

# Using Weather-Based Irrigation Scheduling for Optimizing Cauliflower Production



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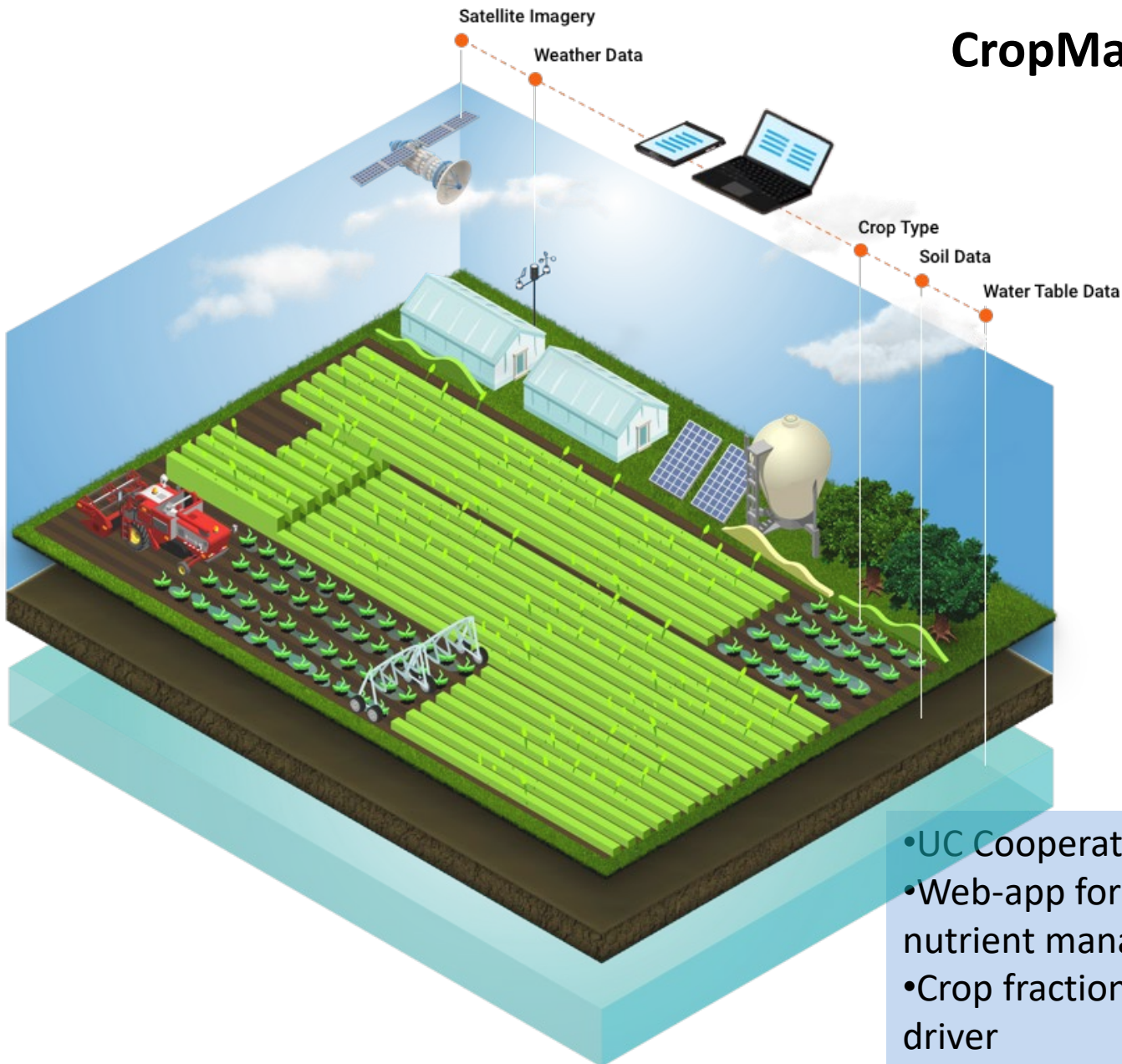
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UC Cooperative Extension

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USDA-ARS



UCCE Irrigation & Nutrient Mgmt Day, 2/17/2020

# CropManage



- UC Cooperative Extension
- Web-app for growers; water & nutrient management
- Crop fractional cover a main driver
- Incorporates CIMIS ETo

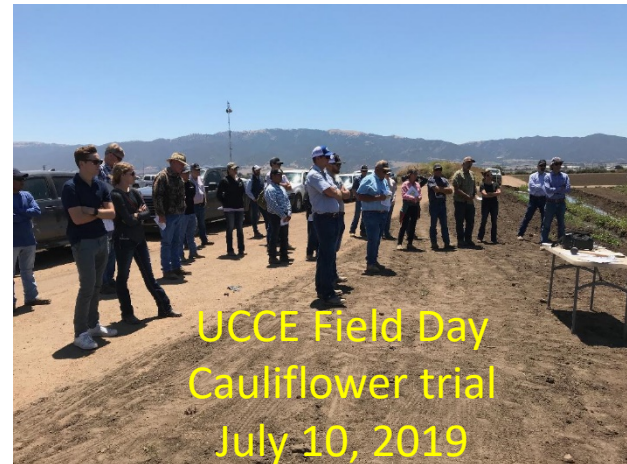
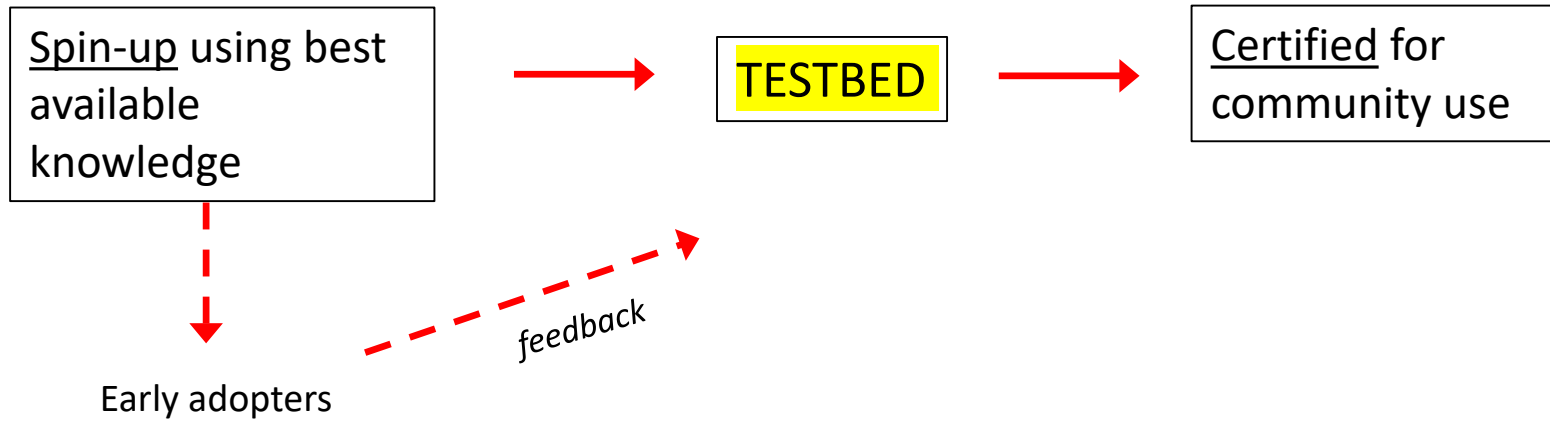
# CropManage testbed

## Series of experiments:

- head lettuce, broccoli (2012-13)
- romaine, green cabbage (2015-16)
- cauliflower, celery (2018-19)
- artichoke, red cabbage (2020-21)

