

Weather-based irrigation scheduling of artichoke and red cabbage



 **University of California**
Agriculture and Natural Resources



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Monterey Bay



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Why irrigation trials in artichoke and cabbage?



- **Water sensitive crops**
- **Water supplies may become more limited in Salinas Valley (Sustainable Ground Water Management Act)**
- **Better water management may help improve nitrogen use efficiency (Ag Order)**
- **Calibrate CropManage online decision-support tool for irrigation scheduling of artichoke and cabbage (1st step are replicated field trials)**

Weather based irrigation scheduling (ET*-based)

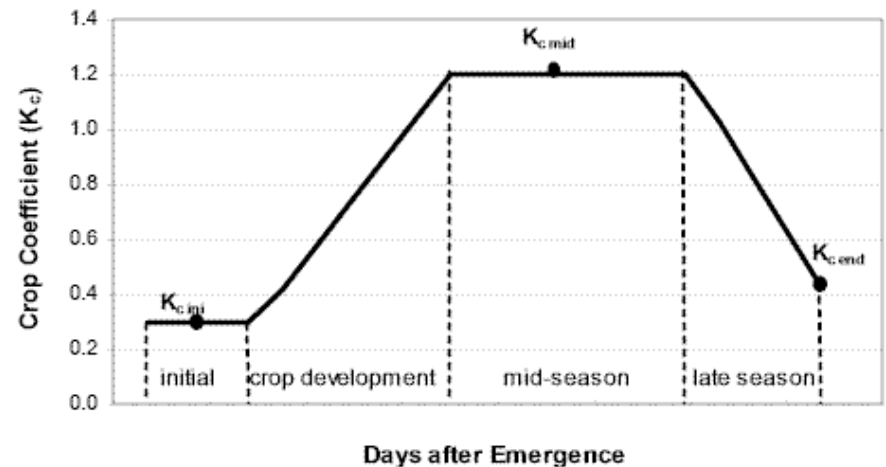


CIMIS station 214

Converting Reference ET to Crop ET:

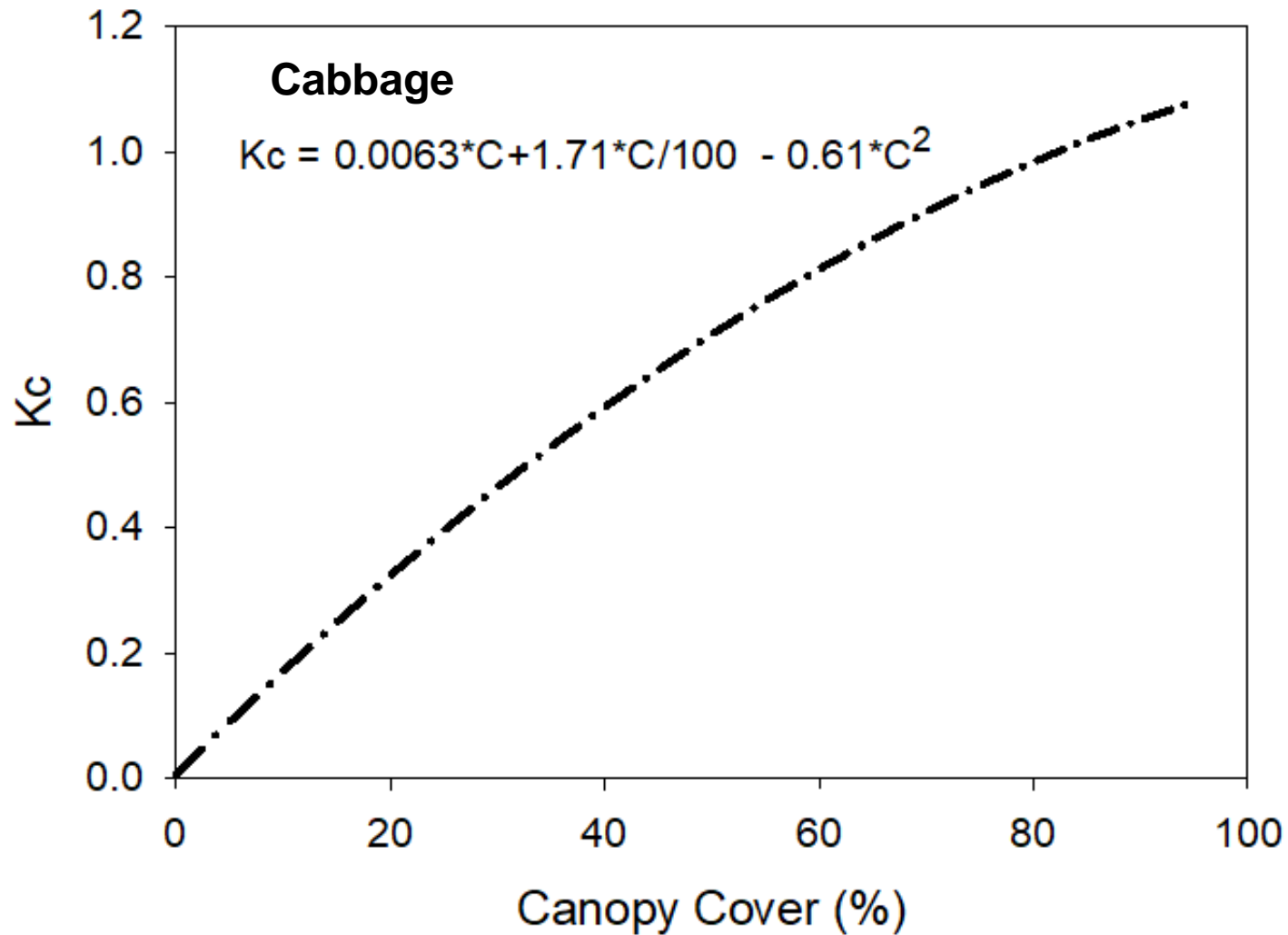
$$ET_{\text{crop}} = ET_{\text{ref}} \times K_{\text{crop}}$$

