Evaluation of Weather-Based Irrigation Scheduling in Celery and Cabbage

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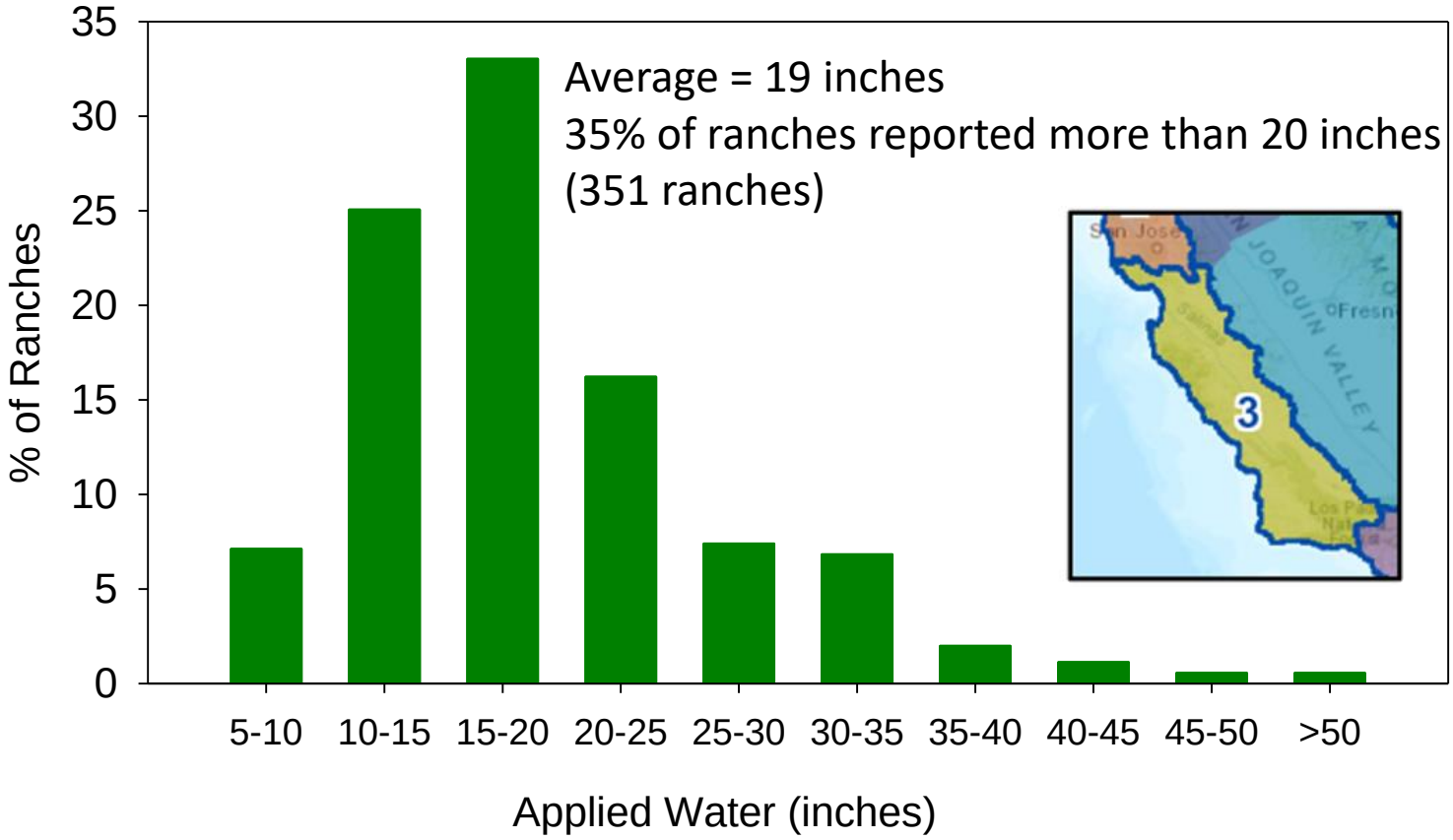
Why irrigation trials in celery and cabbage?

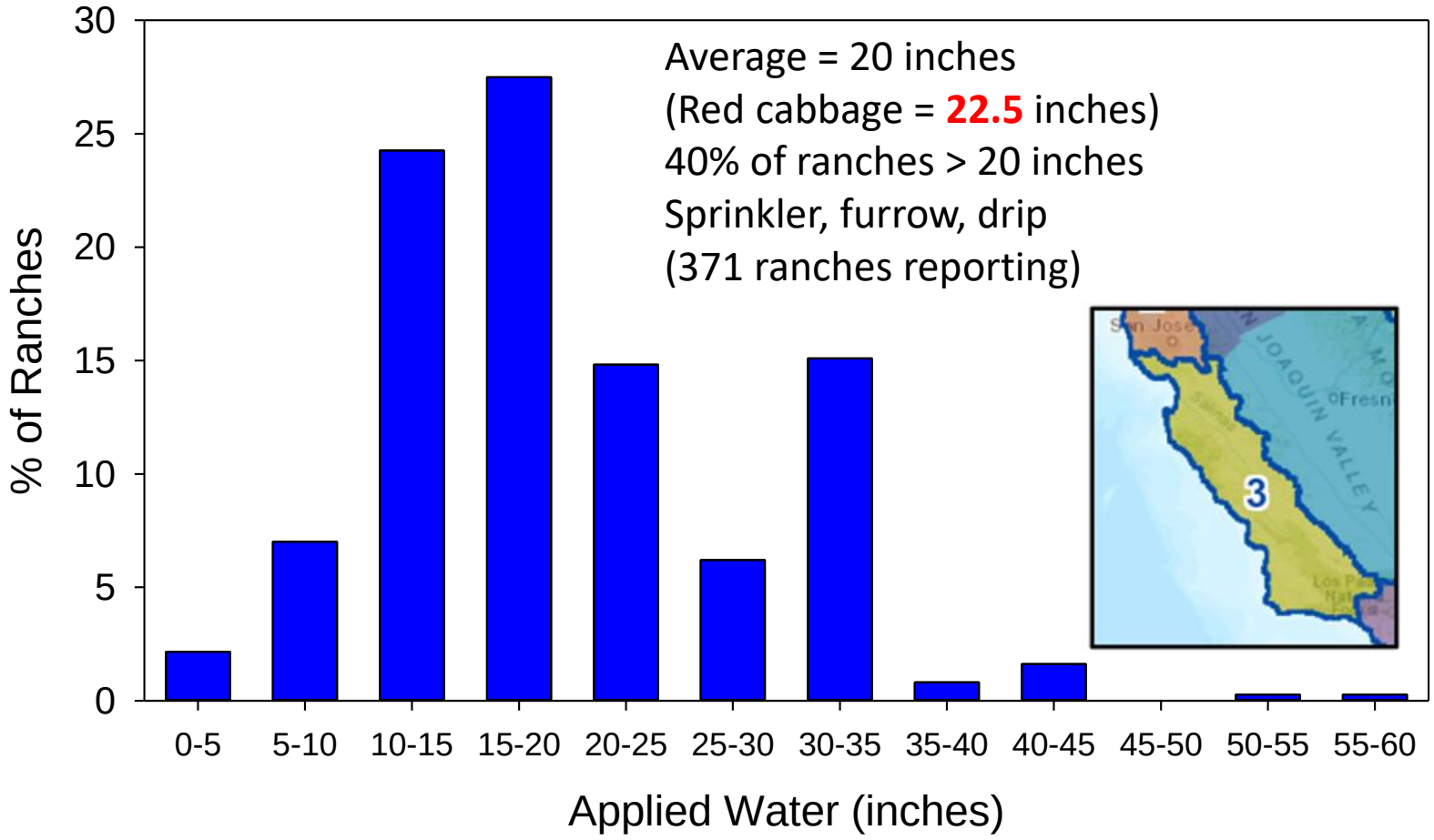
- Water sensitive crops often irrigated by a combination of methods (drip, furrow, sprinkler)
- Water supplies are becoming more limited in the Salinas Valley: Sustainable Ground Water Management Act
- Better water management would help improve nitrogen use efficiency

Reported water use of celery in region 3* (2017)



***CC Water Quality Control Board**

Reported water use of cabbage in region 3* (2014-17)



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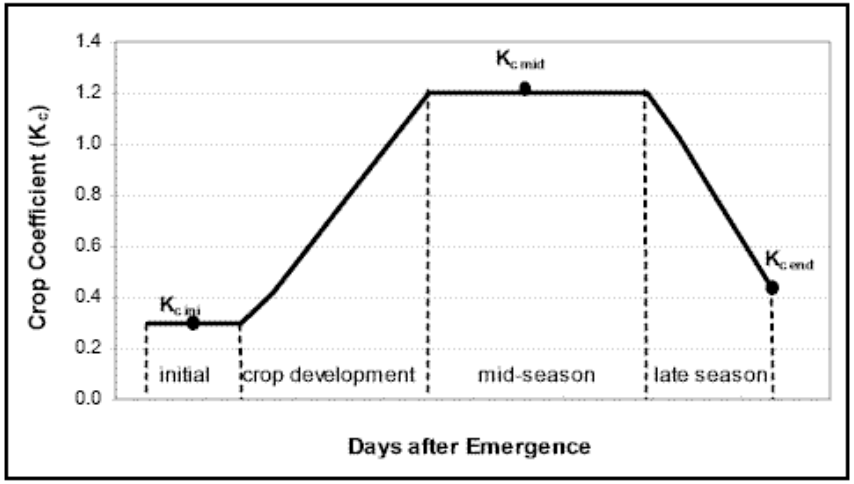
Weather-based irrigation scheduling