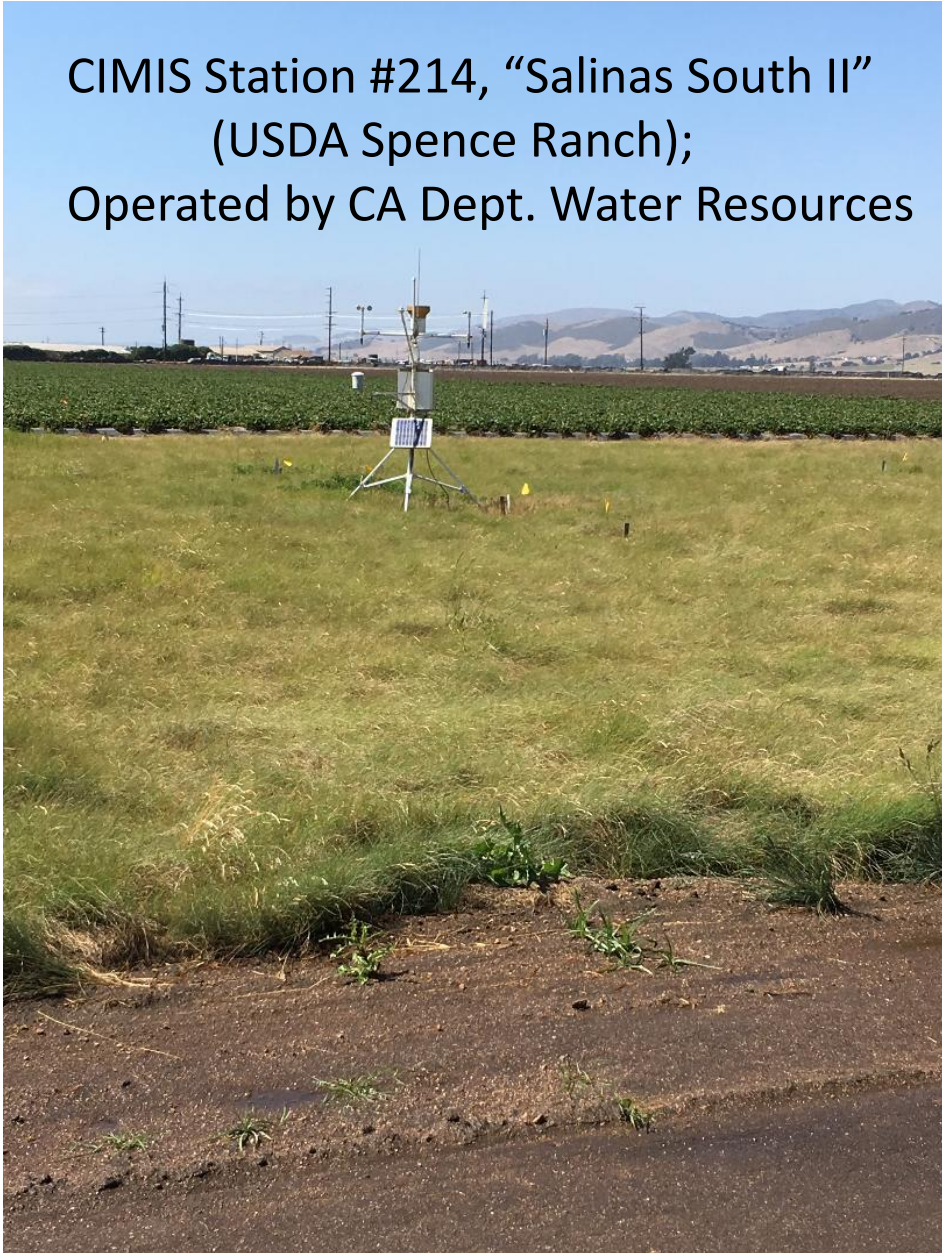
control, replication, repeatability

# Extending CropManage to new crops



# Weather-based irrigation scheduling

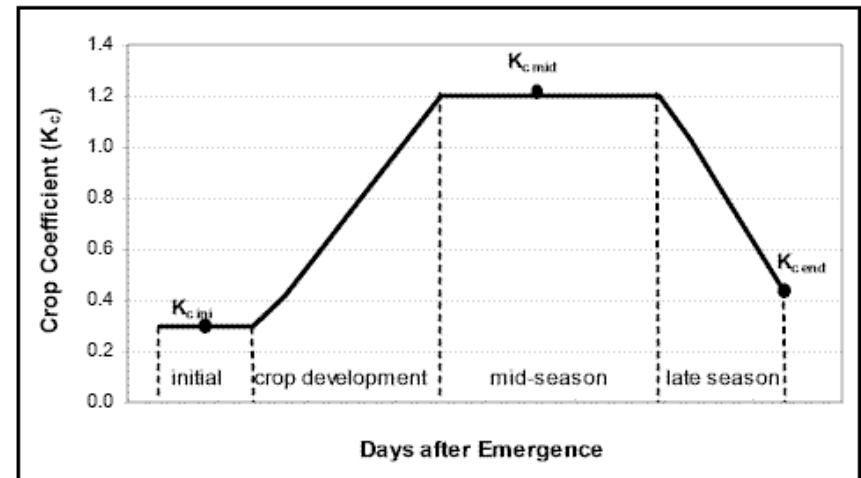
CIMIS Station #214, "Salinas South II"  
(USDA Spence Ranch);  
Operated by CA Dept. Water Resources



Converting reference  $ET^*$  to  
crop  $ET^*$ :

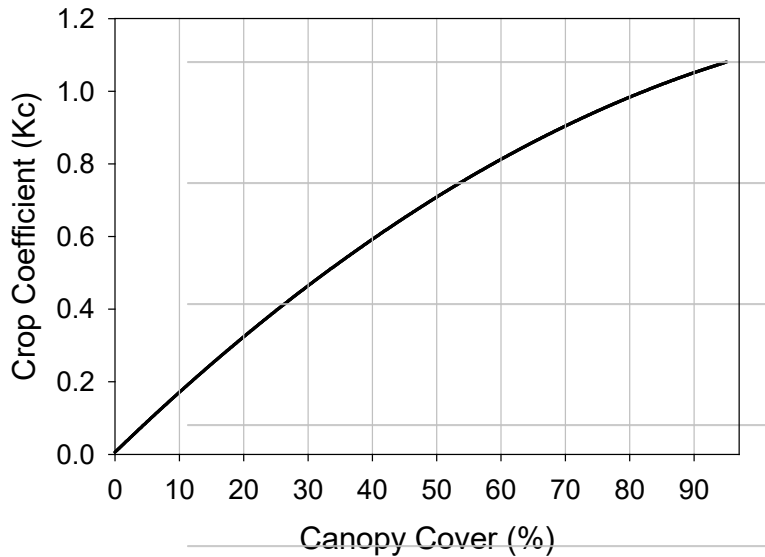
$$ET_{\text{crop}} = ET_{\text{ref}} \times K_{\text{crop}}$$

$K_c$  can vary from 0.1 to 1.2

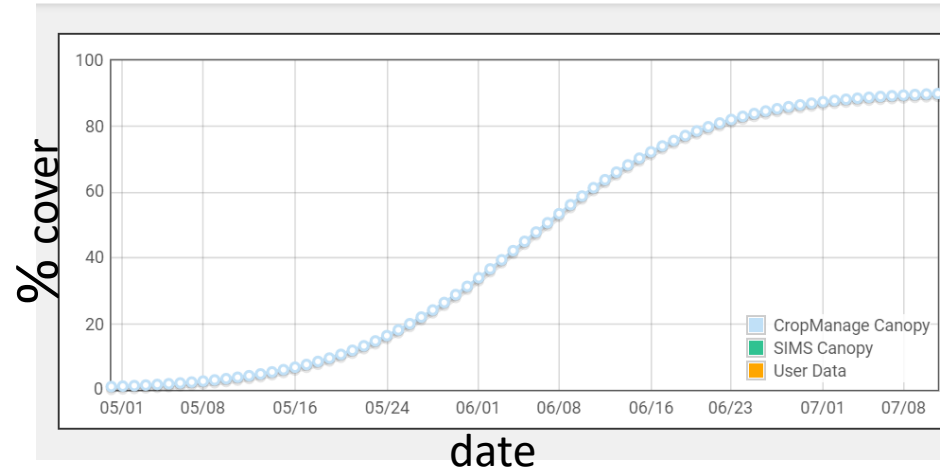


(\*evapotranspiration)

# Crop Kc can be based on canopy cover



cauliflower Canopy Curve



CropManage estimates daily canopy cover based on planting date and anticipated harvest date. The relationship is based on a large database compiled by ground-based camera observations.