K_c can vary from 0.1 to 1.2



* evapotranspiration

Crop Kc can be based on canopy cover



CropManage can be used for ET-based irrigation scheduling

☆ Red Cabbage 100% ET ✕

29 Apr 2020 - 5 Aug 2020 ⚙️ 📊 📄 📈

Upcoming Past 📅

27 Jul 2020

🚰 Drip 🌊 5.1 hr

24 Jul 2020

🚰 Drip 🌊 5.5 hr

📦 UAN32 📏 7 gal/acre

20 Jul 2020

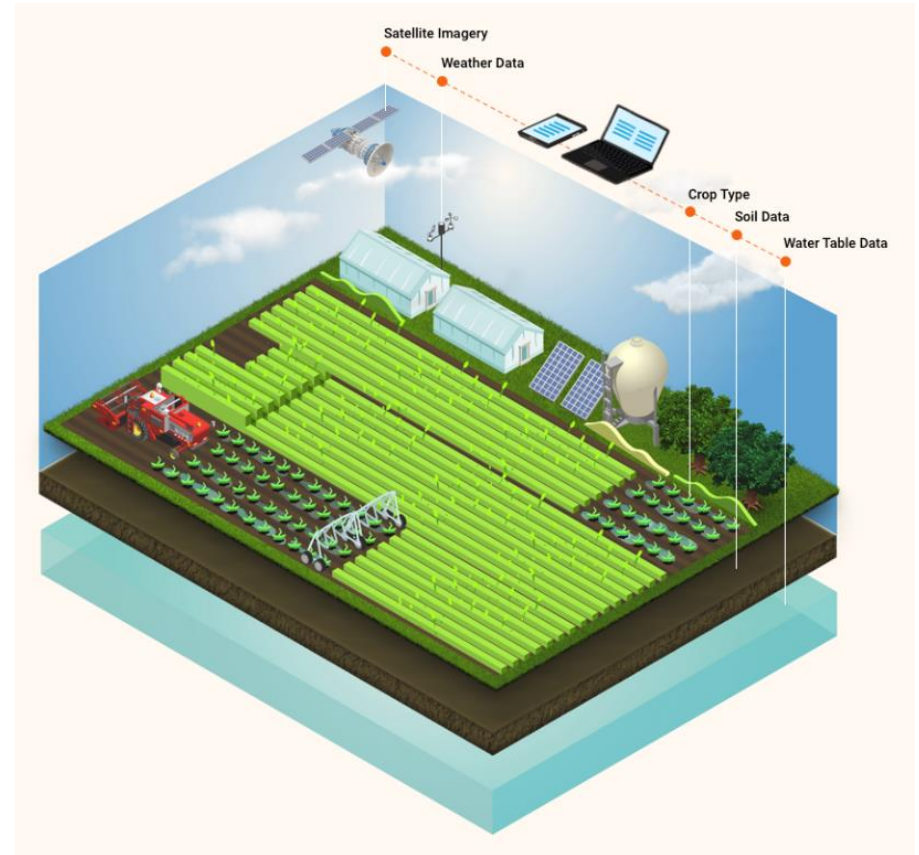
🚰 Drip 🌊 6.4 hr

🍷 Quick Nitrate Strip 📏 0.5 ppm

🍷 Quick Nitrate Strip 📏 0.5 ppm

17 Jul 2020

View all events by: ☰ 📅



Crops currently supported

- Vegetables (artichoke, broccoli, cabbage, cauliflower, celery, lettuce, pepper, spinach, tomato, etc.)
- Berry crops (raspberry, strawberry)
- Tree crops (almond, walnut, pistachio)
- Field crops (alfalfa, corn)



CropManage has been extensively field trialed

- Artichoke
- Head lettuce
- Romaine lettuce
- Green cabbage
- Red cabbage
- Broccoli
- Cauliflower
- Celery
- Strawberry
- Raspberry



Irrigation treatments
of 50% to 150% of
recommended water

Objectives



- Determine water requirement of drip irrigated artichoke and red cabbage for optimizing yield and quality
- Determine if the crop coefficient (ET) models for artichoke and cabbage are accurate

Experimental Approach

- Apply different rates of water based on ET model
- Evaluate yield, quality, soil moisture, crop development of water treatments



Procedures



- Field trials conducted at USDA-ARS Spence Research farm (Chualar sandy loam soil)
- Cabbage and artichoke trials in 2020 and 2021
- Randomized Complete Block Design:
 - 5 drip irrigation trts: (50, 75, 100, 125, 150% ET)
 - 6 replications
 - Individual plots measured 135 ft x 16.7 ft (five 40-inch, wide beds)
- Drip irrigation treatments began after crops were established with sprinklers (~ 22 DAP)
- Sub plots commercially harvested
- Above ground biomass yield evaluated

Trial Details

Event	2020		2021	
	Cabbage	Artichoke	Cabbage	Artichoke
transplant date	4/29/2020	7/29/2020	5/13/2021	6/11/2021
Variety	Rondale	Dole F19	Rondale	Dole F19
Plant lines per bed	2	1	2	1
in-row plant spacing (inches)	12	29	12	36
Sprinkler establishment water (inches)	4.0	3.3	3.1	4.0
1st harvest (DAP)	84	143	78	98
biomass evaluation (DAP)	91	140	84	103
total rain (inches)	0	5.8	0.8	0.8
In seasonal N (lbs/acre)	322	306	270	249