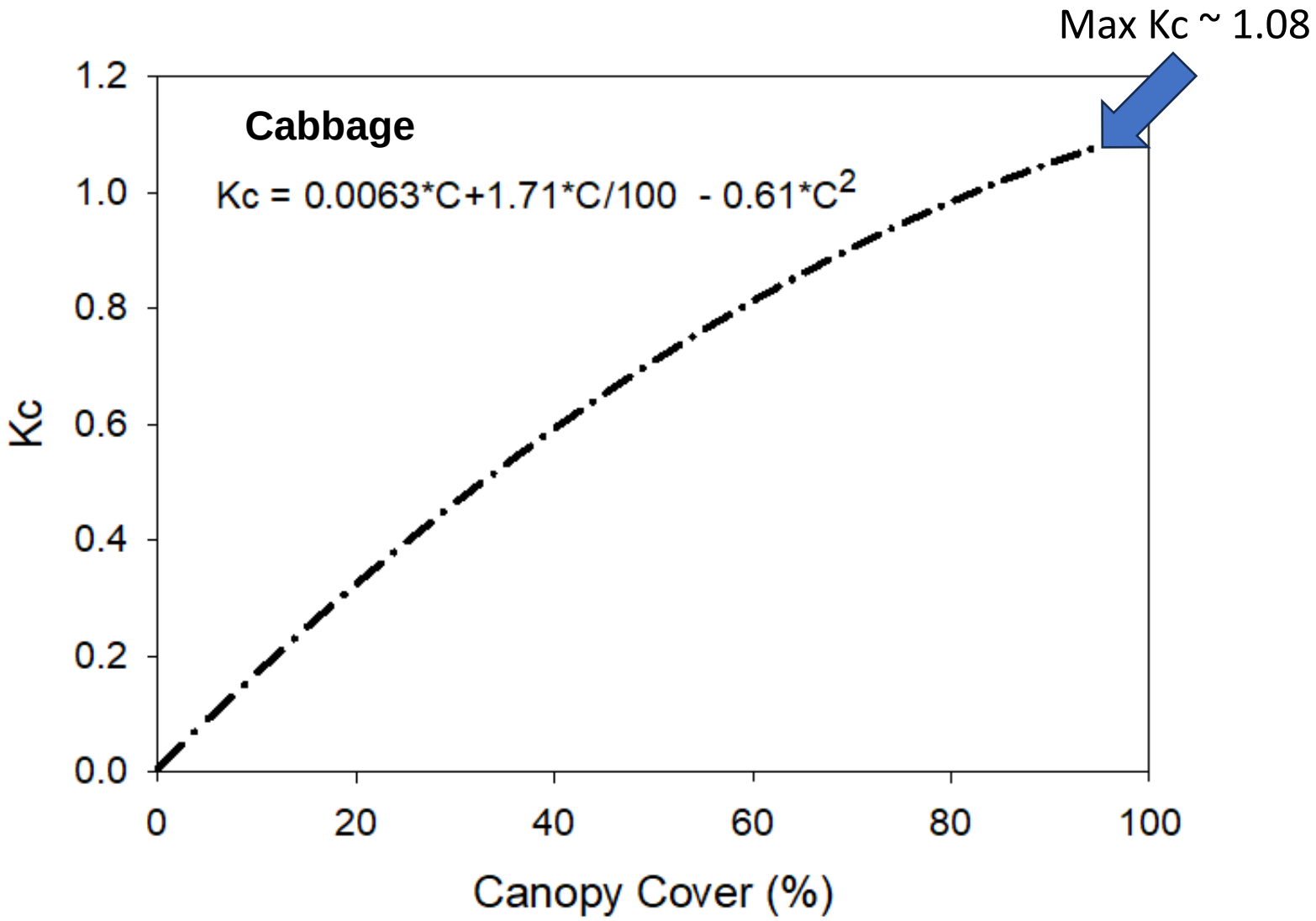
Converting Reference ET to Crop ET:

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

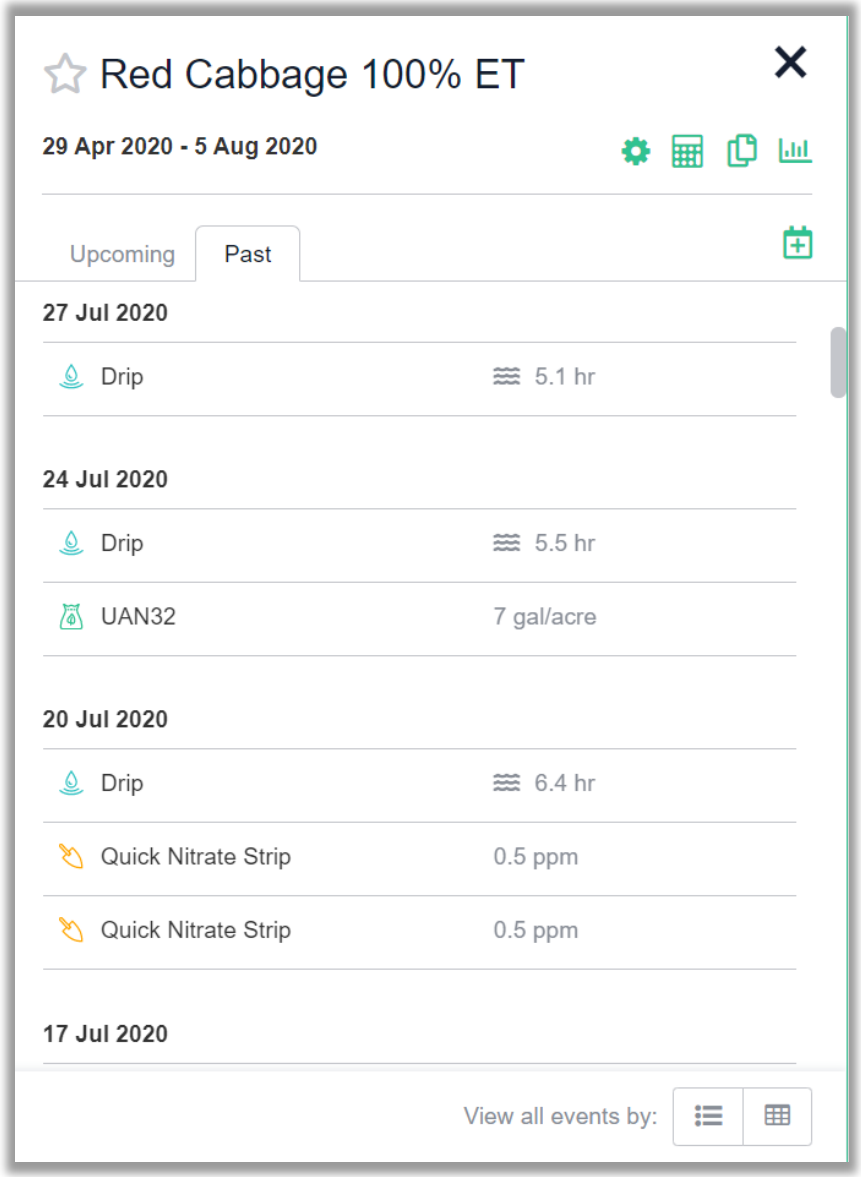
K_c can vary from 0.1 to 1.2

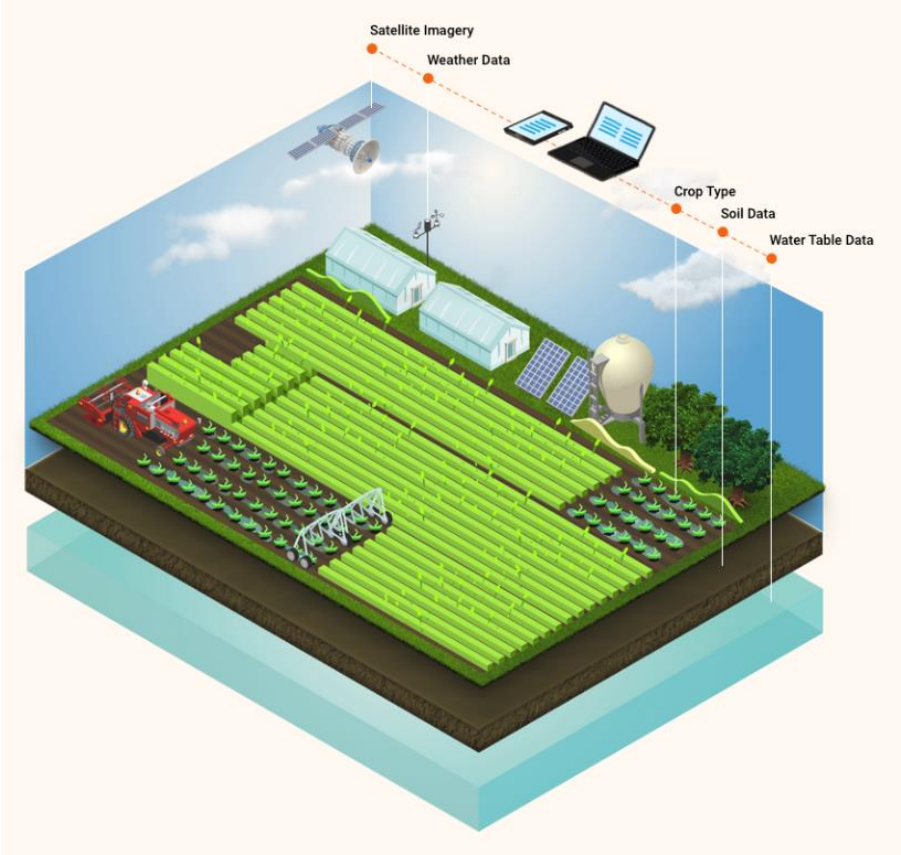


Crop Kc can be based on canopy cover



CropManage can be used for ET-based irrigation scheduling





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Objectives

- Determine water requirement of drip irrigated red cabbage and celery for optimizing yield and quality
- Determine if the crop coefficient (ET) model for cabbage and celery is accurate

