter-Cologne Water Quality Control Act (Porter-C Water Code Division 7). The legislature in the Porter-Col

Total Nitrogen Reporting for Tier 2 and Tier 3 Dischargers with farms/ranches with High Nitrate Loading Risk

70. **By October 1, 2014 and by October 1 annually thereafter**, Tier 2 and Tier 3 Dischargers with a farm/ranch with High Nitrate Loading Risk must record and report total nitrogen applied in the Annual Compliance Form, electronically in a format specified by the Executive Officer, per MRP Order No. R3-2012-0011-02 and MRP Order No. R3-2012-0011-03, respectively.

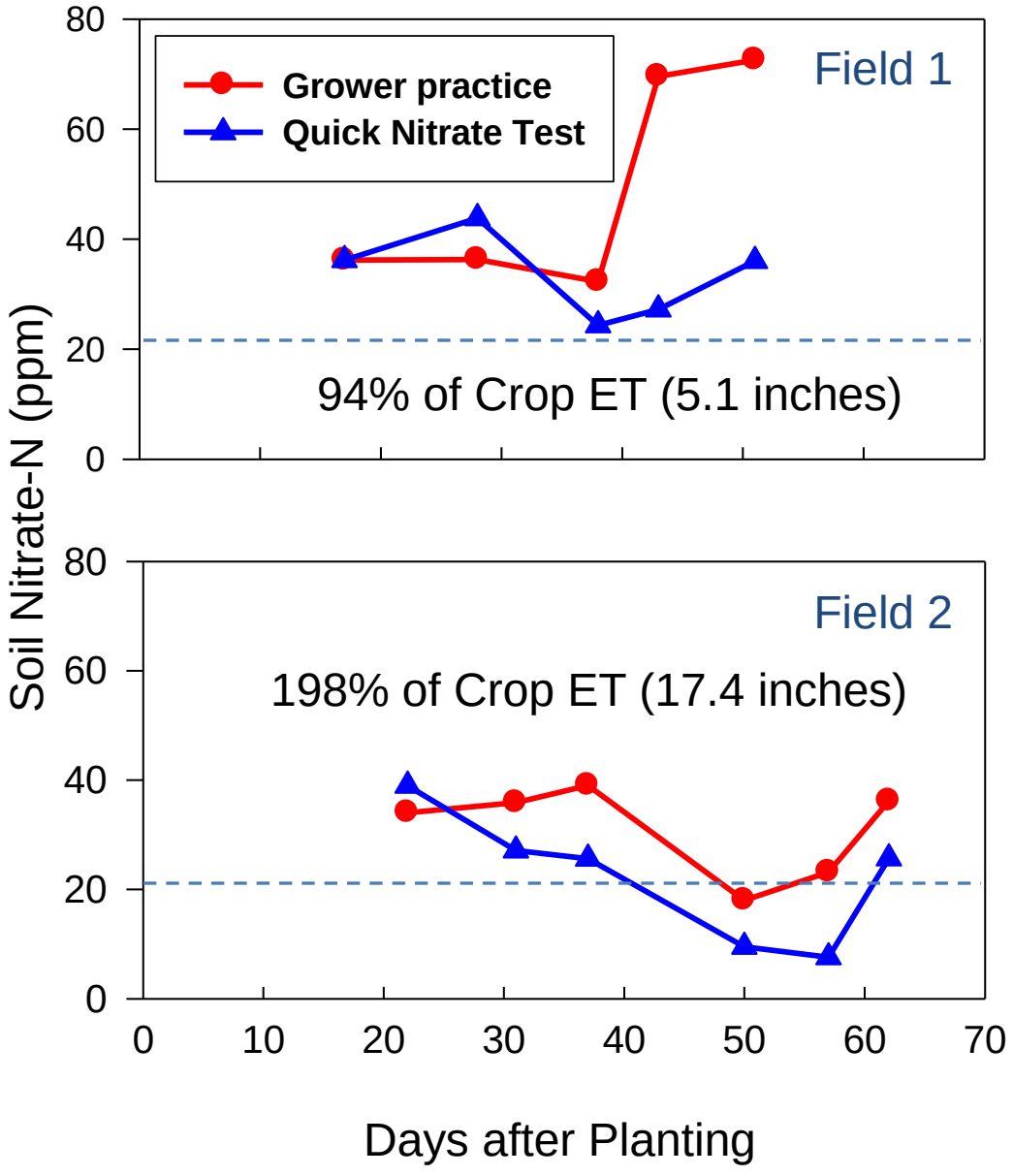
71. As an alternative to reporting total nitrogen applied in the electronic Annual Compliance Form, Tier 2 and Tier 3 Dischargers with a farm/ranch with High Nitrate Loading Risk may propose an individual discharge groundwater monitoring and reporting program (GMRP) plan for approval by the Executive Officer. The GMRP plan must evaluate waste discharge to groundwater from each ranch/farm or nitrate loading risk unit with a High Nitrate Loading Risk.

Tools for Managing Nitrogen Fertilizer in Lettuce

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

How much does irrigation management matter for optimizing nitrogen fertilizer?