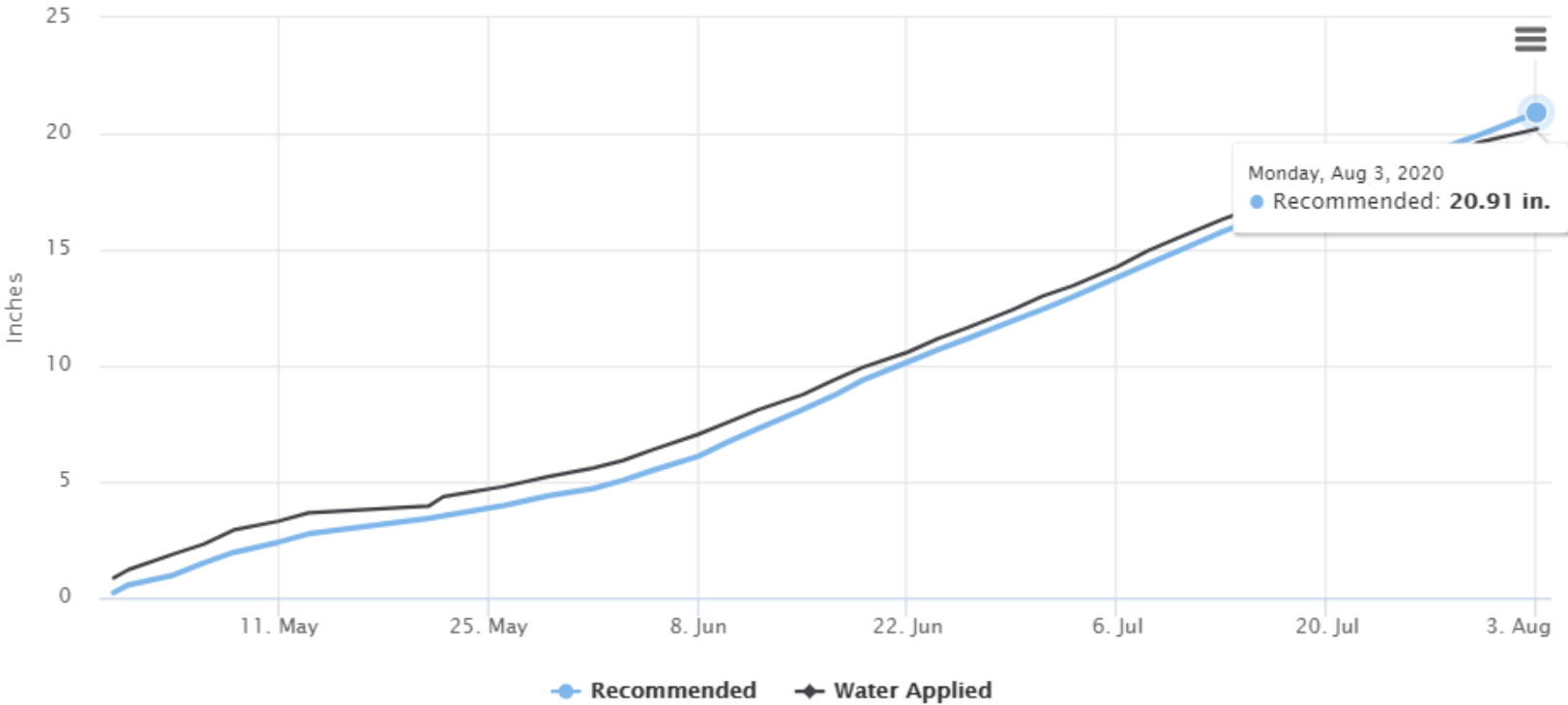
DAP = days after planting

Manifold for applying irrigation treatments



Water volumes were applied following the CropManage model

Applied Water
RED CABBAGE 100% ET



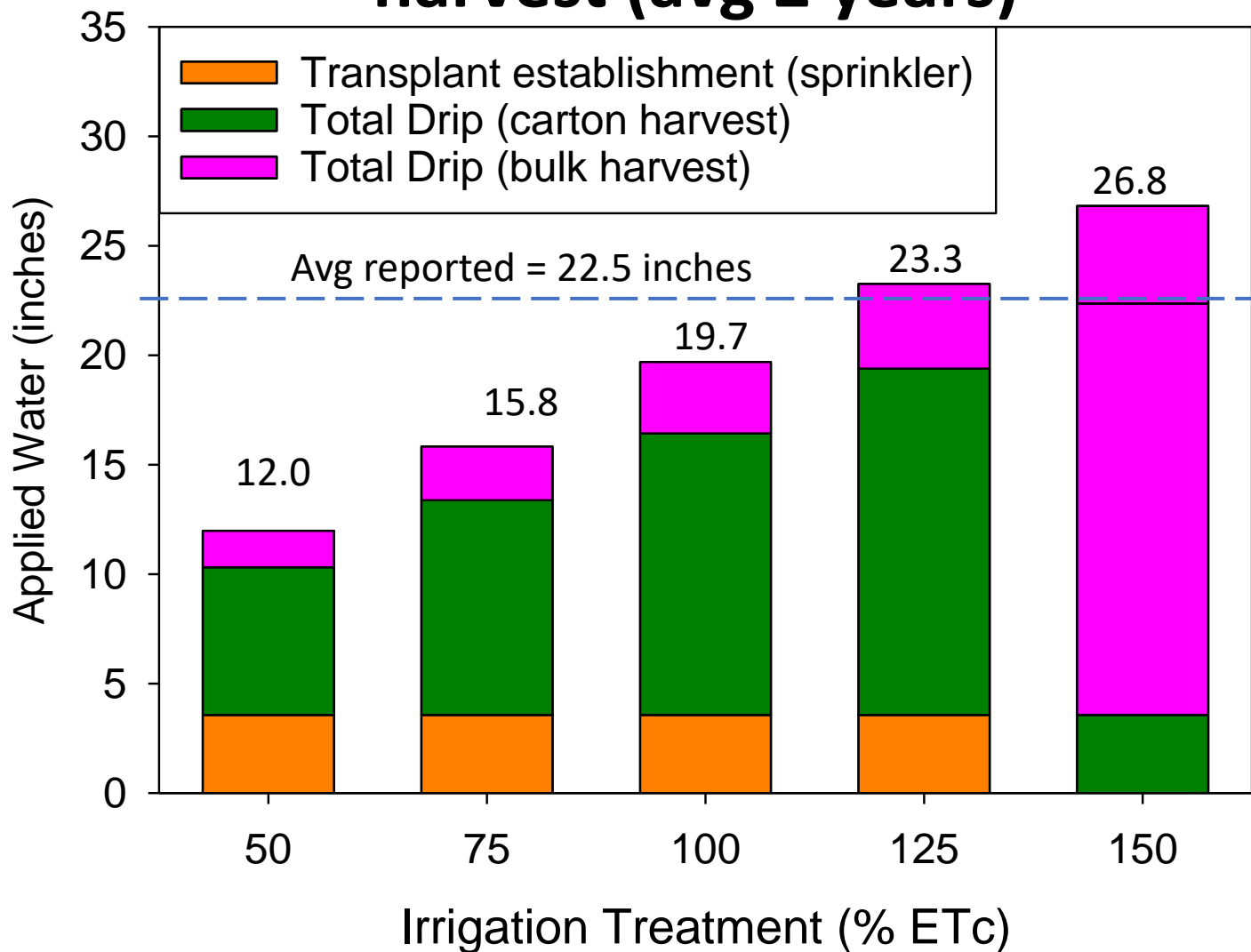
Highcharts.com

Close

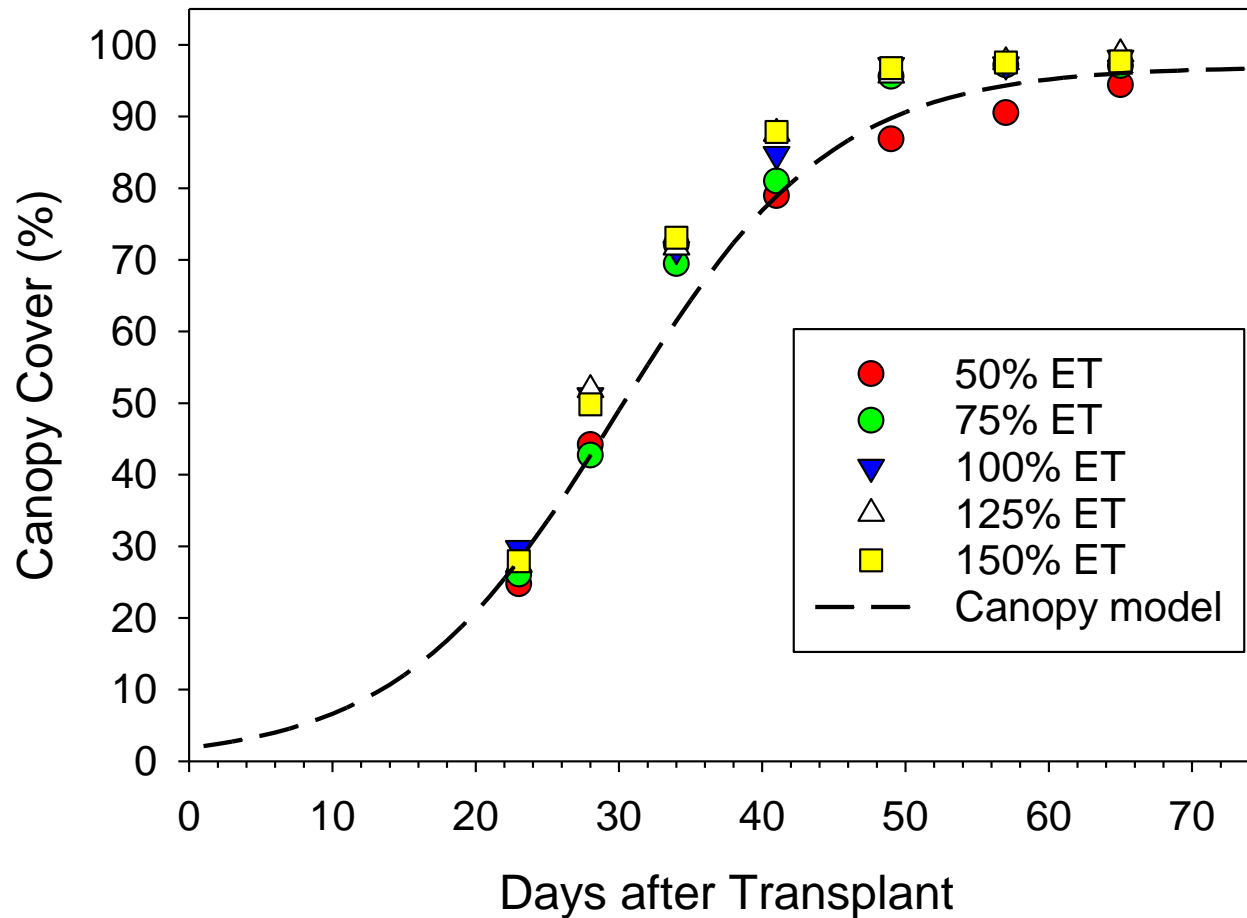
Cabbage Trial Results



Total water applied to 100% ET treatment was 16 inches to carton harvest and 20 inches to bulk harvest (avg 2 years)



Canopy cover was evaluated among treatments and compared with theoretical curve



100% ET (Blue)

150% ET (Yellow)

late June ~mid-season



100% ET (Blue)