Experimental Approach

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

Procedures

- Location: USDA-ARS farm Salinas CA
- Soil: Chualar sandy loam
- Randomized Complete Block Design:
  - -5 drip irrig. Tmts.: (50,75,100,125,150% ET)
  - -6 replications
  - -Plots measured 135 ft x 5 beds (40-inch wide)
- Transplants established with sprinklers (~3.5 inches)
- Irrigation requirement based on 90% distribution uniformity
- Drip irrigated 2 to 3 times per week

Procedures continued

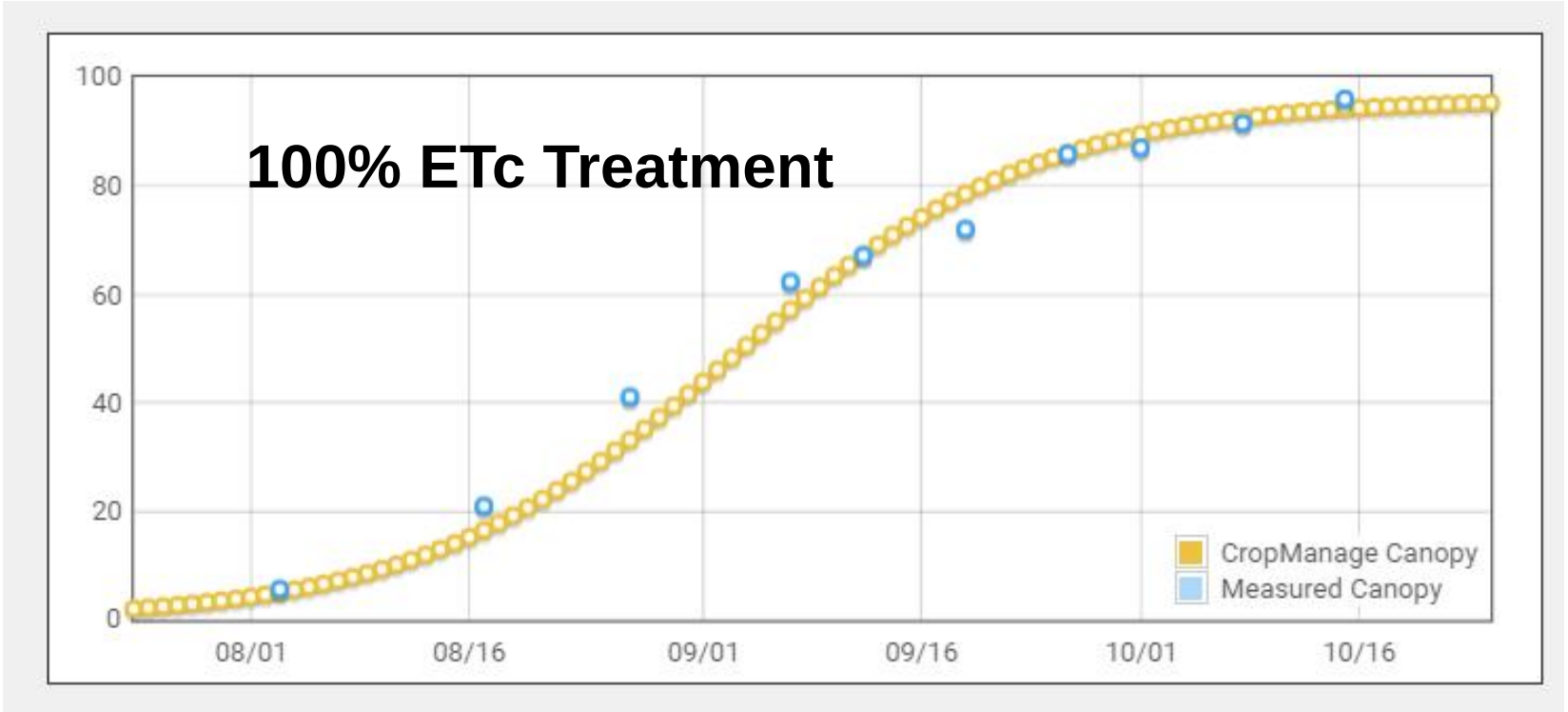
- Uniform fertilizer application: preplant 300 lbs/acre 6-20-20, by drip 320 to 339 lbs N/acre
- Above ground biomass evaluated at maturity to determine fresh and dry matter yield, N uptake
- Sub plots commercially harvested (celery =10 ft x 25 ft, cabbage = 10ft x 30 ft)

Manifold for Applying Irrigation Treatments

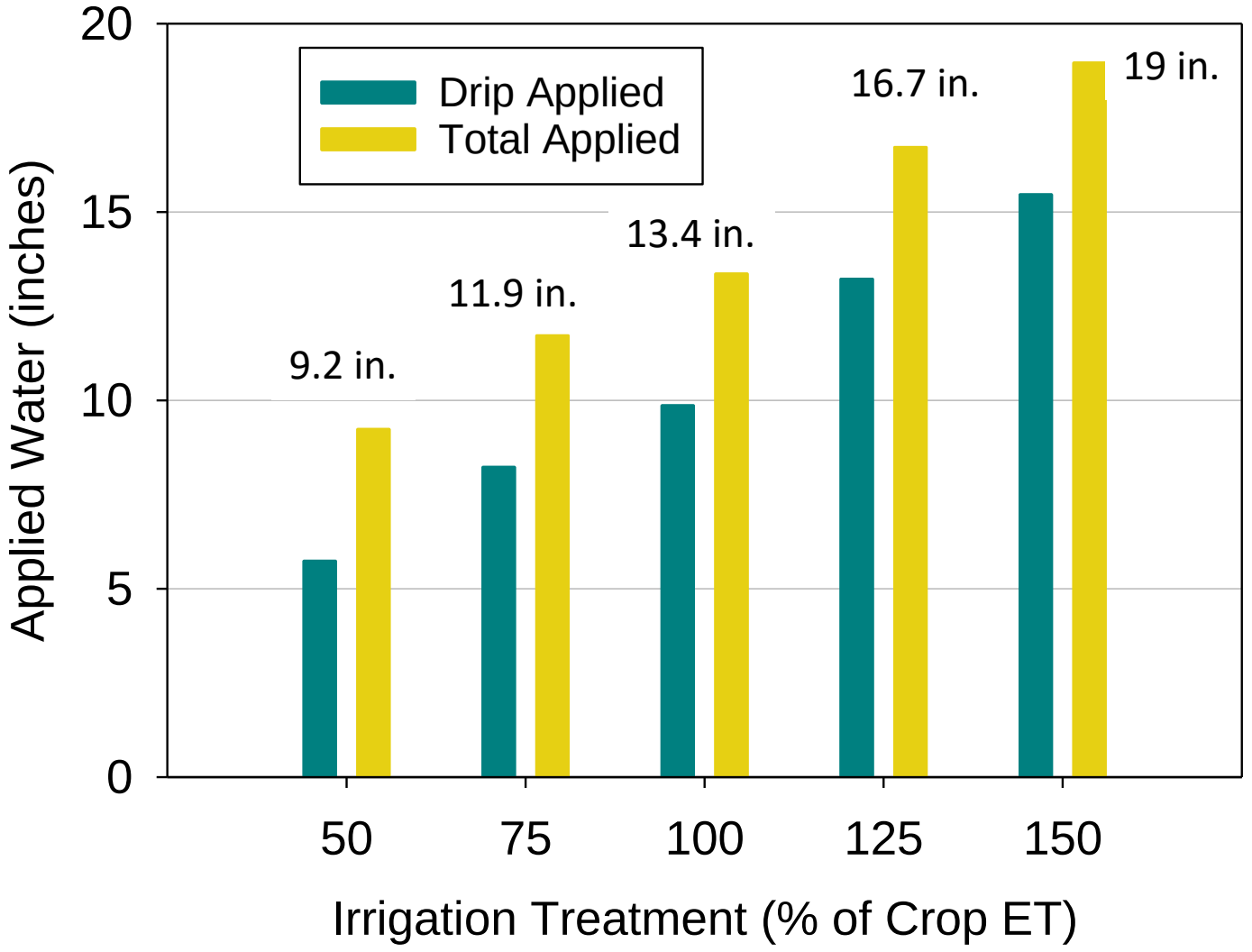
Digital Infra-red camera was used to monitor canopy development