# Rationale for cauliflower study

- **Monterey County “top-10” crop**
- **Water-sensitive crop primarily sprinkler irrigated in Salinas Valley.**
- **Water supplies may become more limited in Salinas Valley due to regulations such as the Sustainable Groundwater Management Act**
- **Better water management may improve nitrogen use efficiency**
- **Improved understanding of water requirements can assist with both farm mgt and basin-scale evaluation**
- **Calibrate CropManage for weather-based irrigation scheduling as it expands to serve new crops**

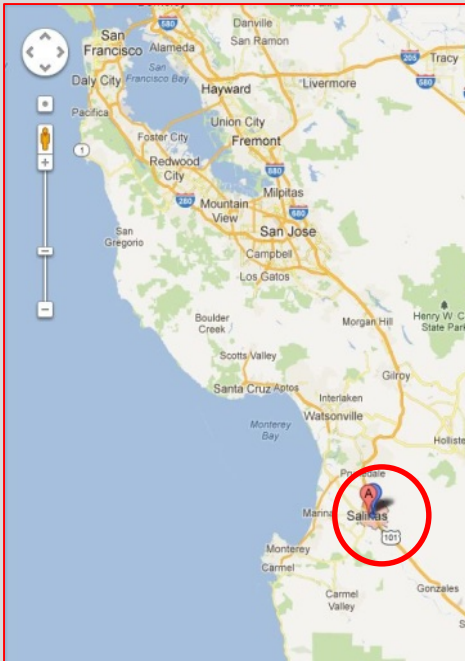
# Objectives

- Demonstrate weather-based irrigation scheduling
- Conduct replicated irrigation trials for cauliflower during 2018, 2019
- Develop crop yield curve as function of applied water (50% - 150% water replacement)
- Serve as CropManage testbed



# Study site

## Spence Ranch



USDA Agricultural Research Station,  
Salinas, California

# Procedures



- Cultivar: Symphony
- Soils: Chualar sandy loam
- Similar experiments performed in 2018 and 2019
- Transplant dates 5/2/18, 4/30/19
- 40" wide beds, 1 seedline, 10.75" spacing, ~1.7ac total area
- Crop established by sprinkler
- Experimental treatments applied by surface drip: 50%, 75%, 100%, and 150% of estimated crop water use (evapotranspiration)
- Complete randomized block design, with 6 replications of irrigation treatments
- Drip irrigate 2x/wk in 2018; 3x/wk in 2019 starting day 40 (~60% cover)
- Equal inputs other than water (ie, fertilizer, herbicide, pesticide, etc.)
- Harvest appx 70 days after transplant; evaluate crop yield, above-ground biomass, tissue water/nitrogen

**Crop establishment  
by sprinklers;  
wireless CropManage  
connection**



**4-way drip irrigation  
manifold with wireless  
connection**



**Layflat & drip lines**



**Flowmeters**

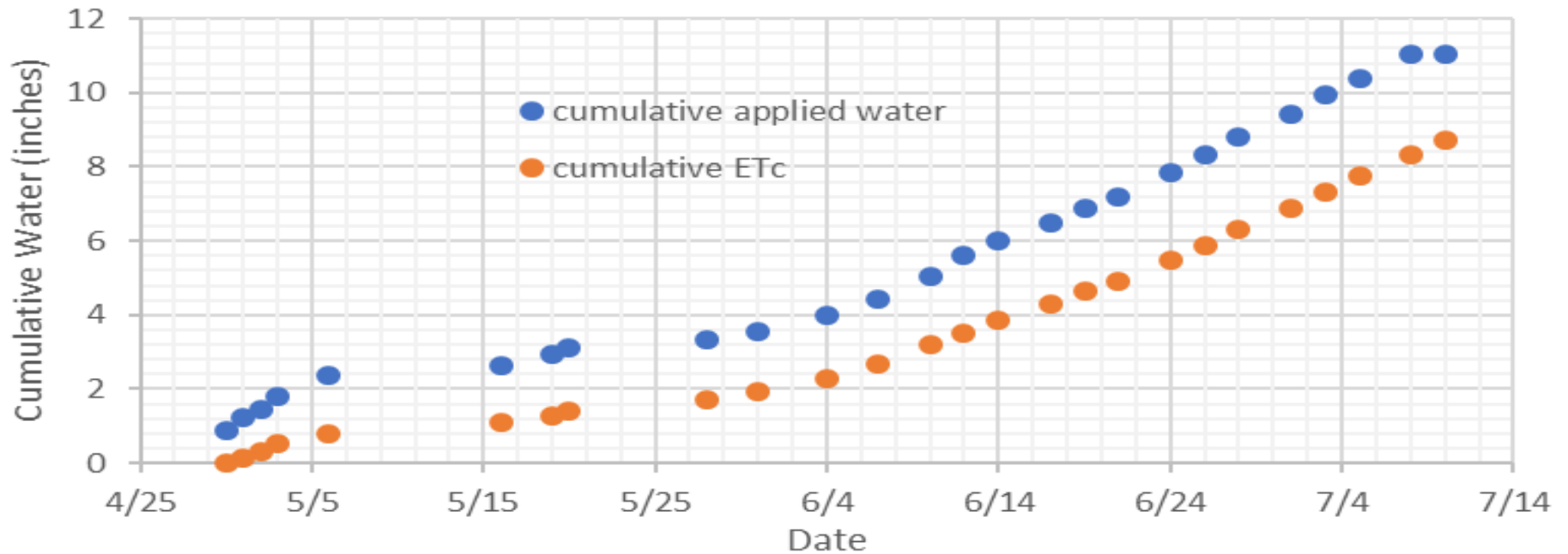
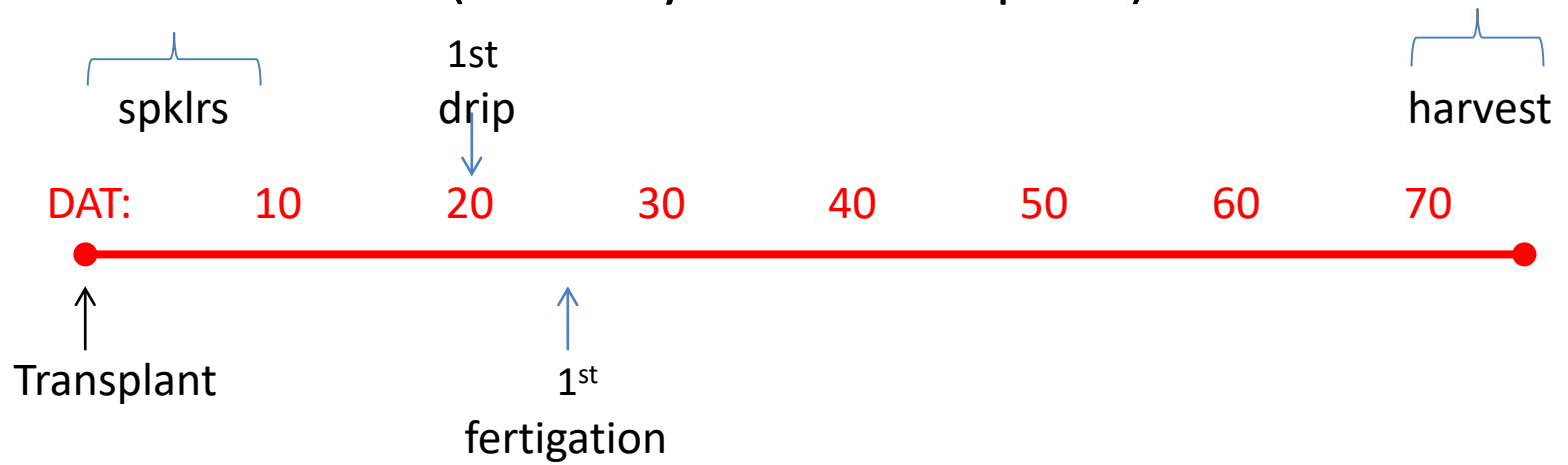