50% ET (Red)

late June ~mid-season

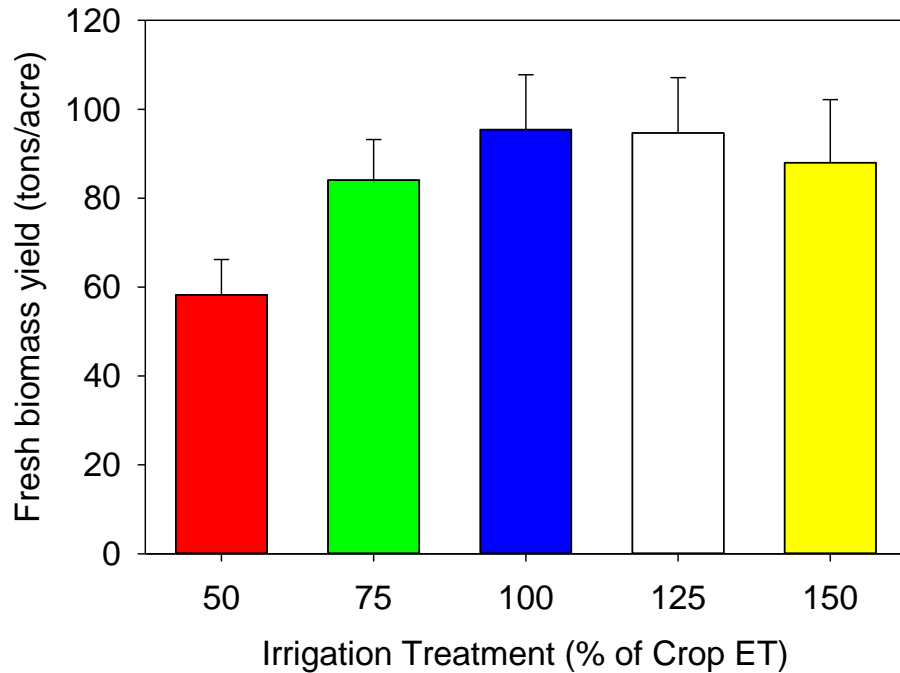


50% ET treatment susceptible to wilting in the afternoon

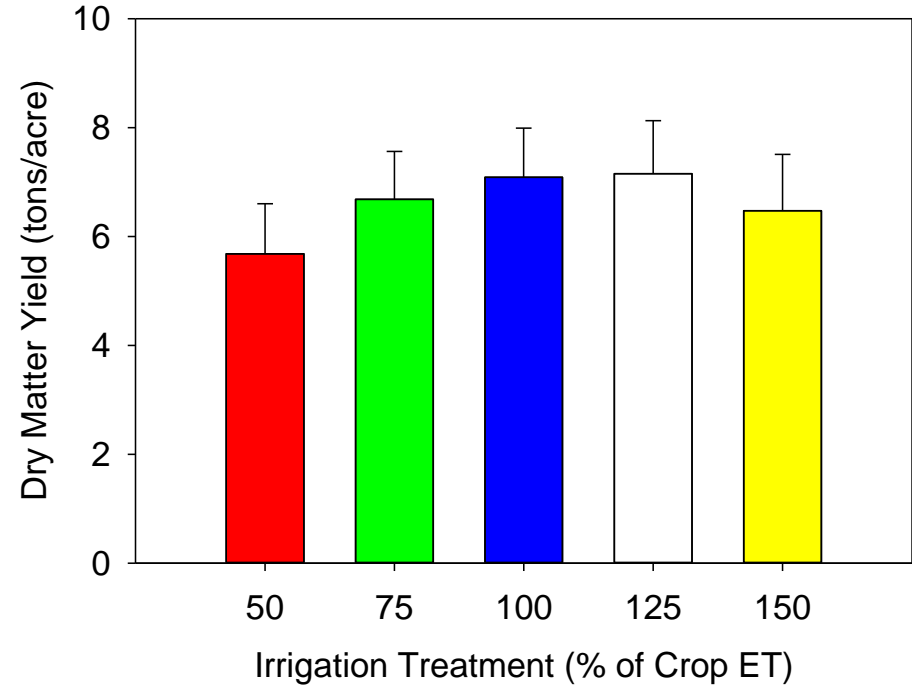


Fresh and dry above ground biomass yield was maximized under the 100% ET treatment (avg. of 2 years)