Celery Trial near Maturity

Canopy model for celery closely matched measured values

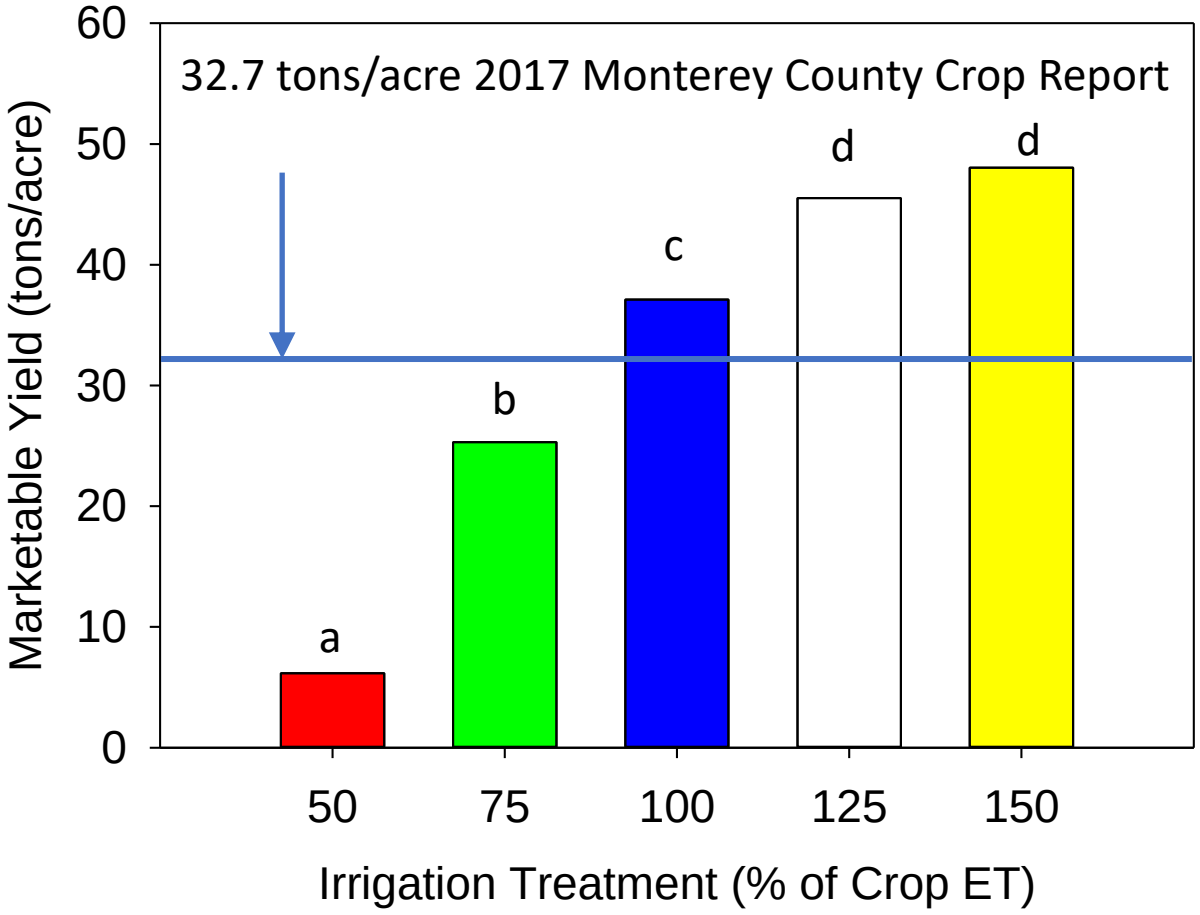


Celery Applied Water for Irrigation Treatments (July 24 – October 24)

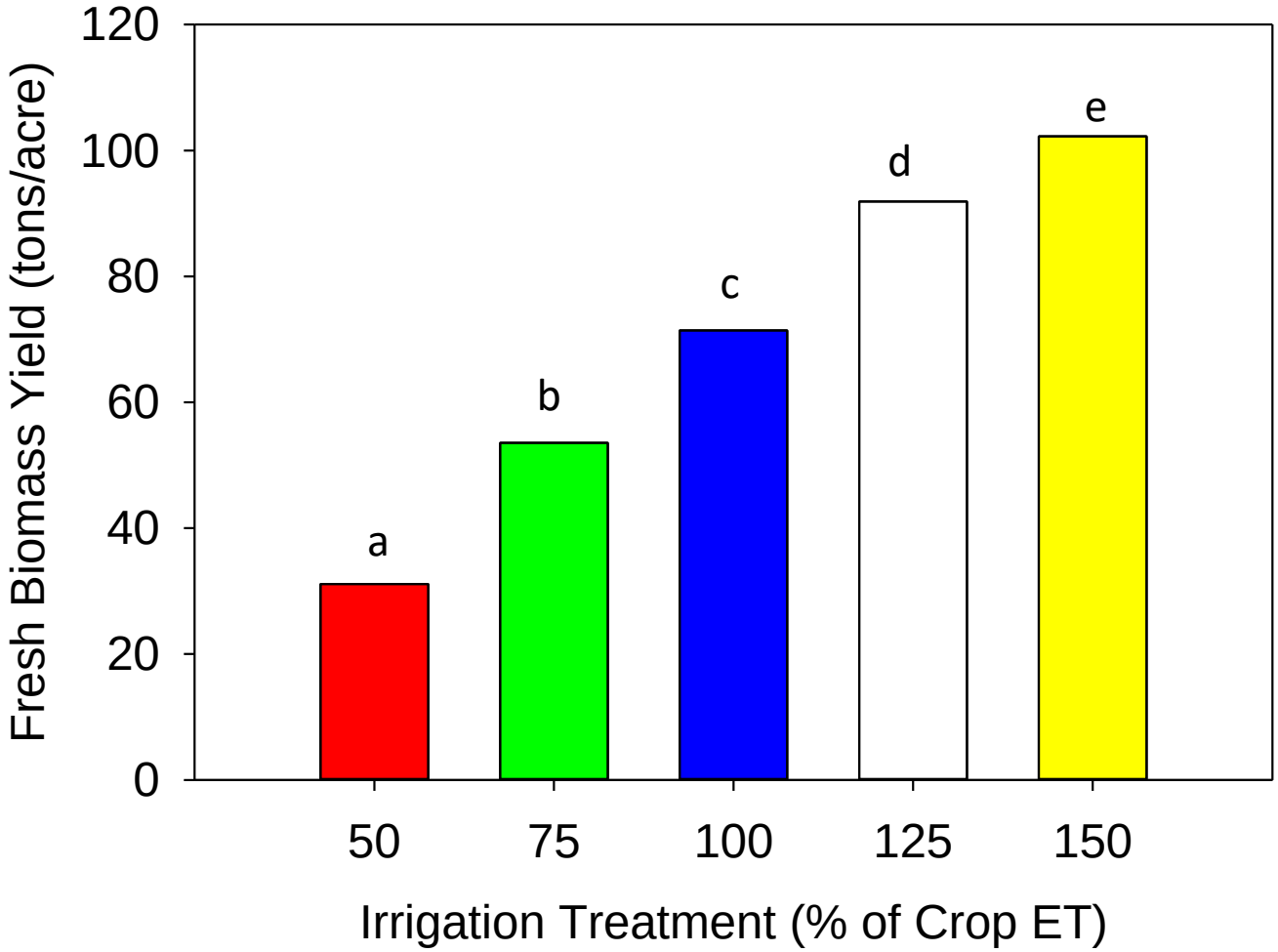


Marketable yield evaluated 85 and 93 DAP

Marketable Yield (93 DAP)