# Results



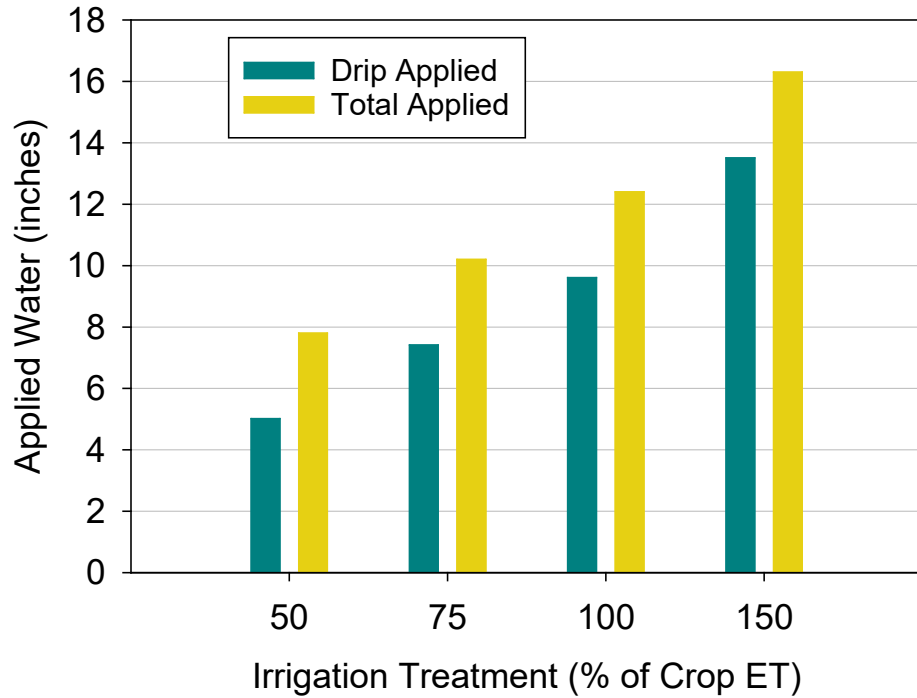
# Timeline, 2019

(DAT: days after transplant)