Nitrogen fertilizer and irrigation interactions



Treatment	Applied N fertilizer (lb/Acre)
Grower	192
QNT	135

Treatment	Applied N fertilizer (lb/Acre)
Grower	302
QNT	160

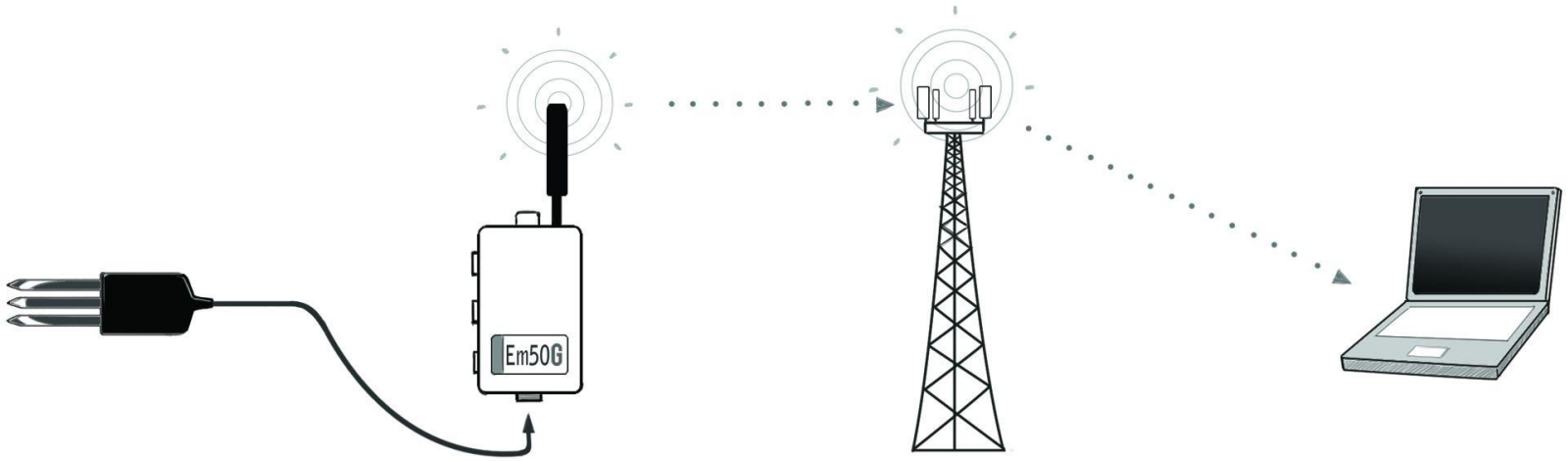
What's new in irrigation management?

- Soil moisture sensors
- Flow meters
- Crop ET
- Irrigation and N management software for vegetables

Dataloggers improve ease of data collection:

- View trends in data
- Interface with multiple sensors
- Built in connectivity

Data Connectivity has improved:



Radio
Cell phone
Satellite
Internet

Data Connectivity: Commercial services

- Hortau
- ClimateMinder
- Ranch Systems
- Puresense
- CropSense (John Deere)
- Decagon
- Irrometer
- Onset Computer
- Spectrum Technology