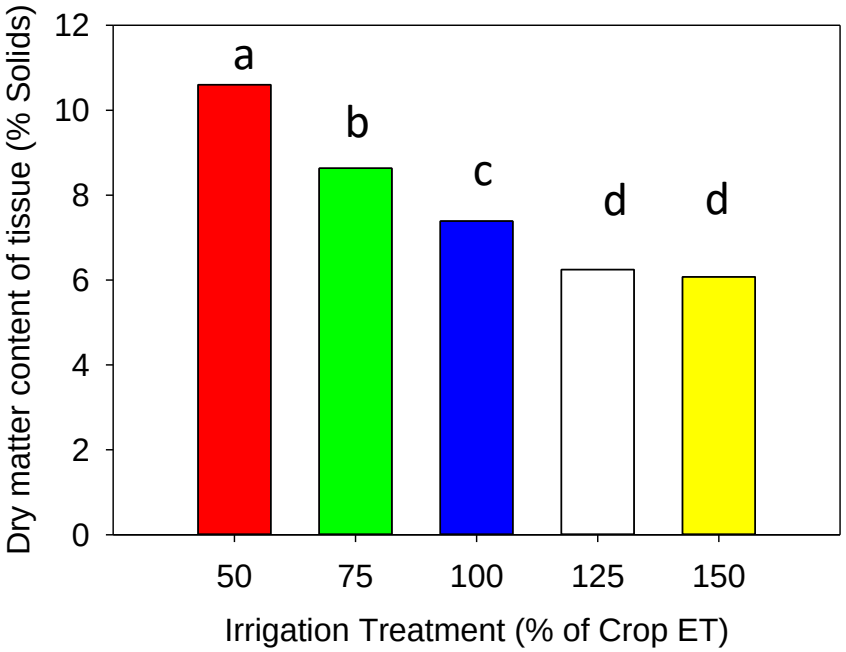


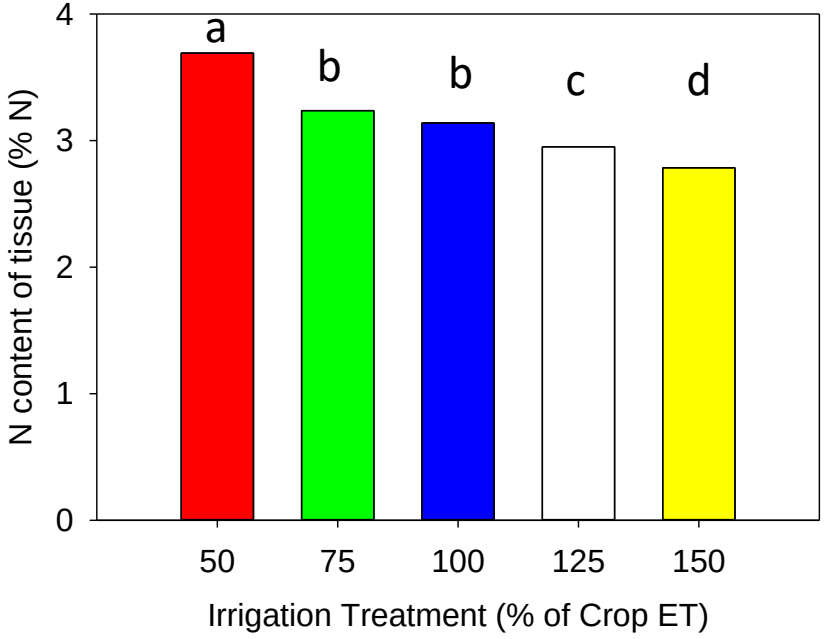
Above ground fresh biomass increased with higher ET water treatments*