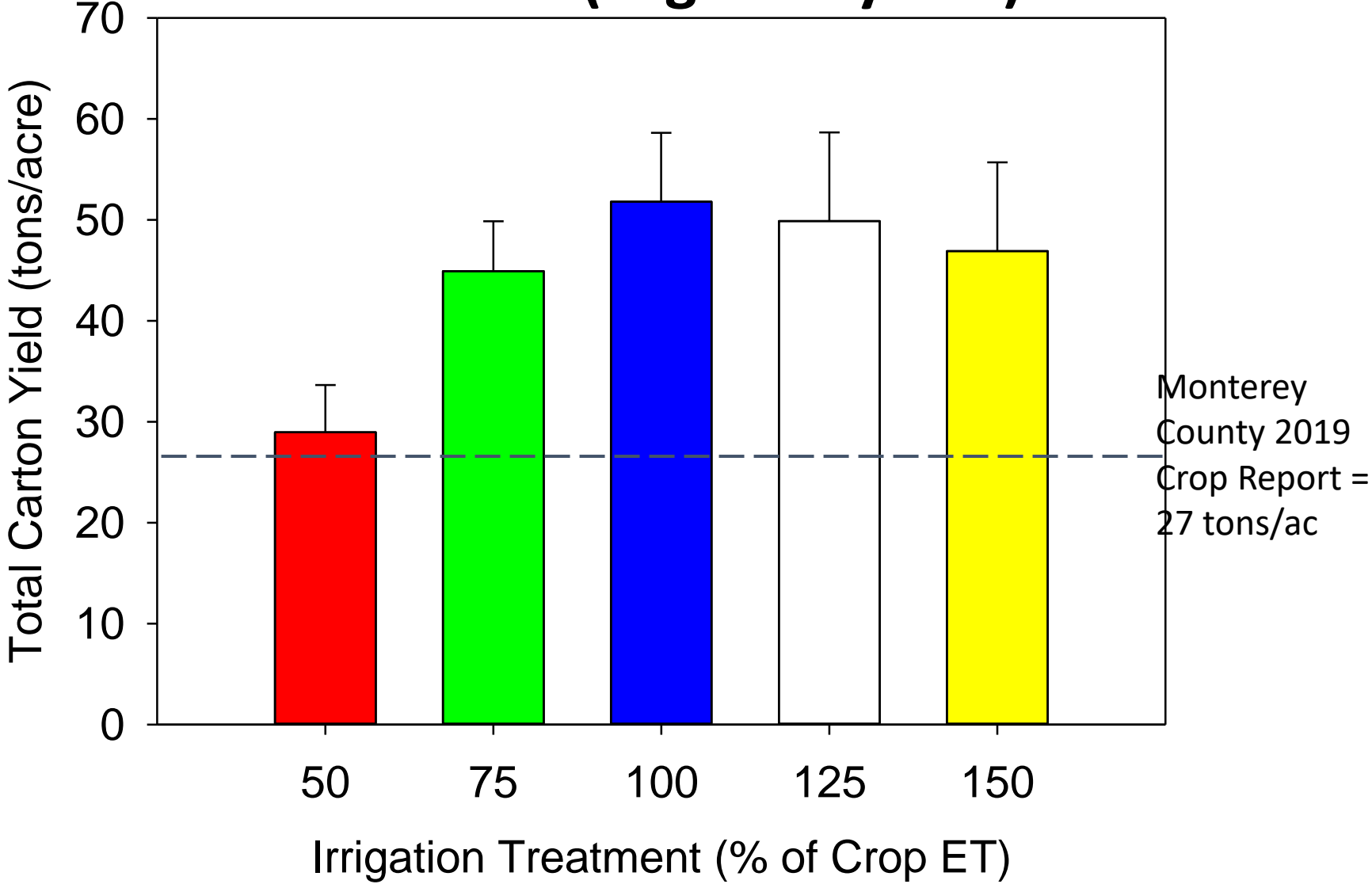
Fresh biomass



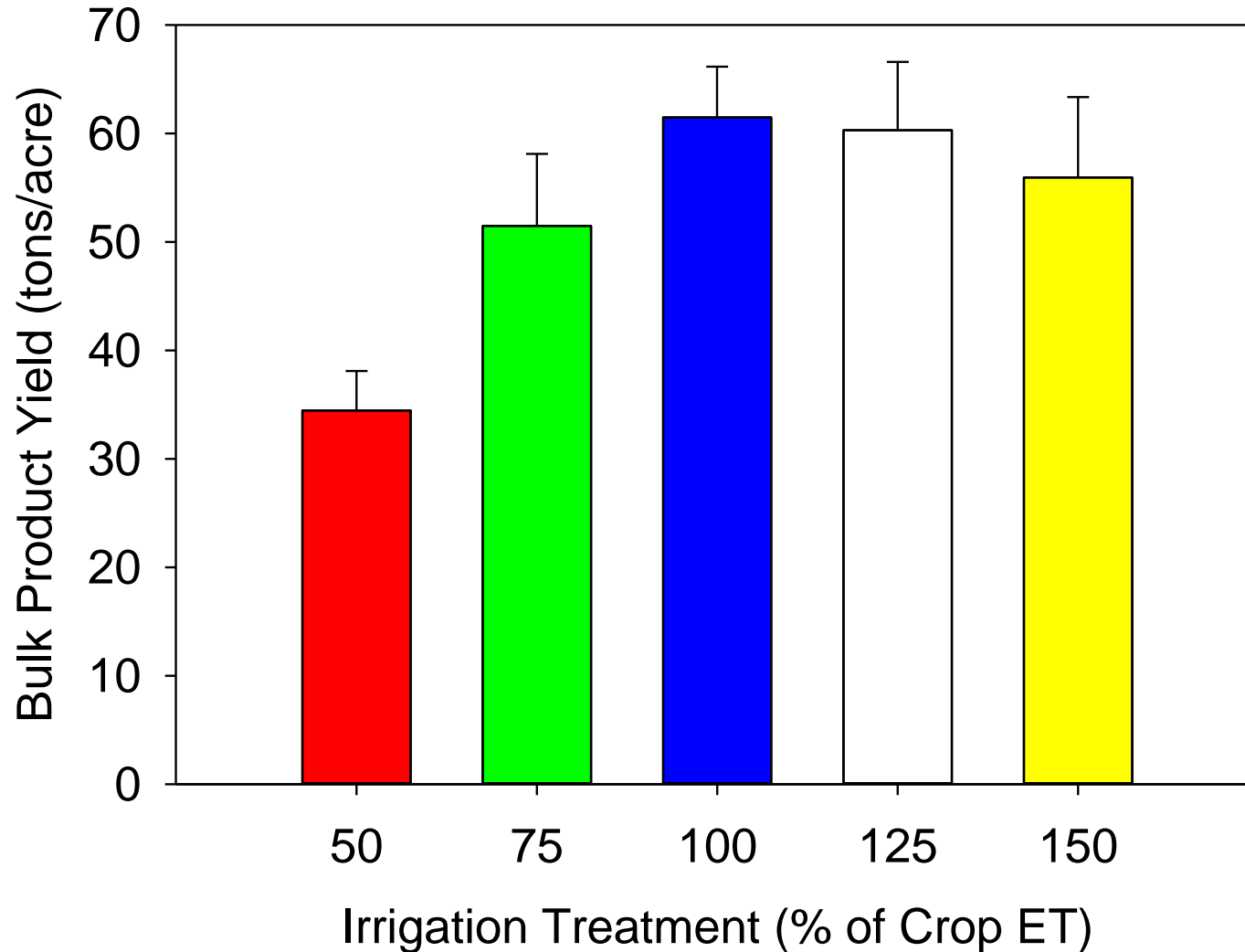
Dry biomass



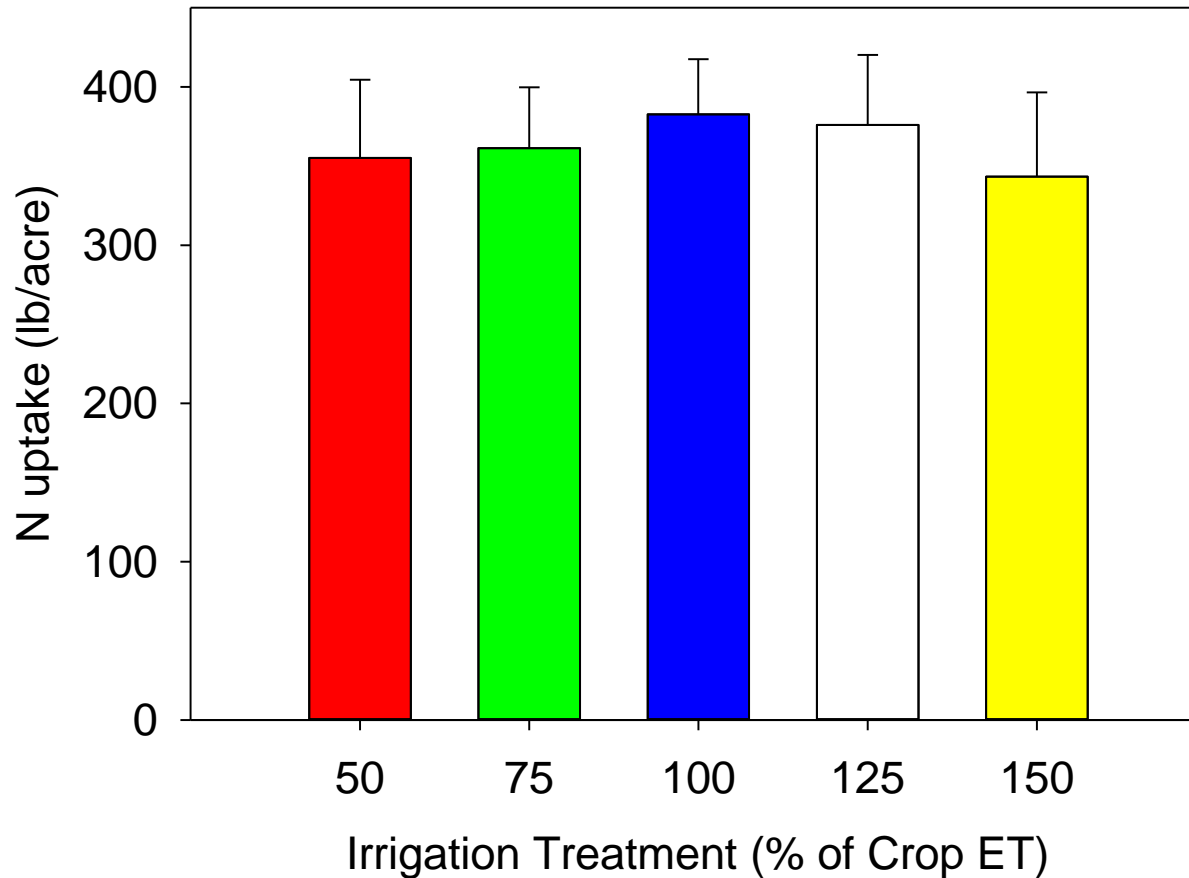
Carton yield was maximized with the 100% ET treatment (avg. of 2 years)



Bulk yield was maximized with the 100% ET treatment (avg. of 2 years)



The 100% and 125% ET treatments had the highest N uptake (380 lbs N/acre, avg of 2 yrs)