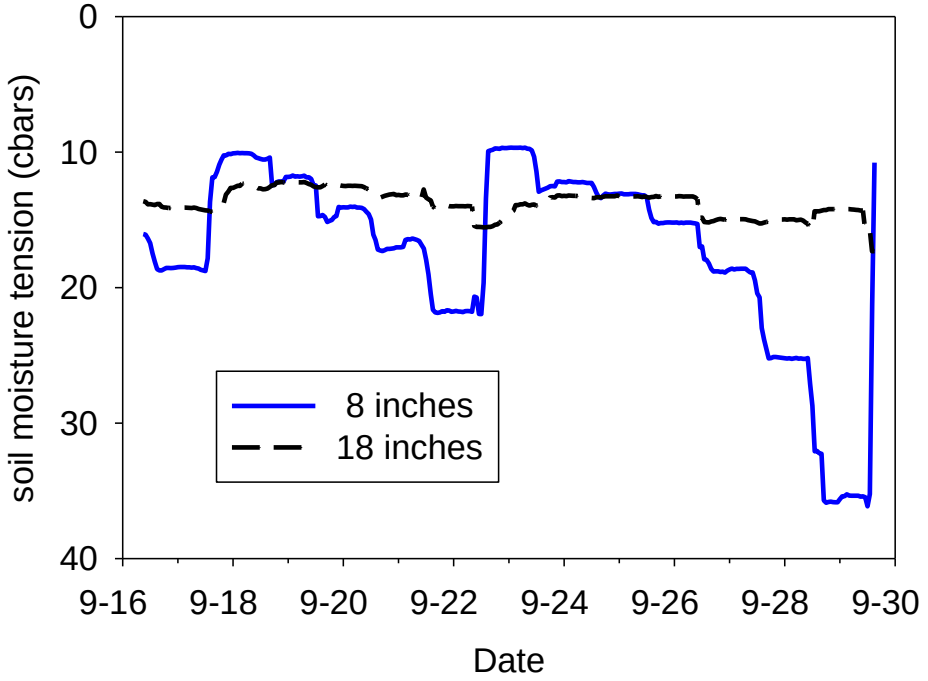
Coastal crops: berries and vegetables

Moderate soil moisture deficits can cause yield loss

Tensiometers monitor the matric potential (tension) of the soil

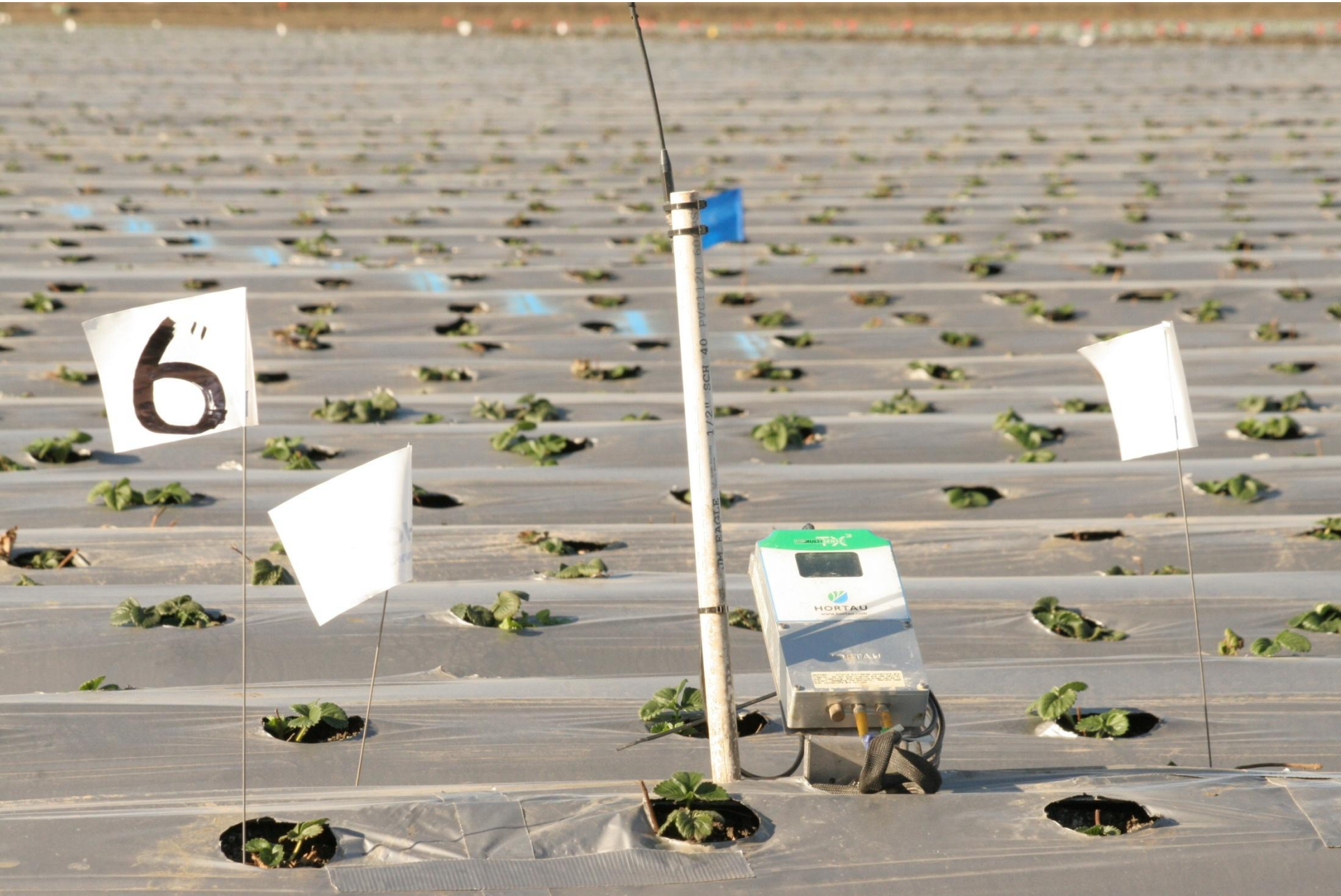
Measurement of soil moisture that is most related to water status in a plant

Logging tensiometers improves interpretation of readings



Electronic gauge

Hortau tensiometer system

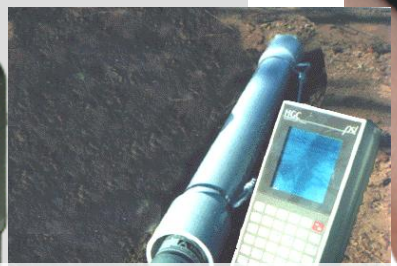


Watermark granular matrix blocks: Soil moisture tension: 0 to 200 cbars

Don’t give up your soil probes and shovels yet:

- Soil moisture sensors monitor a few locations within a field
- Soil moisture sensors are probably not affordable to use in every field
- Ground truthing is still needed

Volumetric soil moisture sensors



- Many manufacturers and models
- Most interface with dataloggers
- Most useful for evaluating relative changes in soil moisture