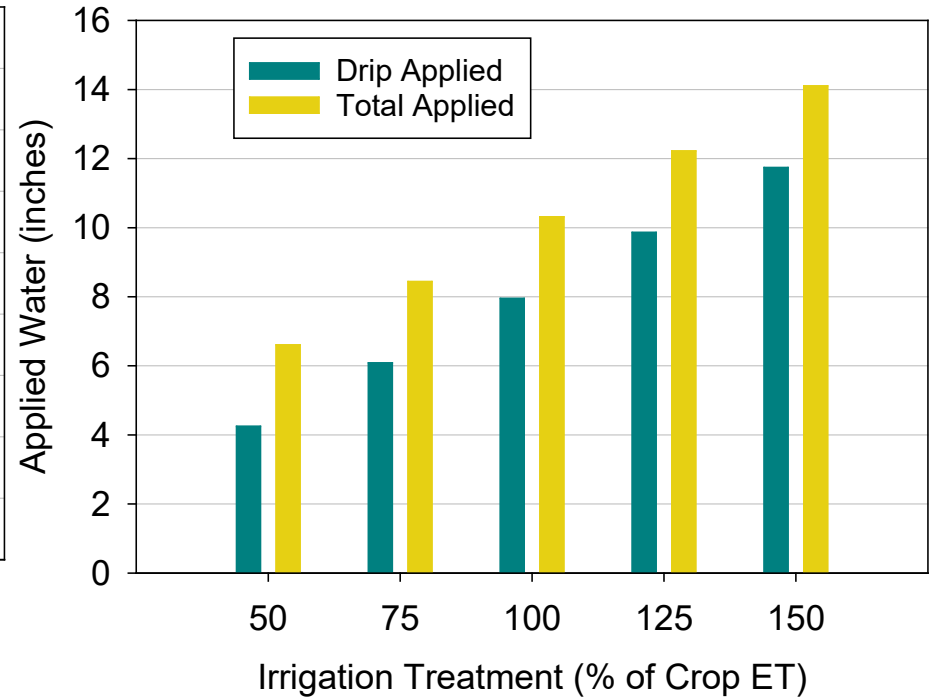


# Applied Water for Irrigation Treatments

## 2018

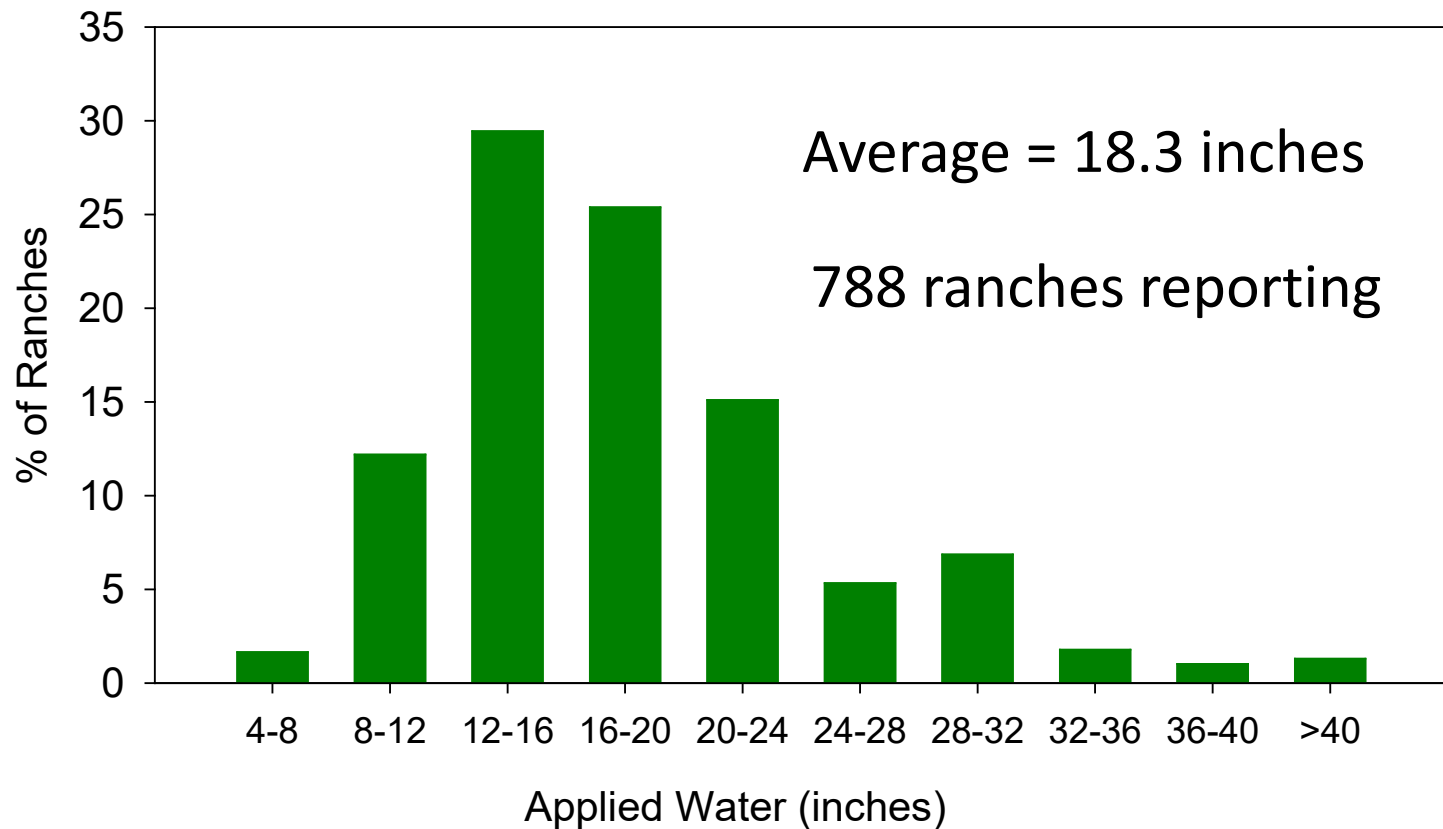


## 2019



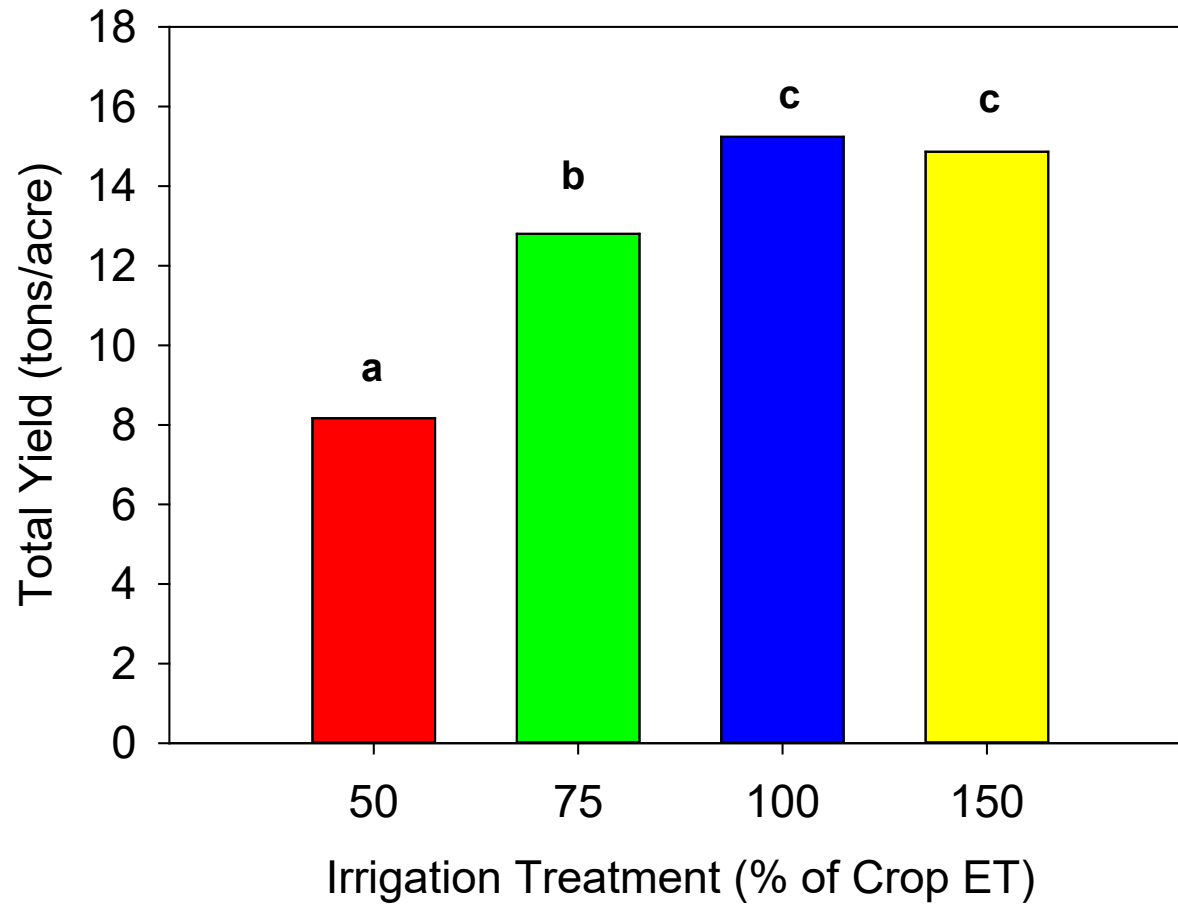
(Difference between Drip and Total due to use of sprinklers for crop establishment)

# Applied water for cauliflower reported to CCRWQCB (2016 and 2017)



# Total yield

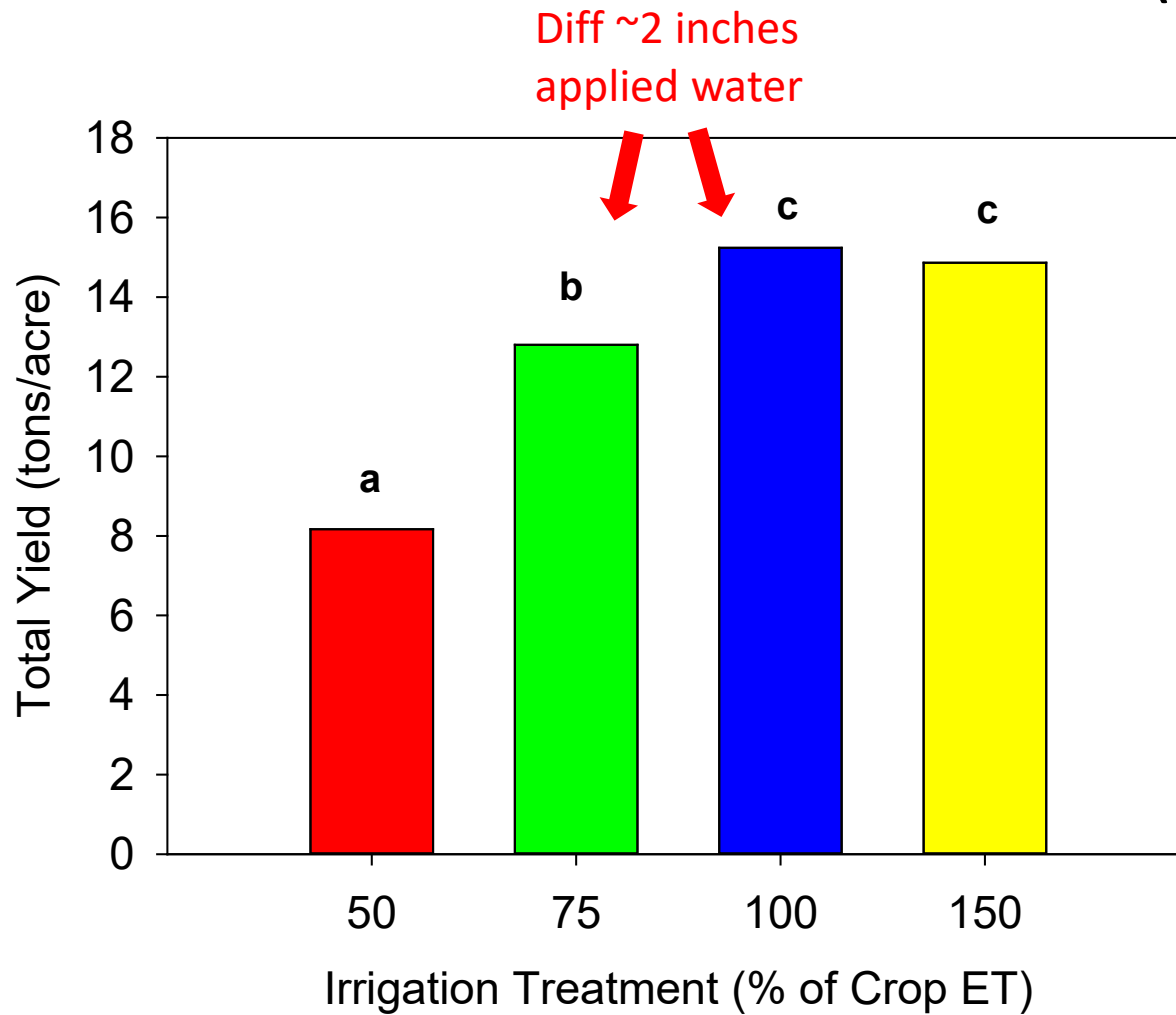
(avg 2018. 2019)