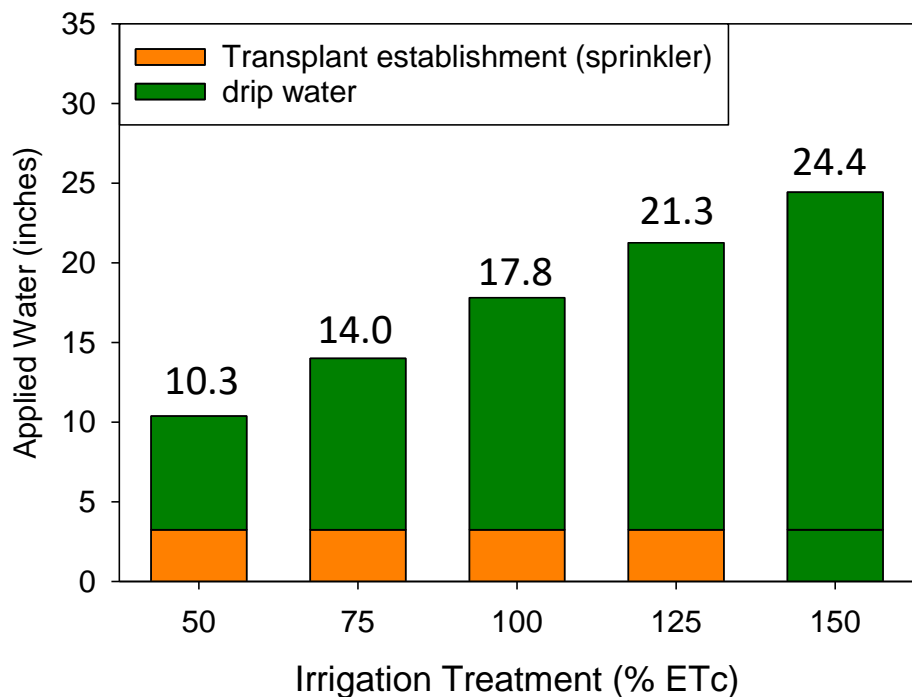


Artichoke Trials Results

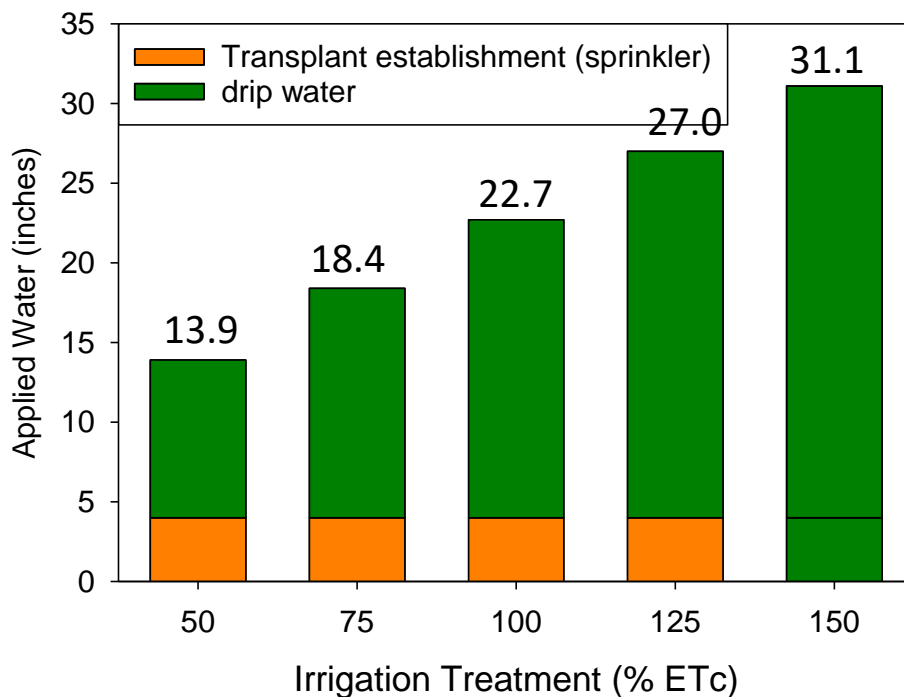


Total water applied to 100% ET treatment was 18 inches in 2020 and 23 inches in 2021