Decagon 10HS

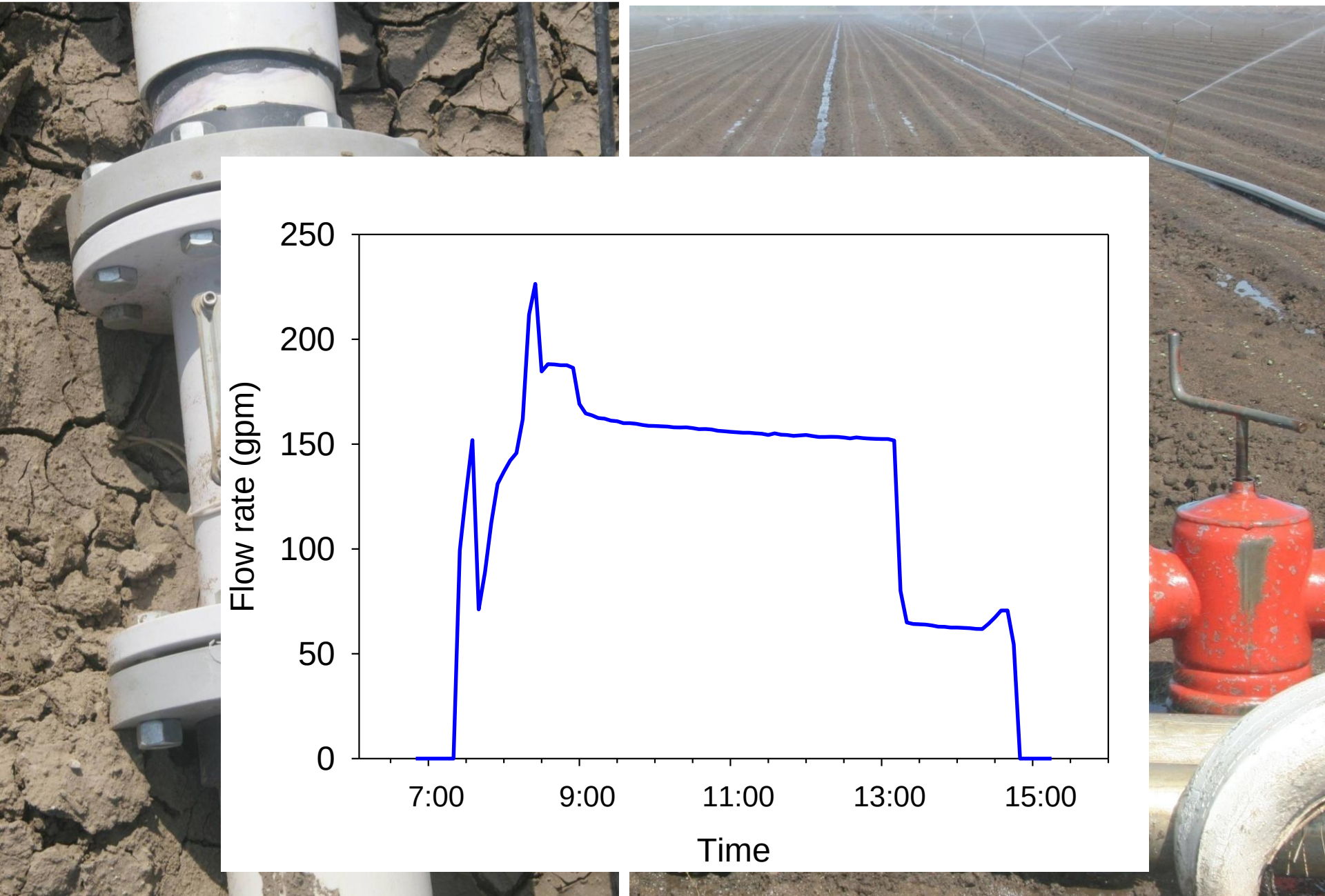
Volumetric Soil Moisture Sensor

Where should soil moisture sensors be located?

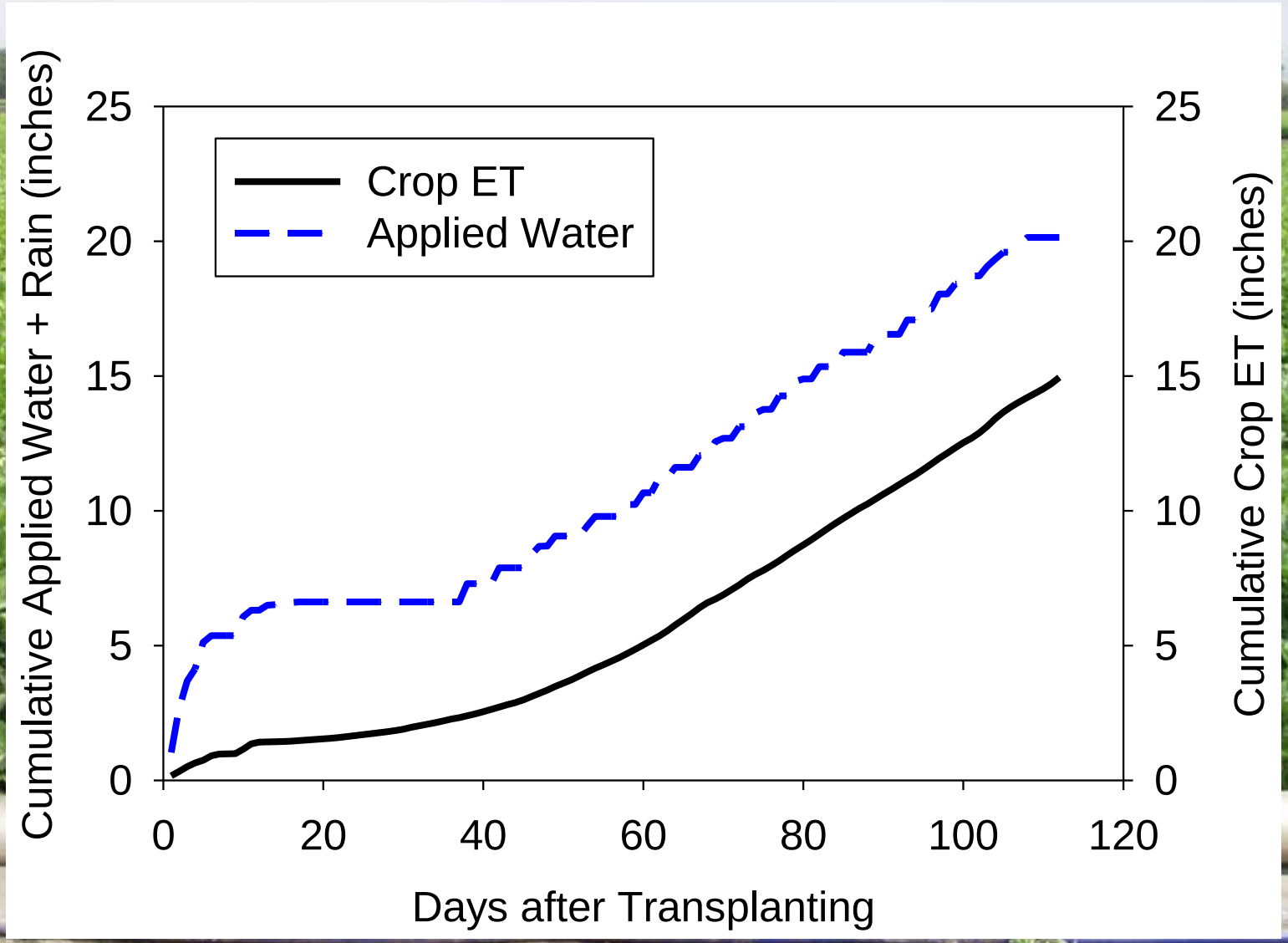
- Rule of thumb: 3 locations in field and 2 depths (eg. 8 and 18 inches)
- Locate sensors in plant row
- Locations should represent head, middle, and tail of the field.