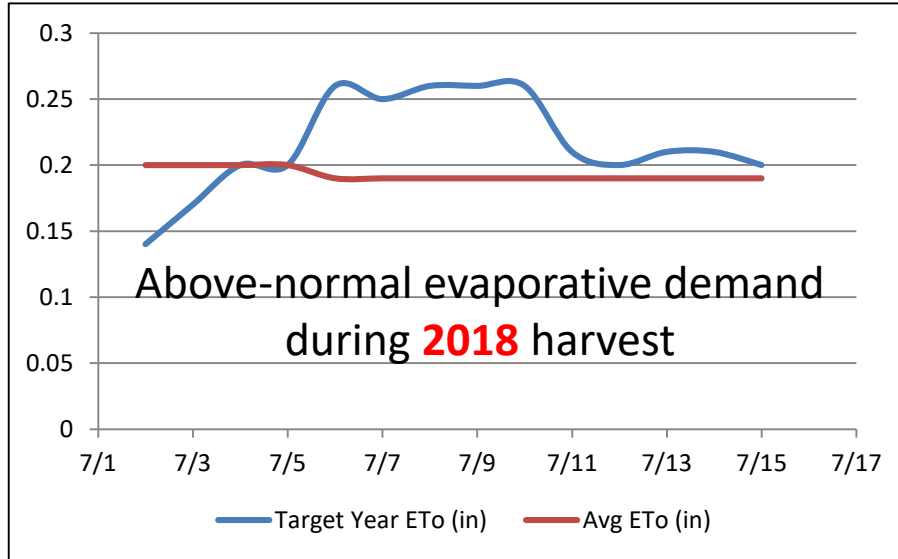
# Total yield

(avg 2018. 2019)