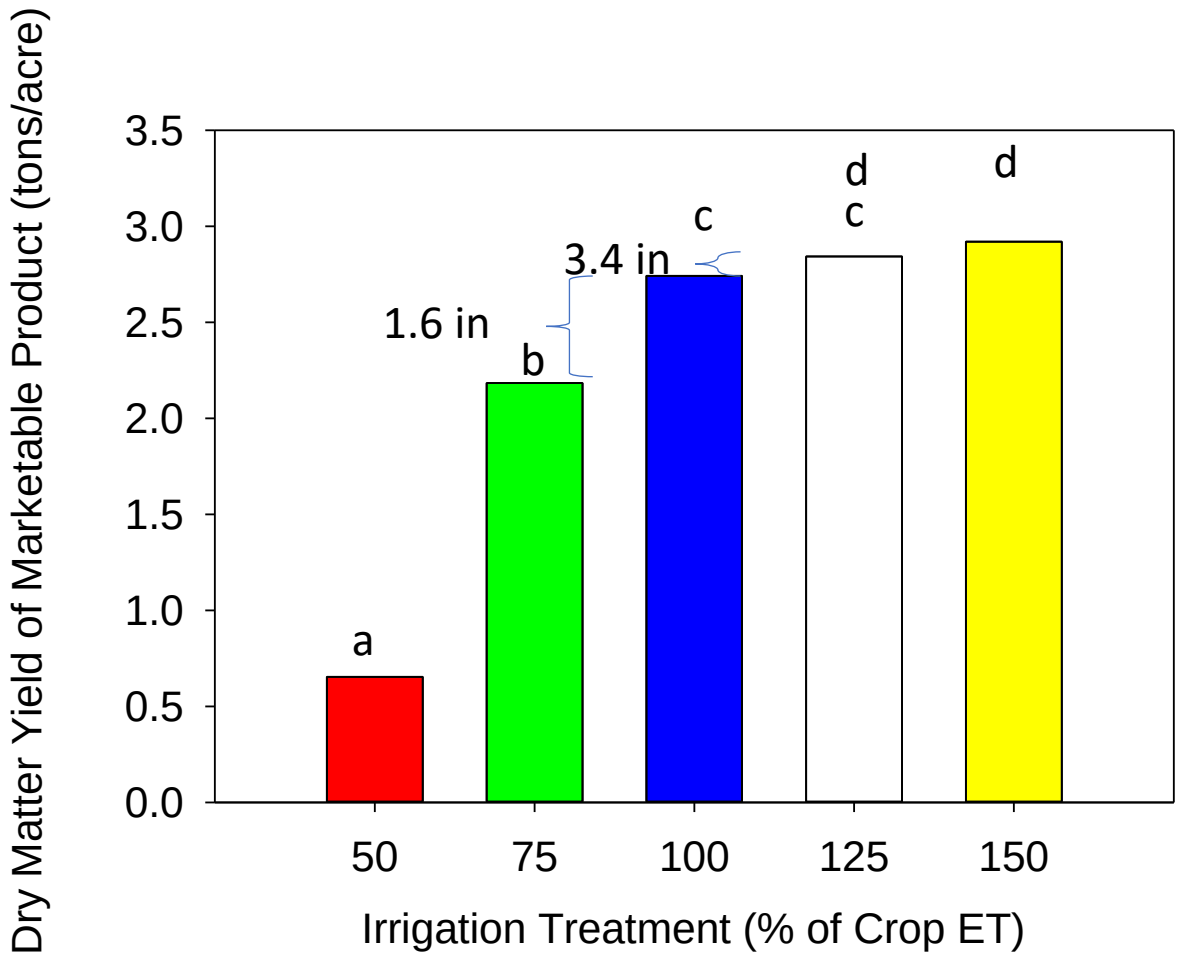
*1 ton/acre = 2.24 metric tons/hectare

Dry matter and N content of tissue decreased with higher water treatments



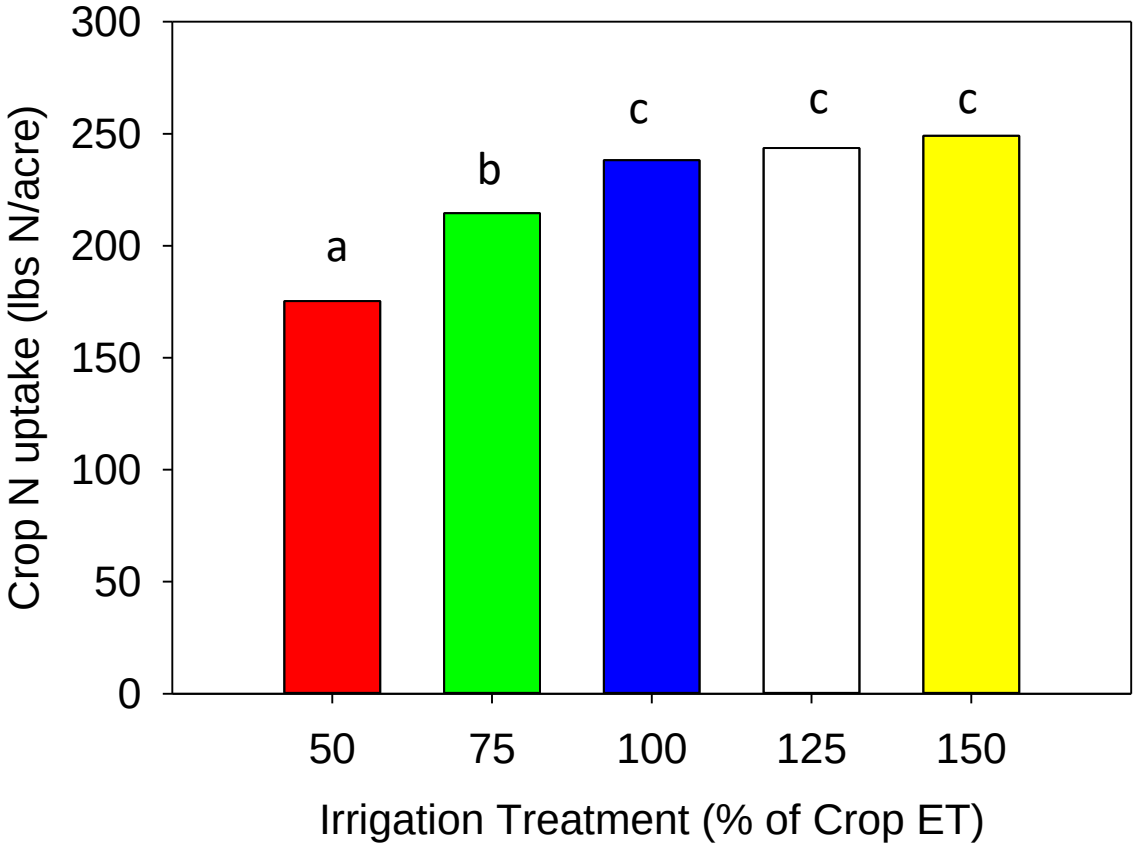


Dry Matter Yield



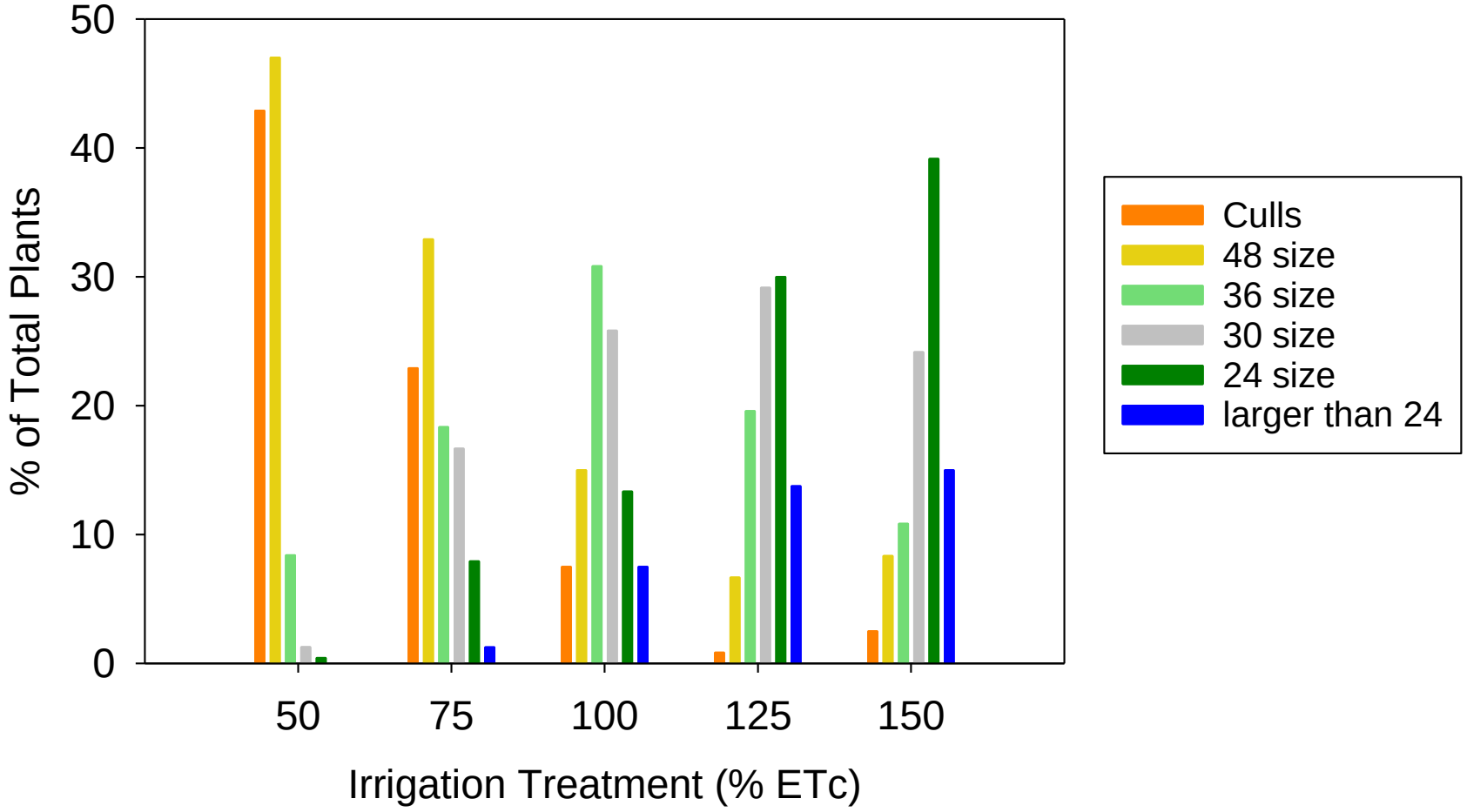
*1 ton/acre = 2.24 metric tons/hectare

Crop N uptake of above ground biomass was similar for 100 – 150% ET treatments

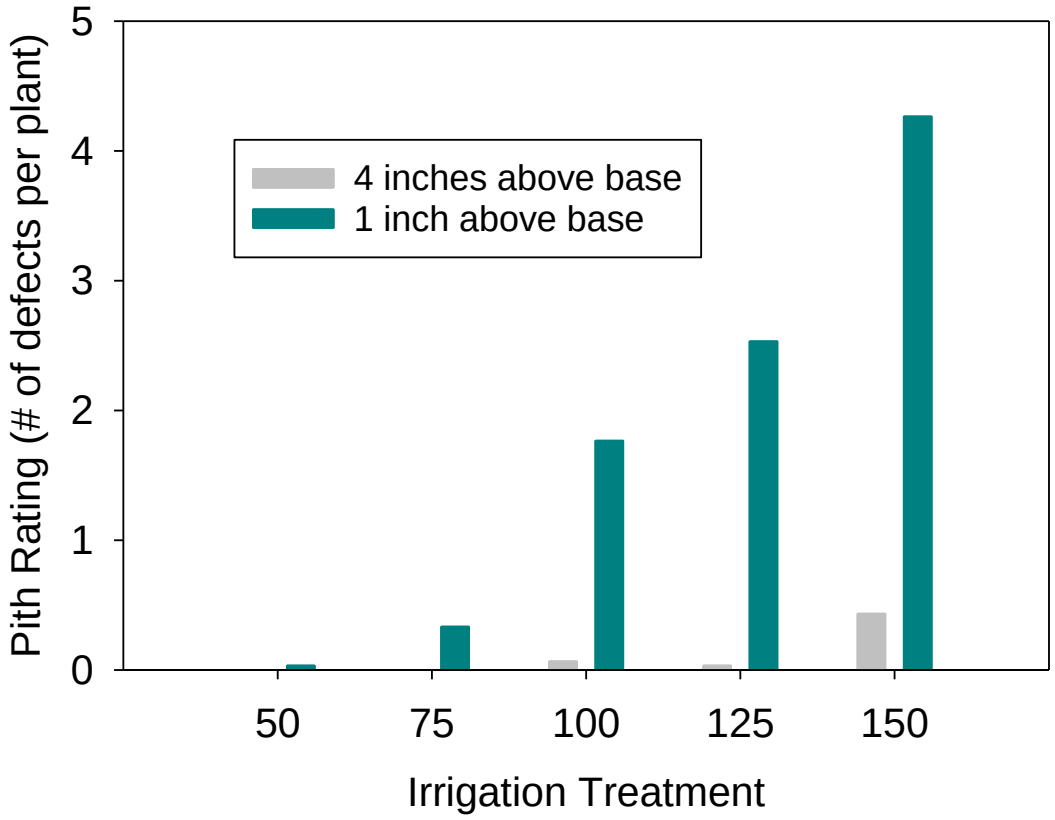


*1 lb/acre = 1.12 kg/hectare

Plant size increased with higher water rates



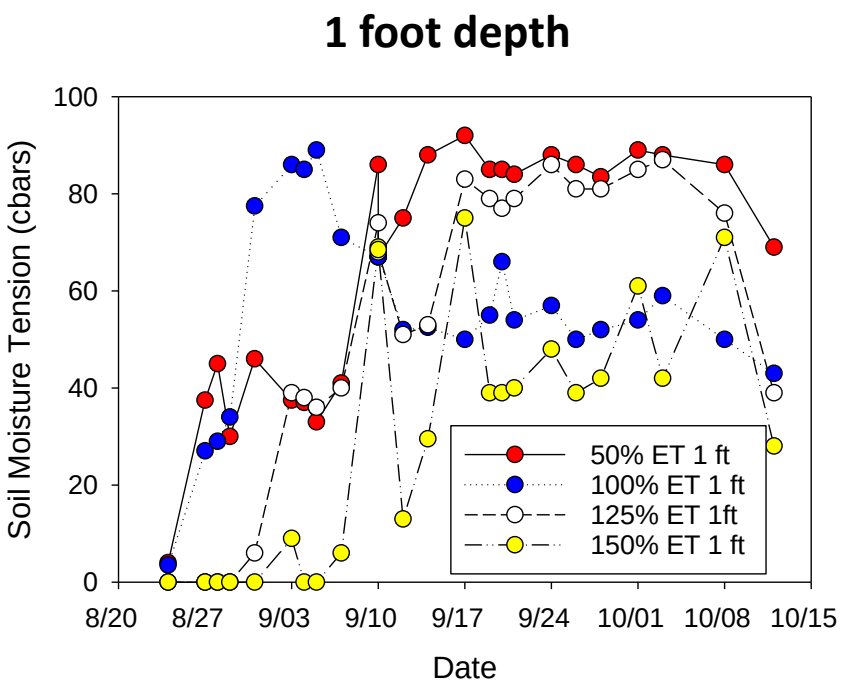
Pith break-down increased in higher water treatments (93 DAP)