How much water did you apply?

Flow meters are not just for wells



Applied Water *vs.* Crop Evapotranspiration



Evapotranspiration

Ranch System

CIMIS weather station

Atmometer

Evapotranspiration can be estimated using CIMIS weather stations:

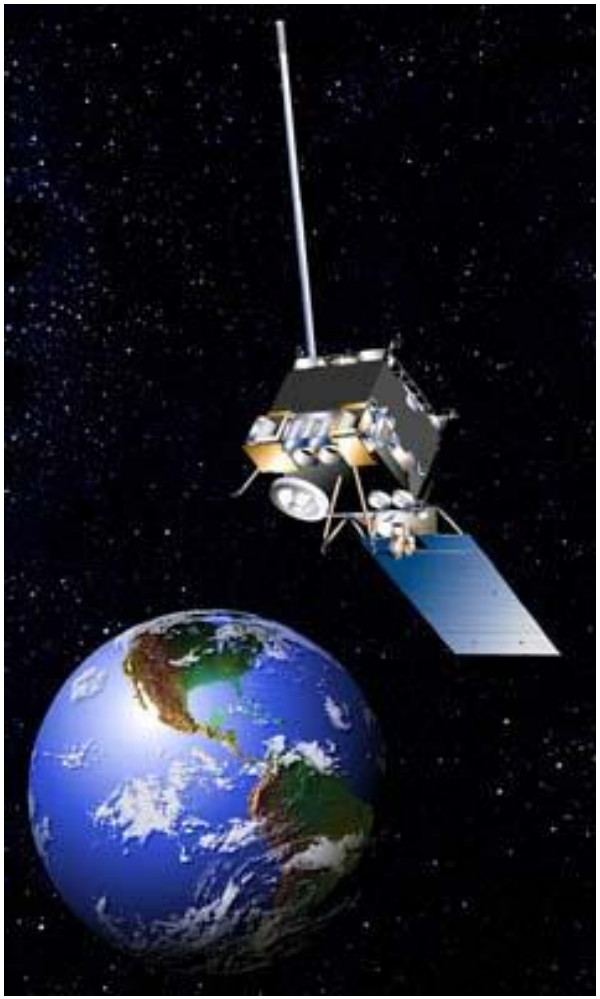
- Solar Radiation
- Wind Speed
- Relative Humidity
- Air Temperature

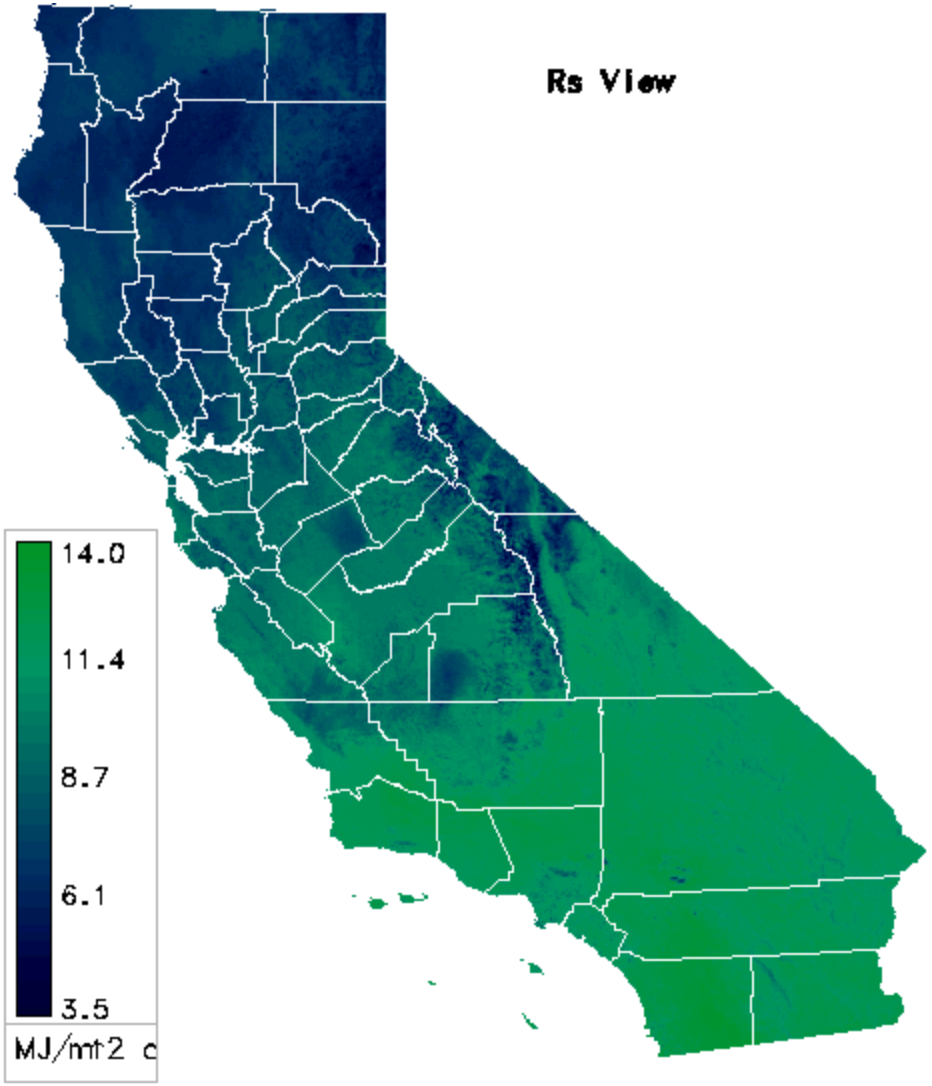
Active CIMIS Stations:

Santa Ynez (64)
Cuyuma (88)
Goleta Foothills (94)
Santa Barbara (107)
Sisquoc (165)
Lompoc (231)
Santa Maria II (232)
Nipomo (202)
San Luis Obispo West (160)

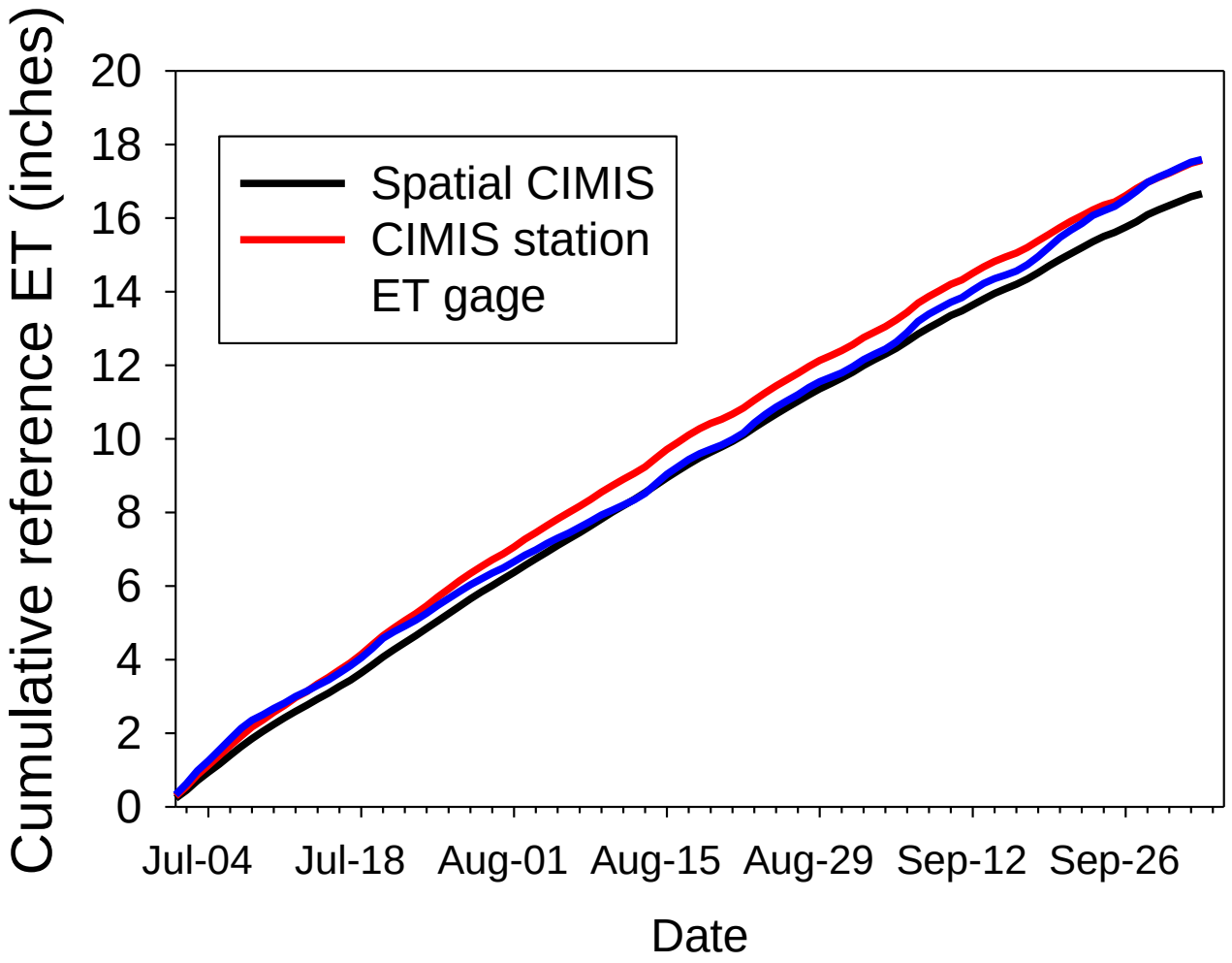
wwwcimis.water.ca.gov

Spatial CIMIS ETo Reporting



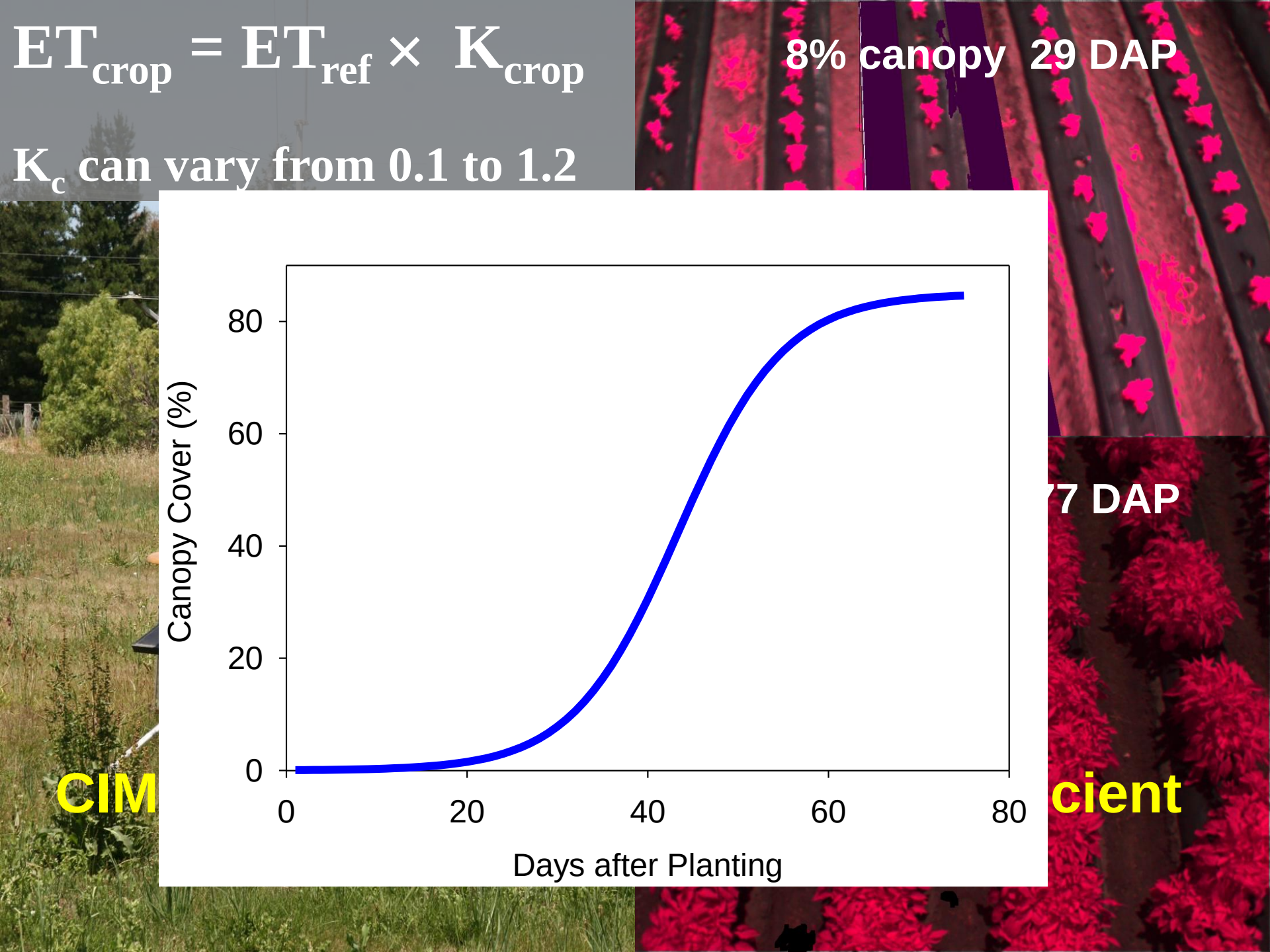


Comparison of different methods of estimated ETo (Gilroy Ca)