2020

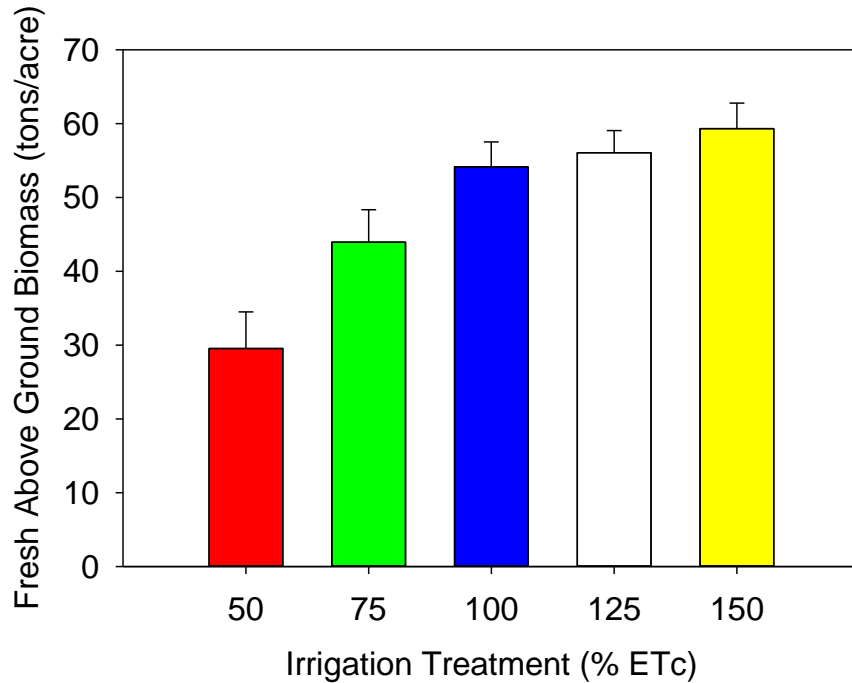


2021

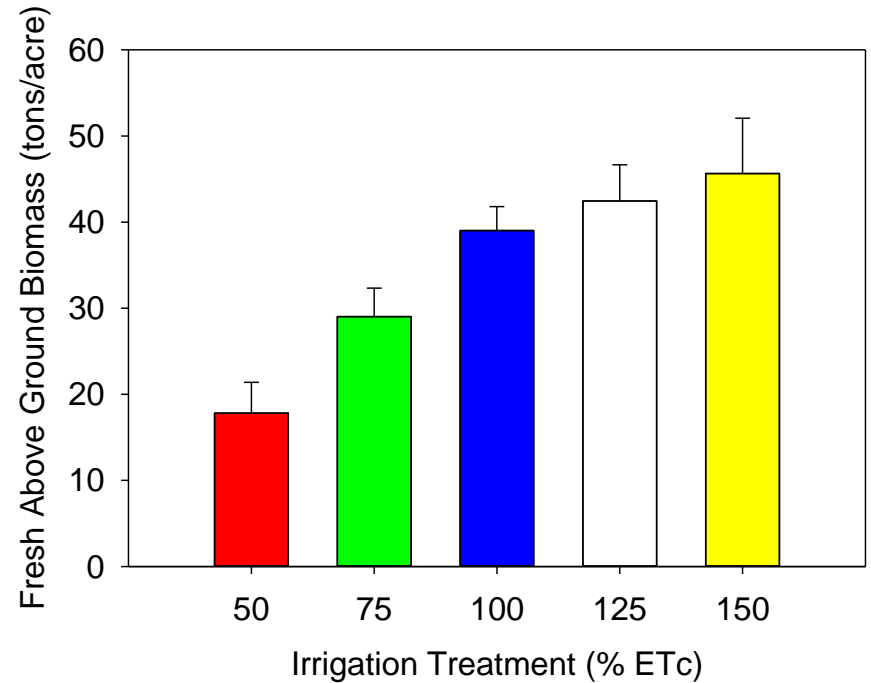


Irrigation treatment effects on above ground **fresh** biomass yield

2020

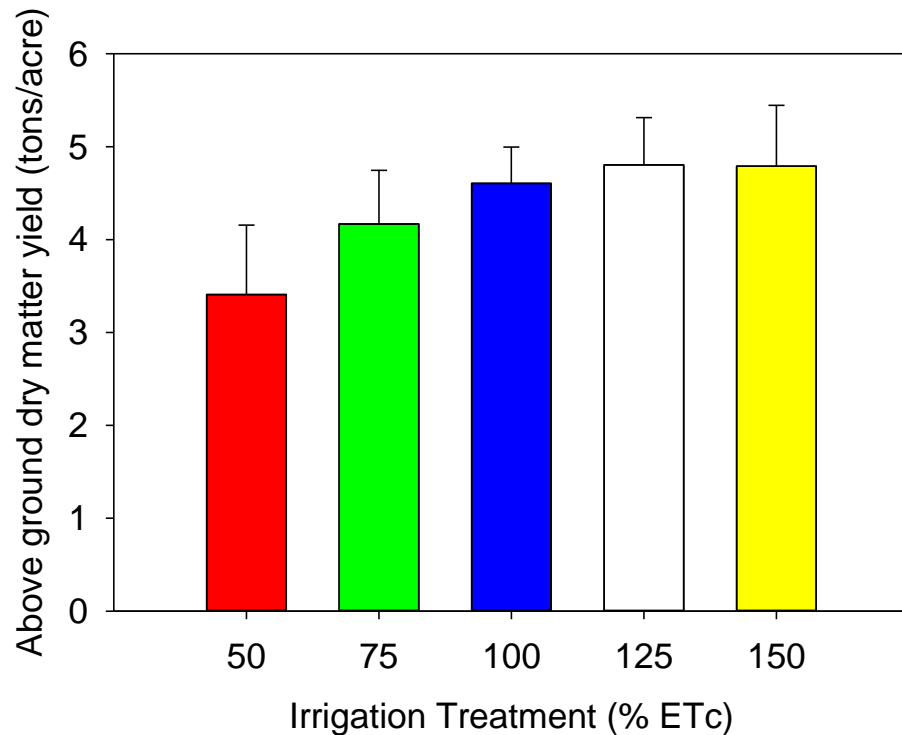


2021

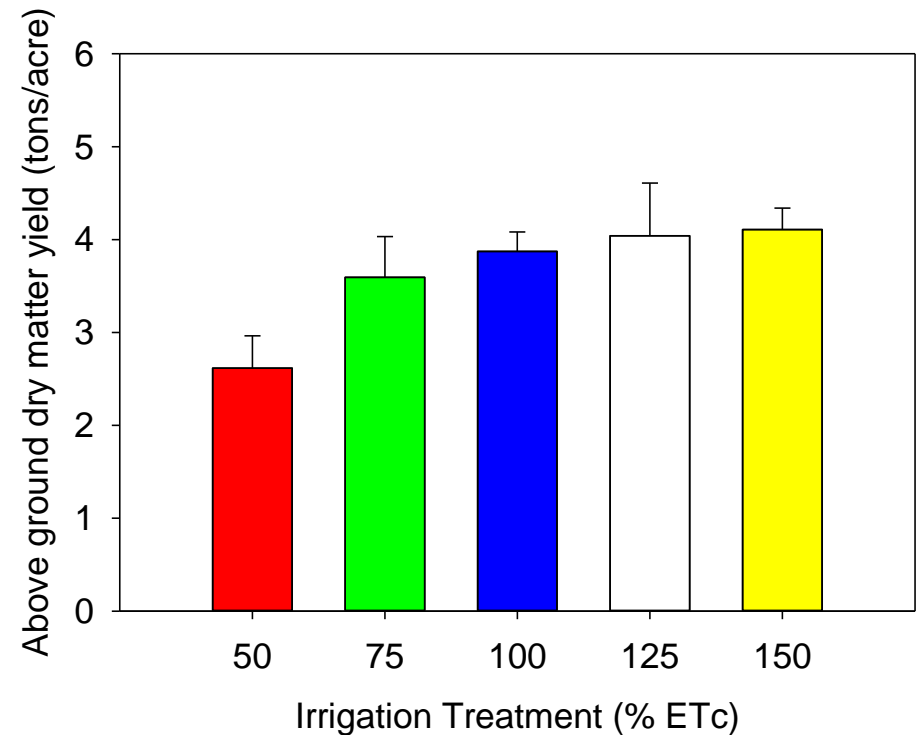


Irrigation treatment effects on above ground **dry** biomass yield

2020



2021



Blue (100 % ET)

Red (50 % ET)