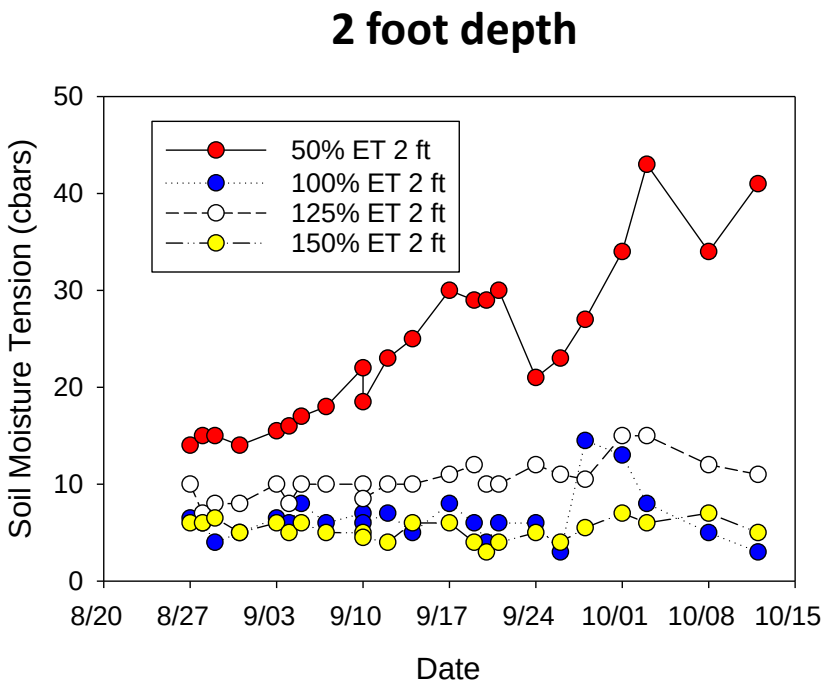


Soil moisture monitored with tensiometers

Difficult to keep 1 foot depth moist

Drier



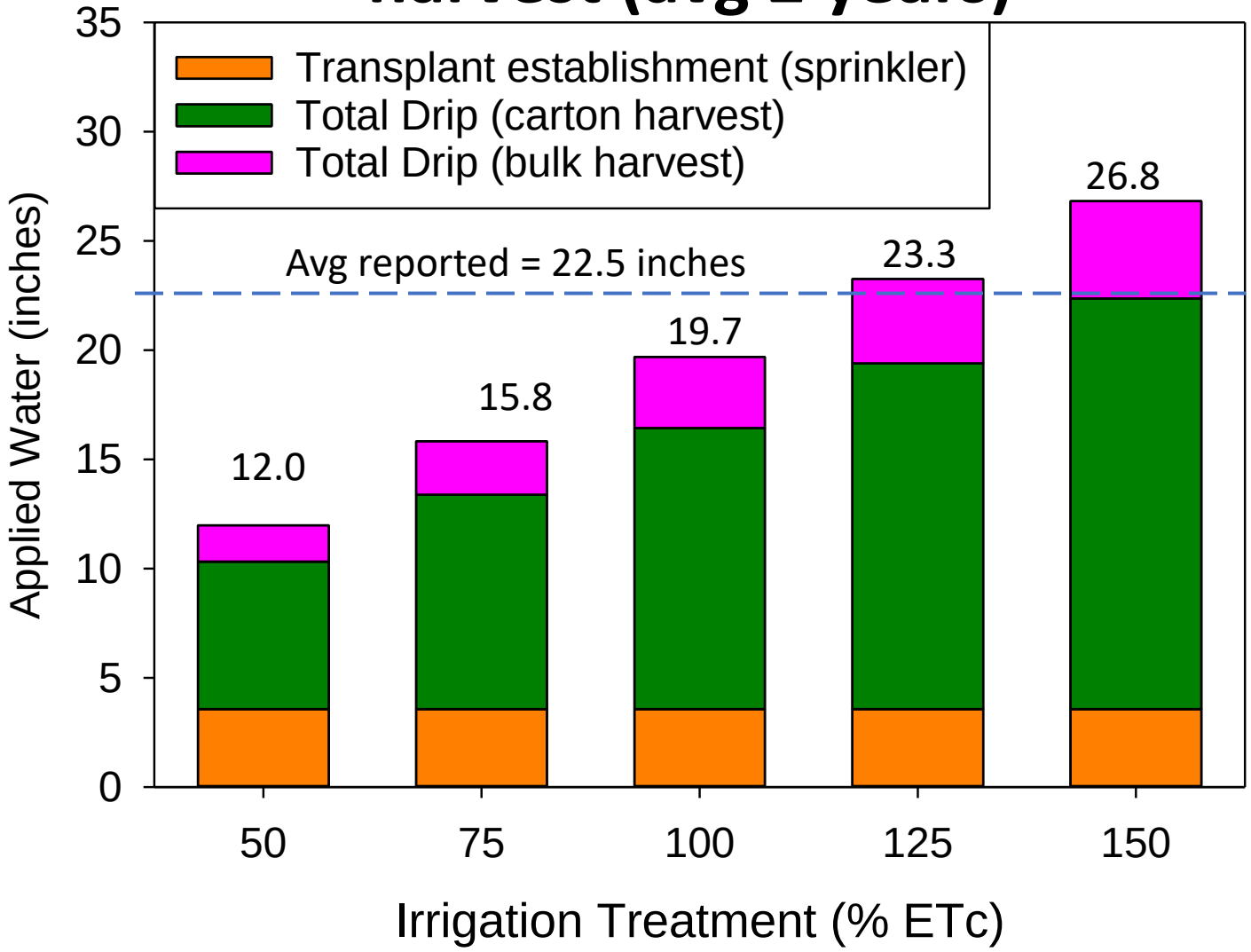


Celery Recommendations and Findings

- **Yield and quality of celery can be optimized with drip irrigation**
- **16 to 17 inches of applied water maximized yield and quality (125% ETc)—consequently CropManage was adjusted to base recommendations on 125% ETc**
- **Higher than county average yield was achieved with 13.5 inches (100% ETc)**
- **Need to irrigate frequently to avoid moisture stress in (especially in sandy textured soils)**
- **Tensiometers can be useful to assure that celery is irrigated often enough to prevent water stress.**


Cabbage Trial Results

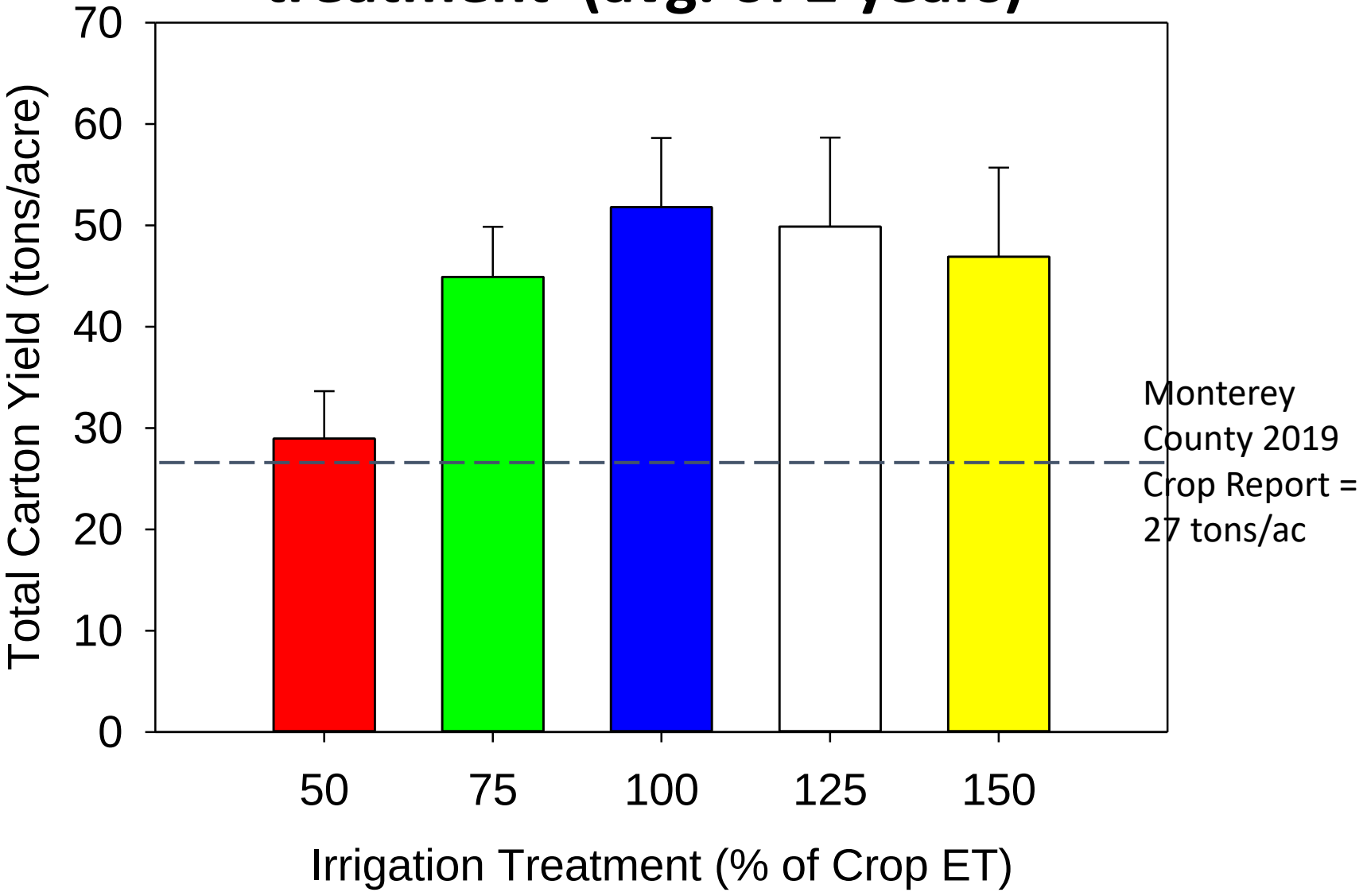
Total water applied to 100% ET treatment was 16 inches to carton harvest and 20 inches to bulk harvest (avg 2 years)