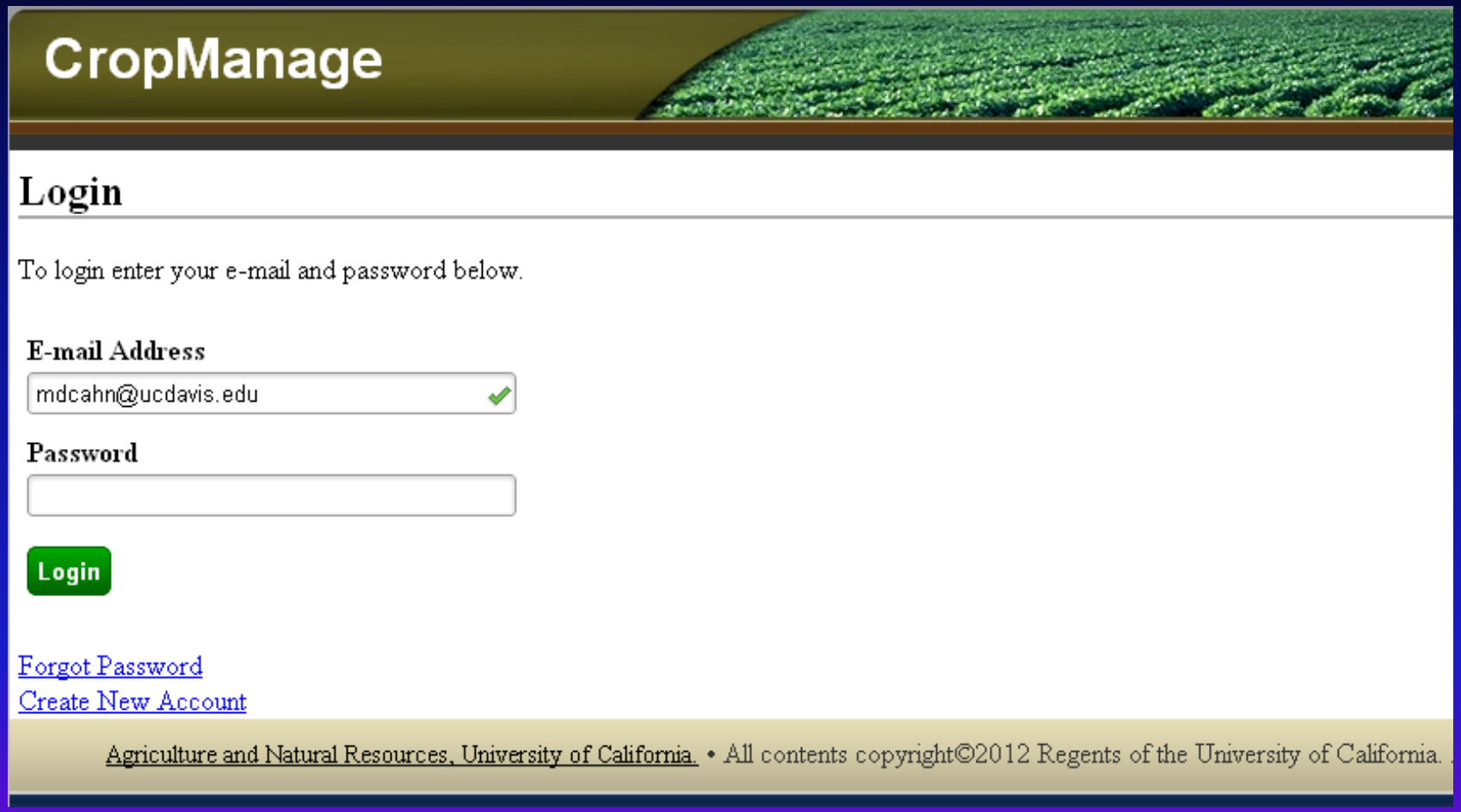


$ET_{crop} = ET_{ref} \times K_{crop}$

K_c can vary from 0.1 to 1.2



Web-based Irrigation and N management software for lettuce



https://ucanr.org/cropmanage

CropManage Web-based software:

Assist growers in managing water and nitrogen fertilizer using information from multiple sources

- ✓Soil tests (quick N test)
- ✓Weather data (CIMIS ETo)
- ✓Soil physical characteristics
- ✓Crop models
- ✓Flow meter
- ✓Soil moisture sensors

Main Uses

- ✓Maintain and share irrigation, fertilizer, and soil test records within a farming operation.
- ✓Manage information for multiple fields and ranches
- ✓Guide irrigation schedule using CIMIS evapotranspiration data and crop models
- ✓Guide nitrogen fertilization decisions based on crop uptake model and quick nitrate test

CropManage

Ranch List

Select a Ranch to work in from the list below.

- Bondenson
- Bondesen
- Bryon's Test
- Calla Roberts Ranch
- Chualar
- Corey
- East Garlinger Ranch
- Fanoe
- Gabilan Ranch
- Home
- Ikeda Bros Ranch 37
- J Pettit
- Martella UC trial
- Molera
- North Garlinger
- North Mortensen Ranch
- South Mortensen Ranch
- Test Ranch
- USDA-ARS Spence
- Whalebone Ranch

Ranch/Field: Corey, Lot 49, silty clay
Planting: R R Lettuce Cy. 49, 8.0 acres
Crop: Iceberg 2 row, 40 inch bed, 4/17-6/29/12

Planting

Soil Summary

Show / Hide Columns

Sample Date	Crop Stage	Sample Reading (ppm)	Sample Depth (ft)	Sample Analysis	Soil Nitrate-N (ppm)	Soil Mineral N (lb/acre)
5/1/12	1st sidedress	20	1	Quick Strip	10.53	34.28
5/19/12	1st drip fertigation	28	1	Quick Strip	14.74	47.99
5/25/12	2nd drip fertigation	45	1	Quick Strip	23.68	77.13
6/4/12	3rd drip fertigation	45	1	Quick Strip	23.68	77.13

New Soil Sample | View all Nutrients

Fertilizer Summary

Show / Hide Columns