# Note on defects

*CIMIS ETo*

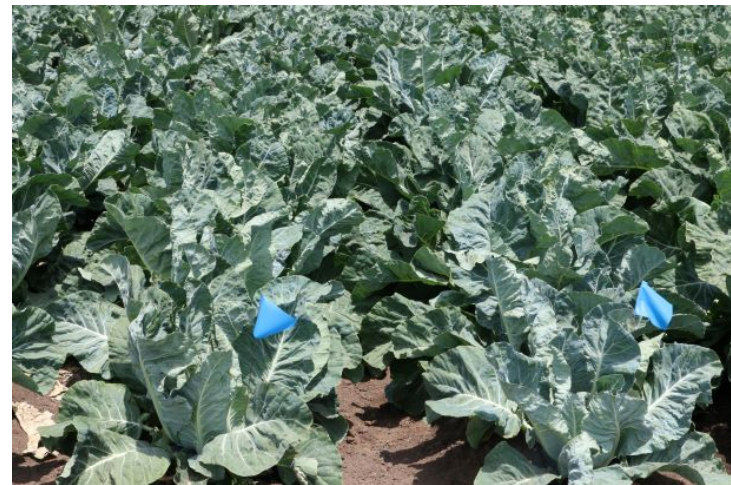


100% water treatment resists wilting & associated curd discoloration

50% water

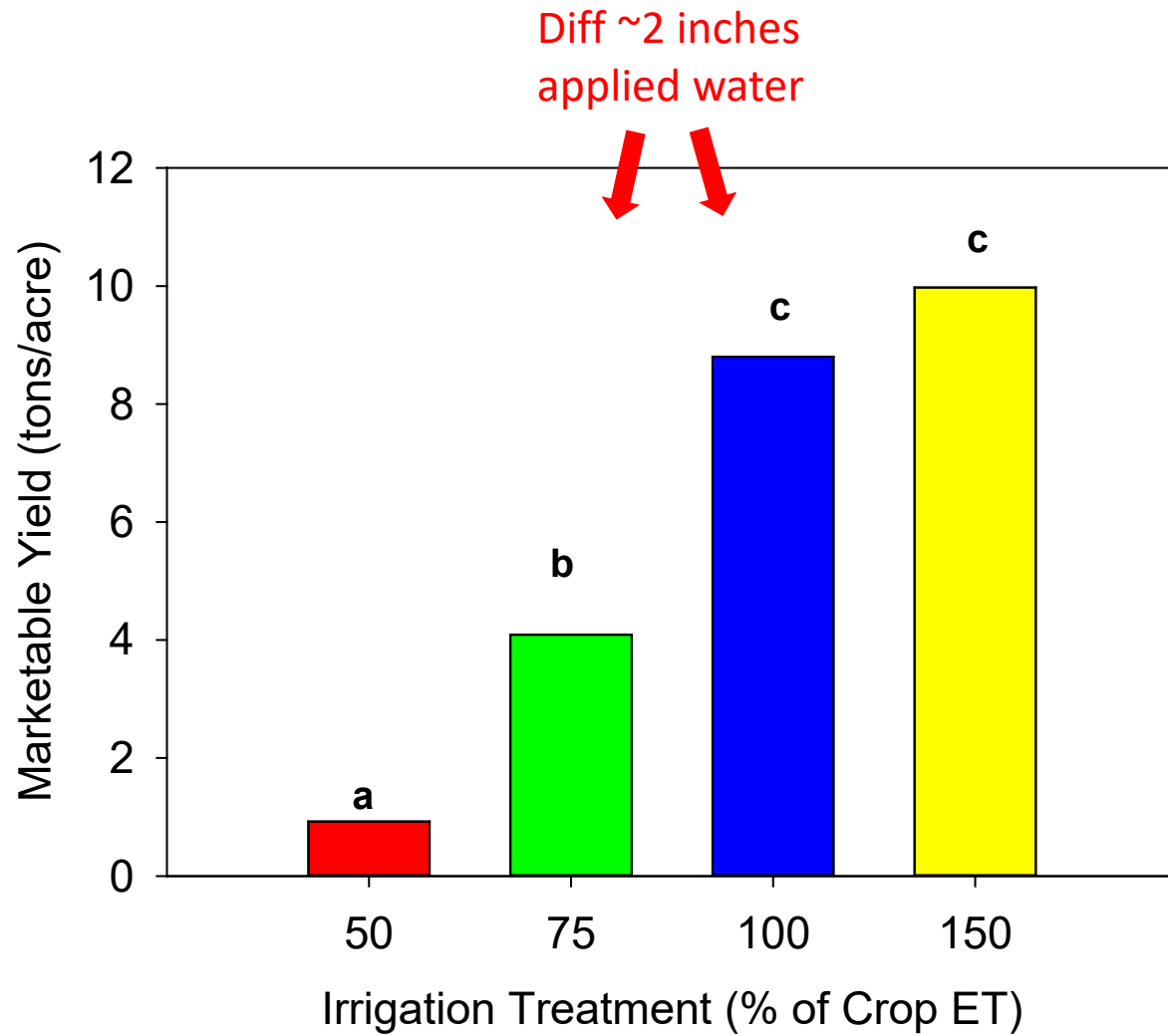


100% water

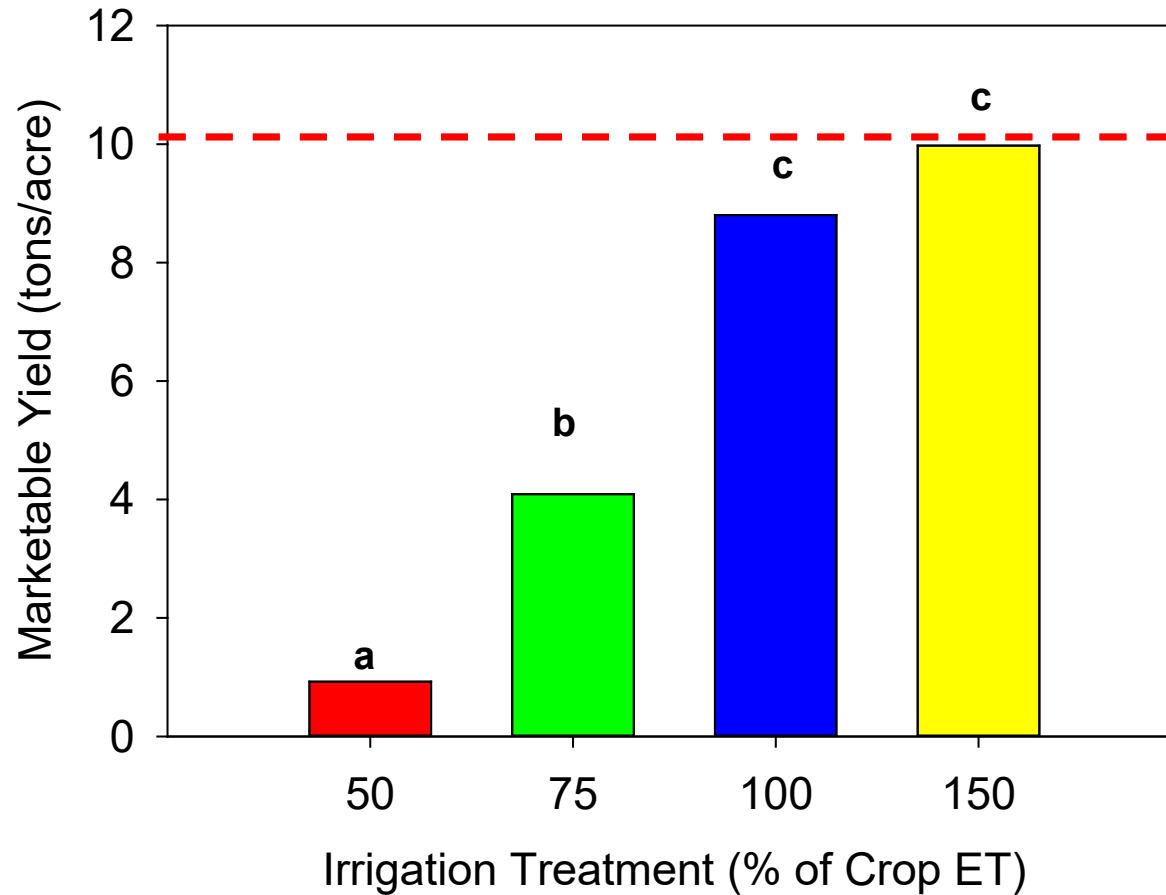


# Marketable yield

(avg 2018,2019)



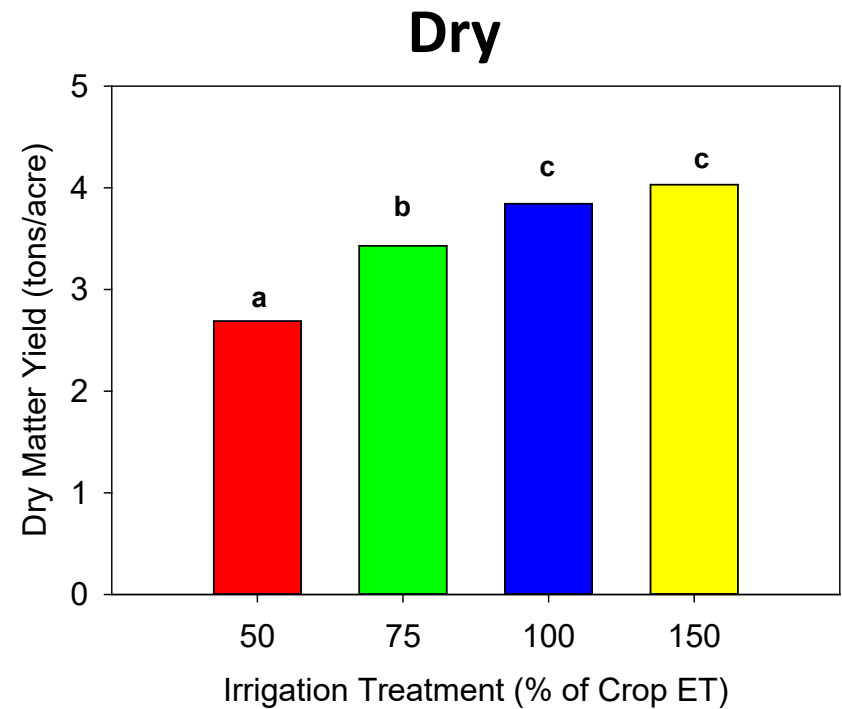
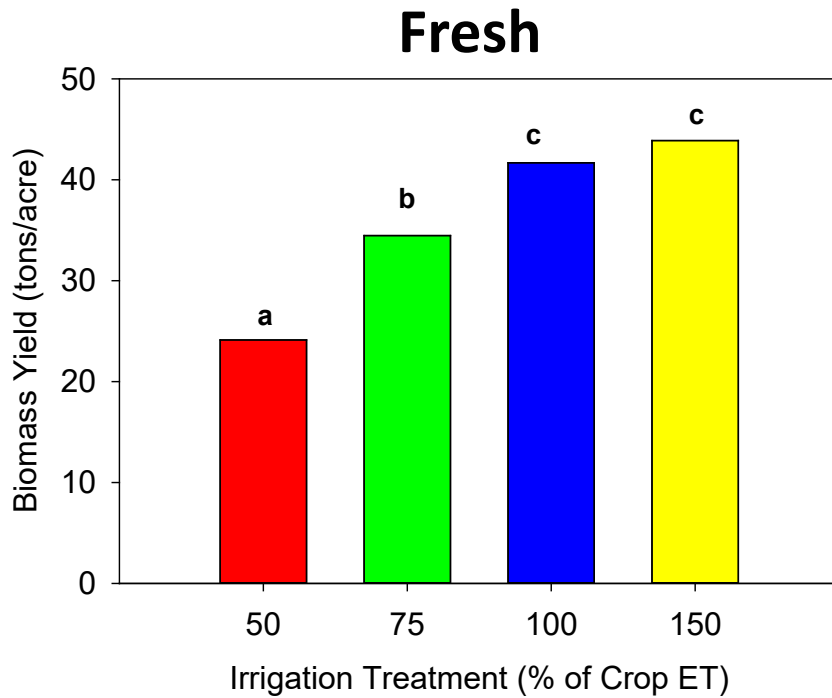
# Marketable yield