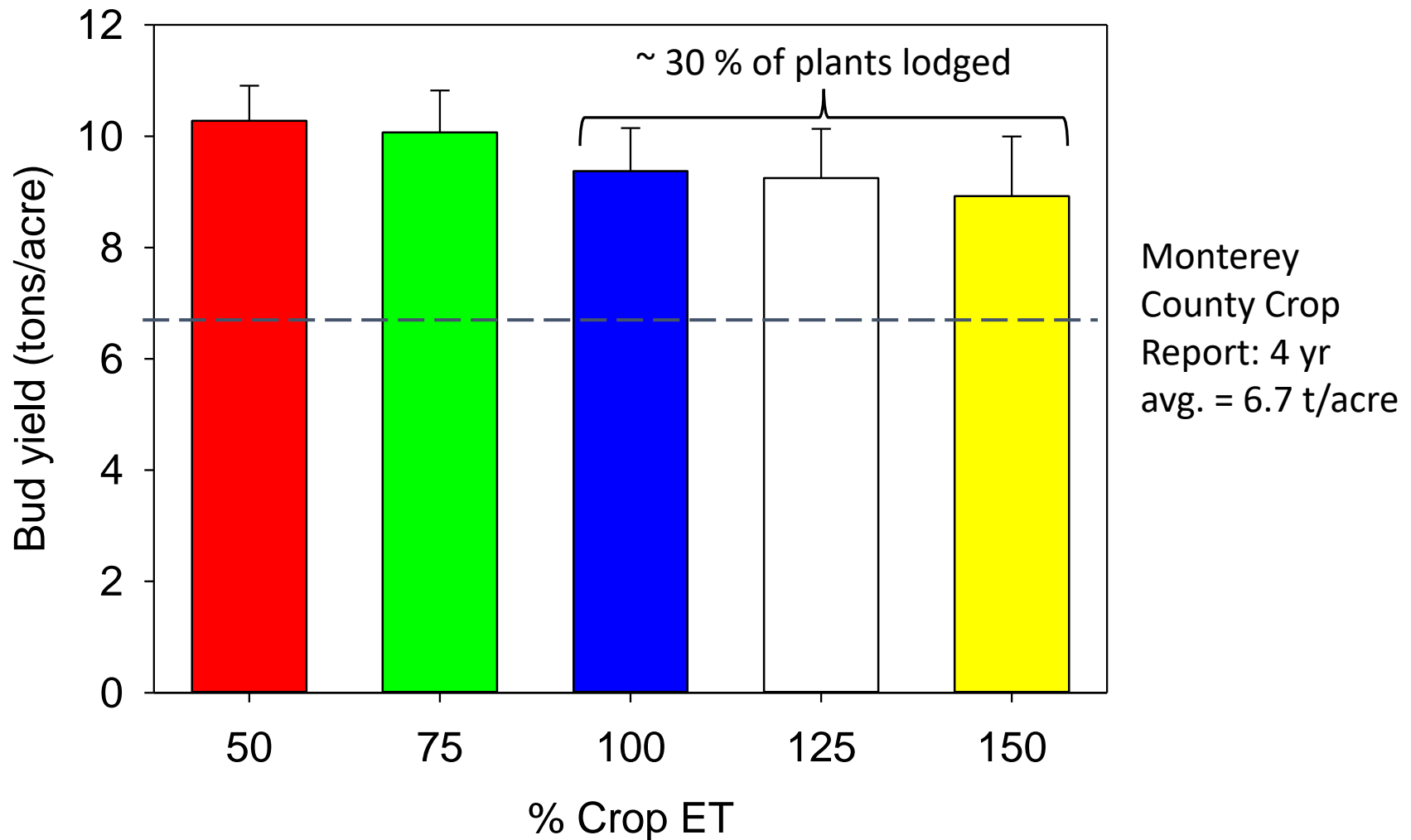


Year 1 harvests: 12/22/20 – 3/5/21

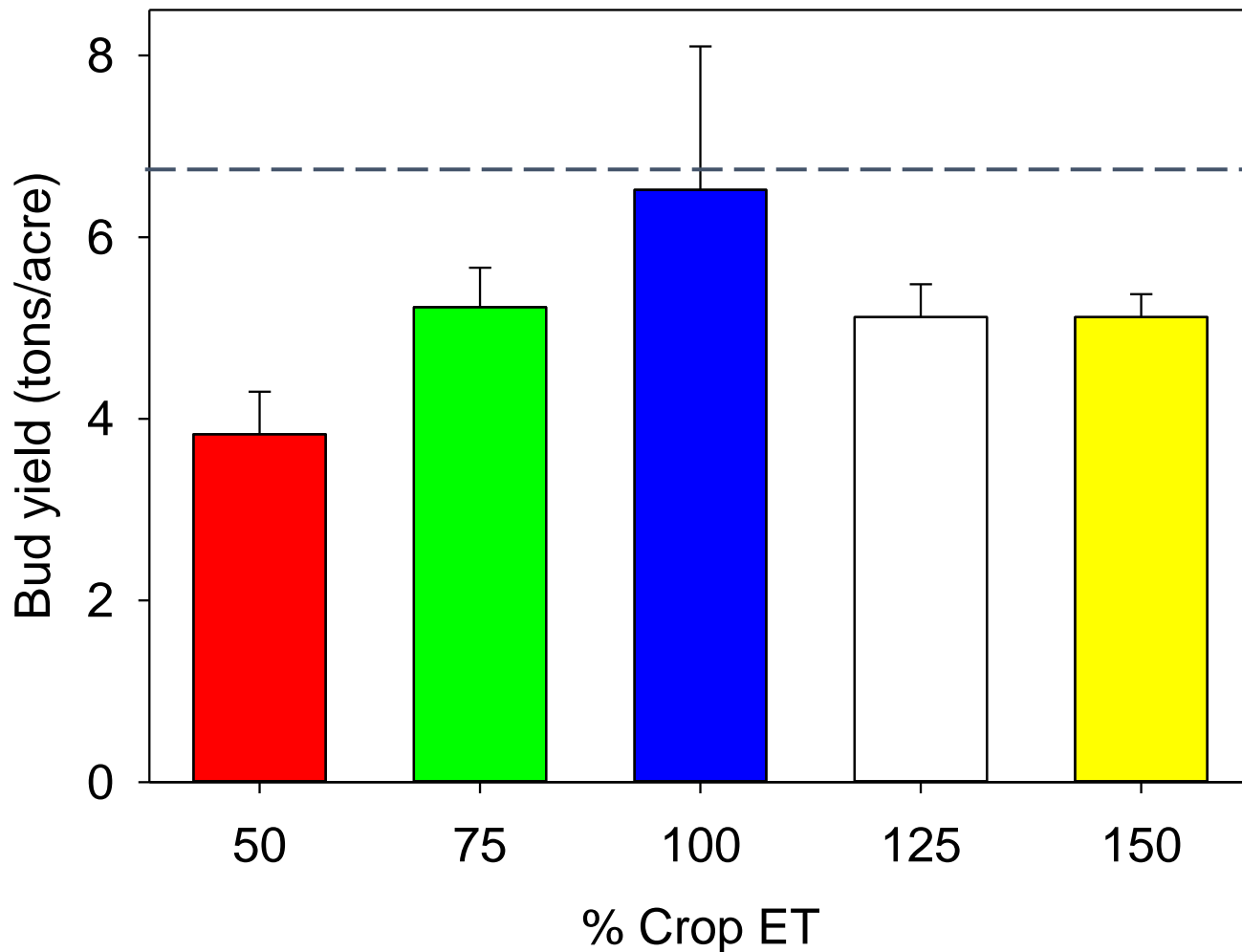
Year 2 harvests: 9/17/21 – 11/8/21



Yields were not significantly different among treatments in 2020 due to rain during the harvest period

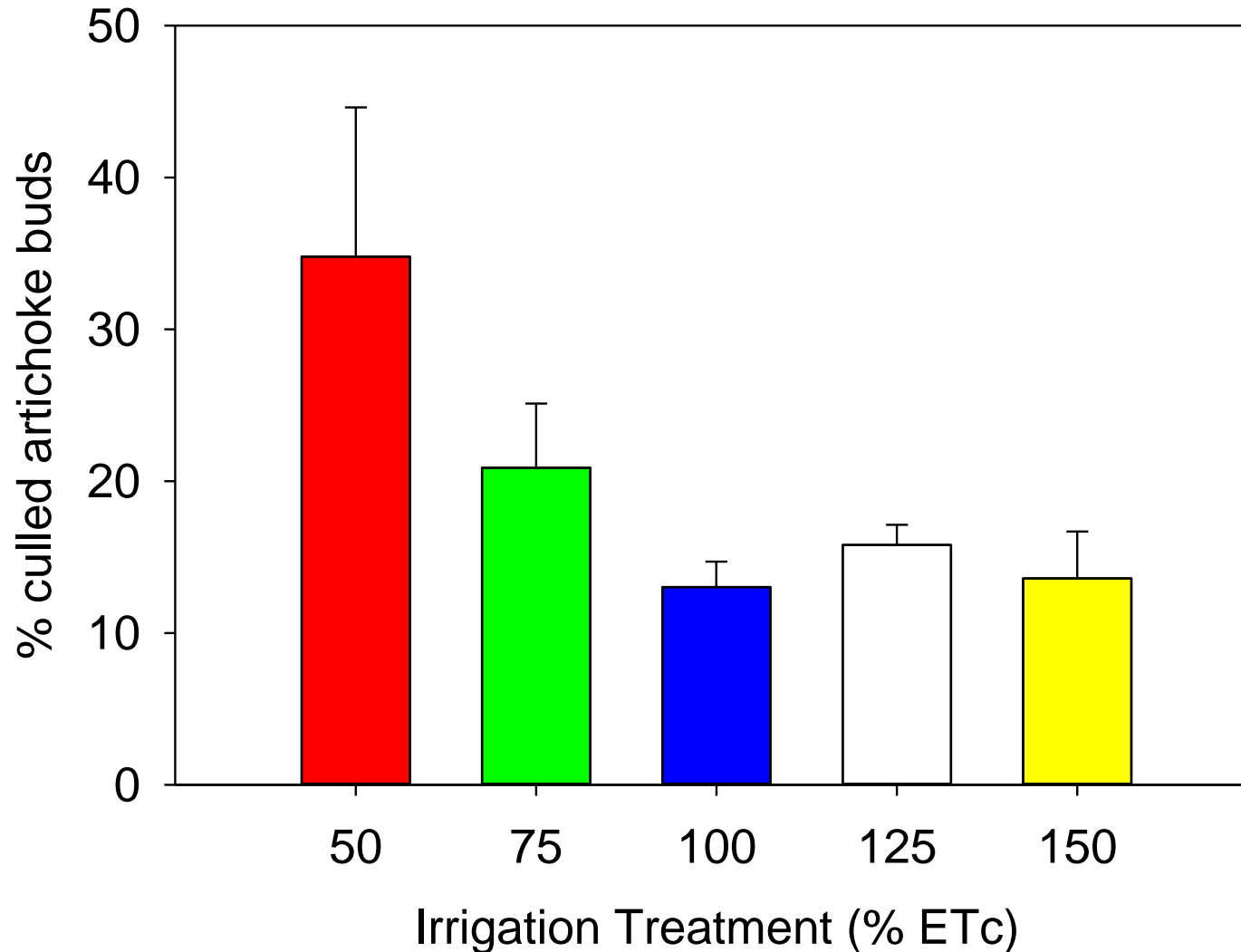


Bud yield was maximized in the 100% treatment in 2021



Monterey
County Crop
Report: 4 yr
avg. = 6.7 t/acre

Applying 100% or greater of CM recommendation minimized defects (2021)



Findings and Next Steps

- **Yield and quality of cabbage can be optimized with drip irrigation.**
- **CropManage (100% ET) recommendation optimized irrigation scheduling of red cabbage.**
- **16 inches of applied water maximized yield and quality of carton harvest and 20 inches for bulk harvest (100% ETc).**
- **CropManage (100% ET) recommendation optimized yield in artichoke but may need 125% ET to optimize quality.**
- **23 to 27 inches of water maximized artichoke yield and quality during the summer season.**
- **Next step is to field test CropManage irrigation recommendations in commercial artichoke and cabbage fields.**

Acknowledgements

- **CDFA Specialty Crop Block Grant**
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Questions?