Fertilizer Date	Crop Stage	Soil NO_3-N (ppm)	Fertilizer N Recommended (lb N/acre)	Cumulative N Uptake	Fertilizer	Applied N (lb N/acre)	Applied Fertilizer
5/5/12	Pre-thinning	15.79	14.2	4.02	15-8-4	78.0	50.0 gallons/acre
5/22/12	1st drip fertigation	14.74	21.5	13.82	28-0-0-5	37.1	12.0 gallons/acre
5/27/12	2nd drip fertigation	23.68	4.9	18.88	28-0-0-5	30.9	10.0 gallons/acre
6/7/12	3rd drip fertigation	23.68	11.8	36.25	28-0-0-5	30.9	10.0 gallons/acre
Totals			**52.4**			**176.9**	

New Fertilizing

Irrigation Summary

Show / Hide Columns | Show Previous Co

Water Date	Irrigation Method	Recommended Irrigation Interval (days)	Recommended Irrigation Amount (inches)	Recommended Irrigation Time (hours)	Irrigation Water Applied (inches)	Kc	Canopy Cover (%)	
4/17/12	Sprinkler	N/A	N/A	N/A	0.94 in	0.00	0	
4/19/12	Sprinkler	0.7	0.35 in	1.15 hrs	0.49 in	0.70	0	
4/21/12	Sprinkler	0.6	0.40 in	1.34 hrs	0.61 in	0.70	0	
4/23/12	Sprinkler	0.6	0.38 in	1.28 hrs	0.58 in	0.70	0	
4/26/12	Sprinkler	1.3	0.09 in	0.30 hrs	0.28 in	0.48	0	
5/6/12	Sprinkler	2.9	0.41 in	1.36 hrs	1.30 in	0.16	2	
5/18/12	Drip	4.9	0.58 in	3.84 hrs	0.91 in	0.20	12	
5/22/12	Drip	6.5	0.24 in	1.61 hrs	0.74 in	0.23	21	
5/27/12	Drip	4.7	0.45 in	3.03 hrs	0.64 in	0.37	35	
6/1/12	Drip	3.4	0.70 in	4.65 hrs	0.44 in	0.56	52	
6/3/12	Drip	3.0	0.35 in	2.34 hrs	0.11 in	0.69	58	
Totals			**3.95 in**	**20.89 hrs**	**7.04 in**			

New Watering | View Flow Meter Data | View Rainfall Data

Summary

- Water management plays a critical role in managing N fertilizer in shallow rooted vegetables
- Connectivity using radios, cell phones and the internet facilitates real-time monitoring of crop water use
- Using a combination of ET and soil moisture monitoring is probably the best approach to evaluating irrigation scheduling in cool season vegetables