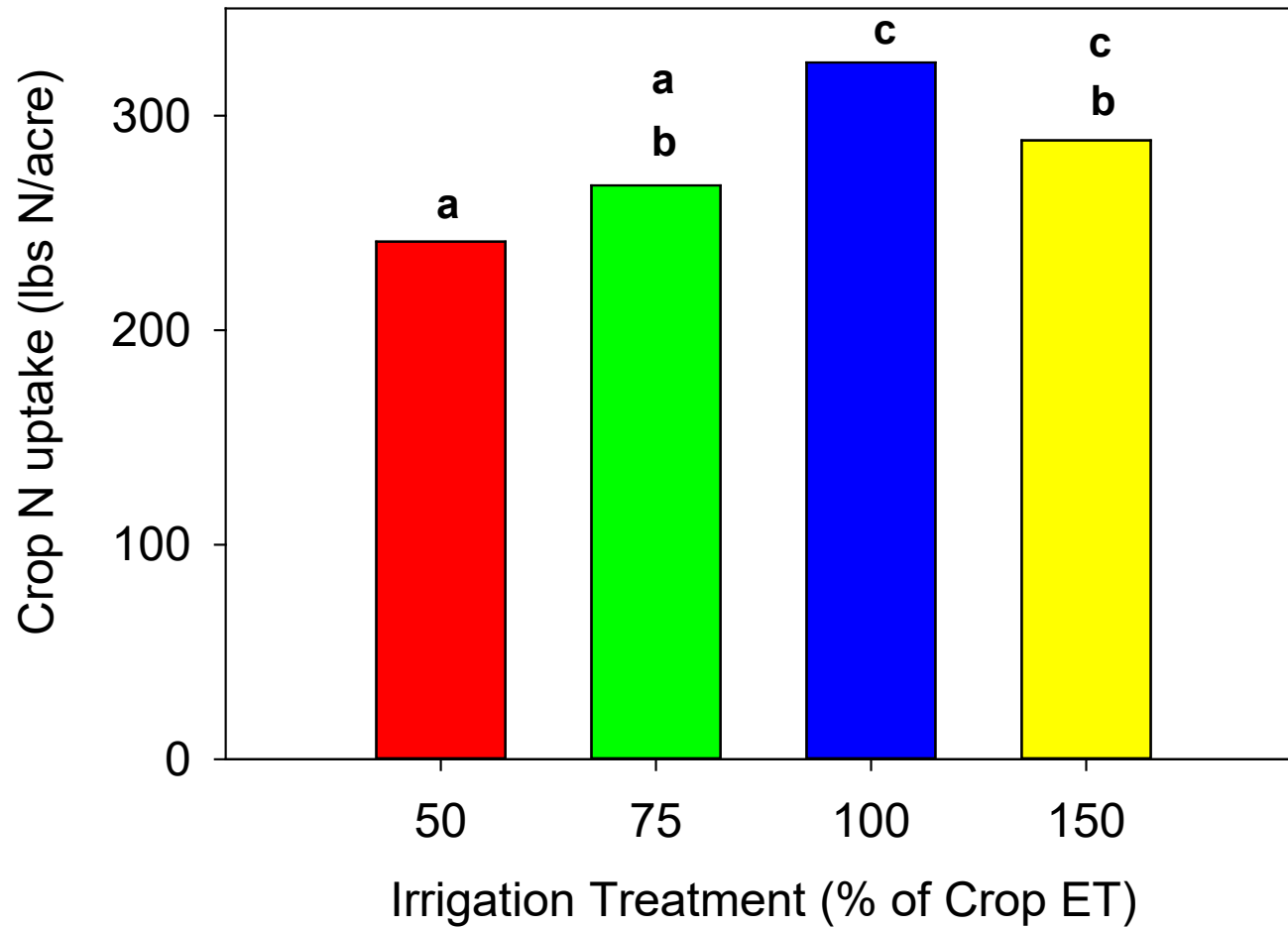
Industry avg  
~10 ton/ac  
"fresh" product  
per 2018  
Monterey Co.  
Crop Rpt

# Above-ground biomass

(avg 2018,2019)

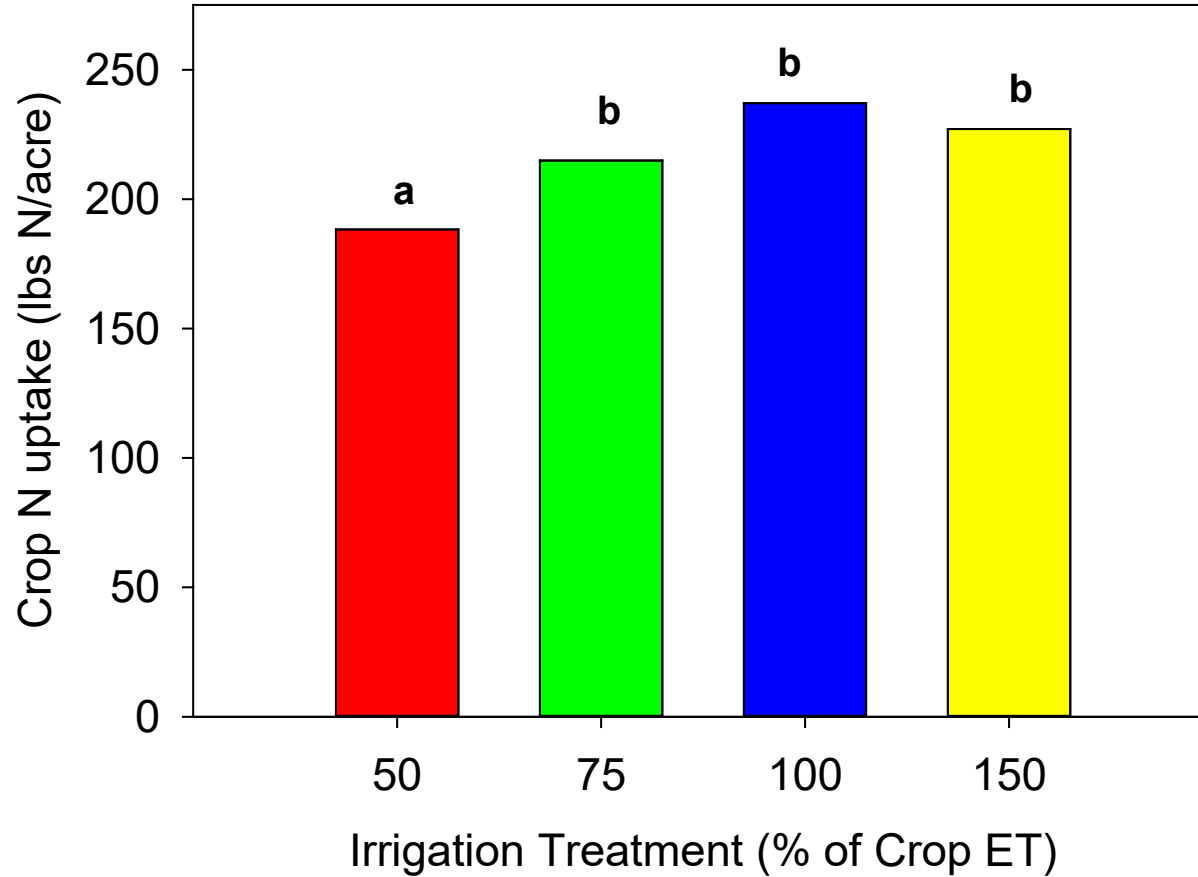


# Crop N uptake, 2018



# Crop N uptake (avg of 2018, 2019)

Average applied N = 318 lbs/acre



# Conclusions

- Cauliflower can be produced under drip but frequent irrigations (3x/week) may be needed when plants reach maturity or on sandy textured soils with low water holding capacity.
- Under typical Salinas weather conditions, it is probably unnecessary to apply more than a combined total of 12-16" of water under this irrigation regime (sprinkler followed by drip).
- Exercise caution during unusually warm conditions after heads are well-developed, to avoid discoloration. This can involve applying extra water to avoid wrapper leaf wilting, or physically tying the leaves closed.
- Some indication that fertilizer N "recovery" (amount of applied N taken up by plants) was maximized in the 100% water treatment
- In addition to farm management, improved knowledge of Kc's for various crops helps to assess basin scale water requirements.



# Conclusions, continued

- The CropManage app has been calibrated for use in cauliflower and is now ready for industry use.
- A “crop sensitivity factor” was added to provide greater resilience to wilting, by effectively increasing the CropManage applied target to about 125% of water use.
- We invite any feedback on your experiences with this tool!



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