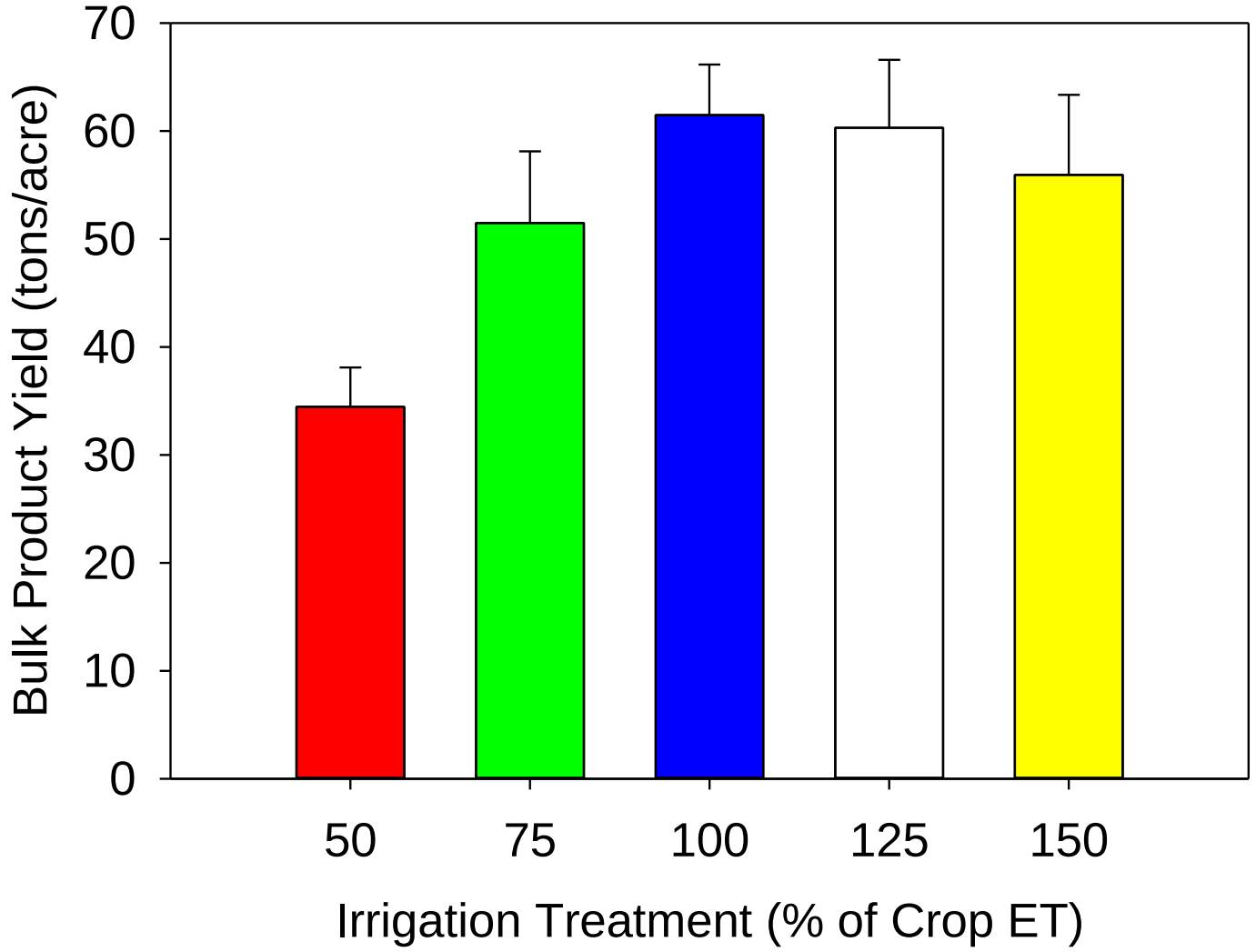
100% ET (Blue) 150% ET (Yellow)

50% ET treatment susceptible to wilting in the afternoon

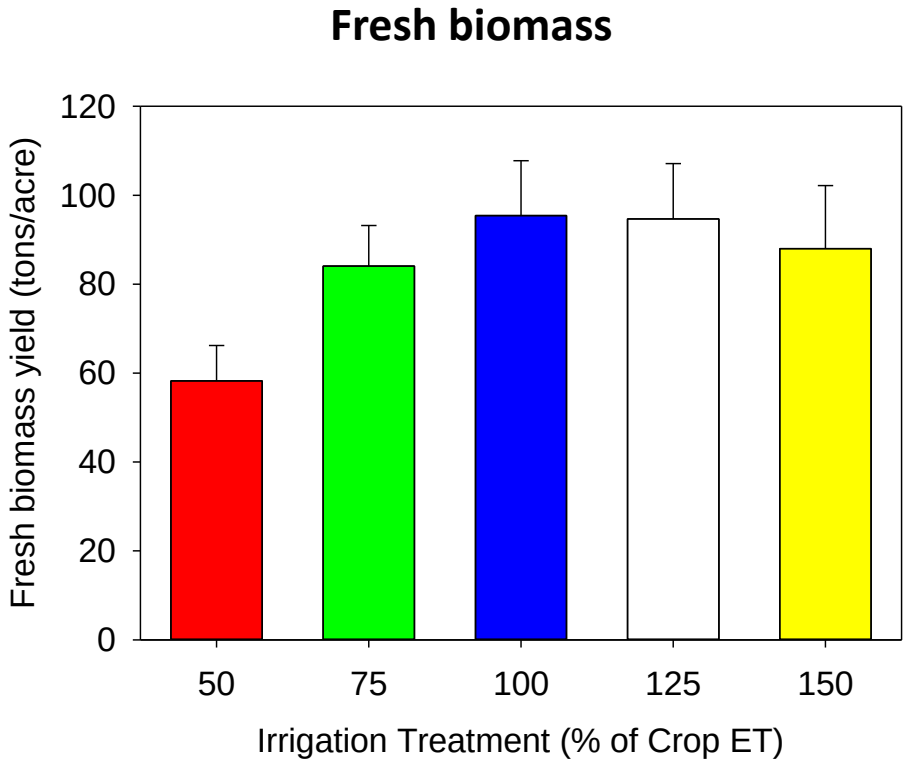
Carton yield was maximized with the 100% ET treatment (avg. of 2 years)

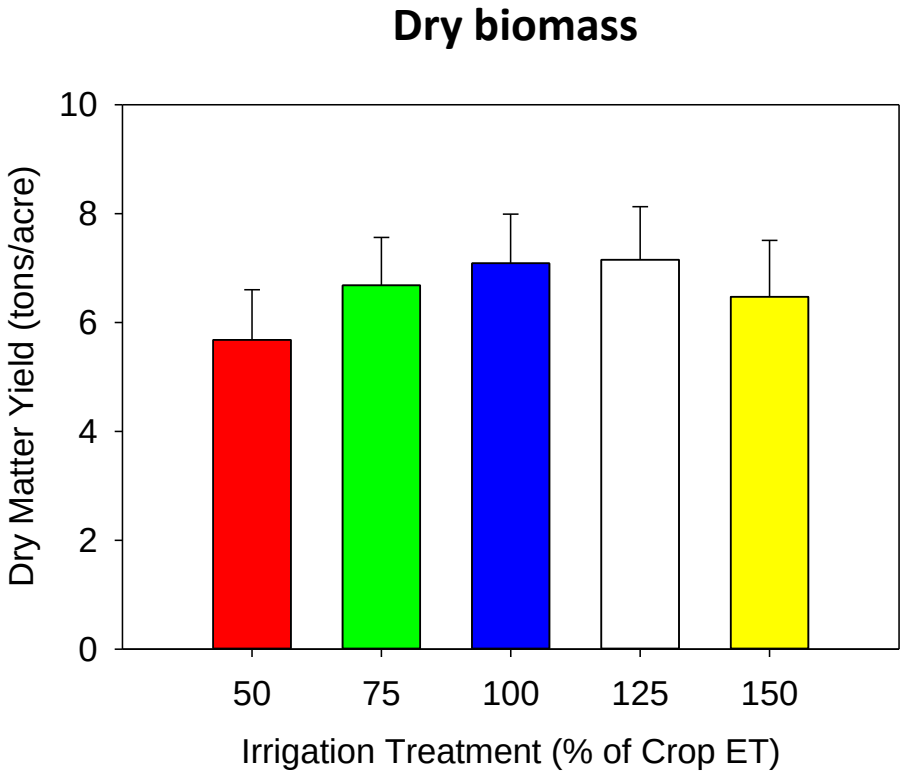


Bulk yield was maximized with the 100% ET treatment (avg. of 2 years)

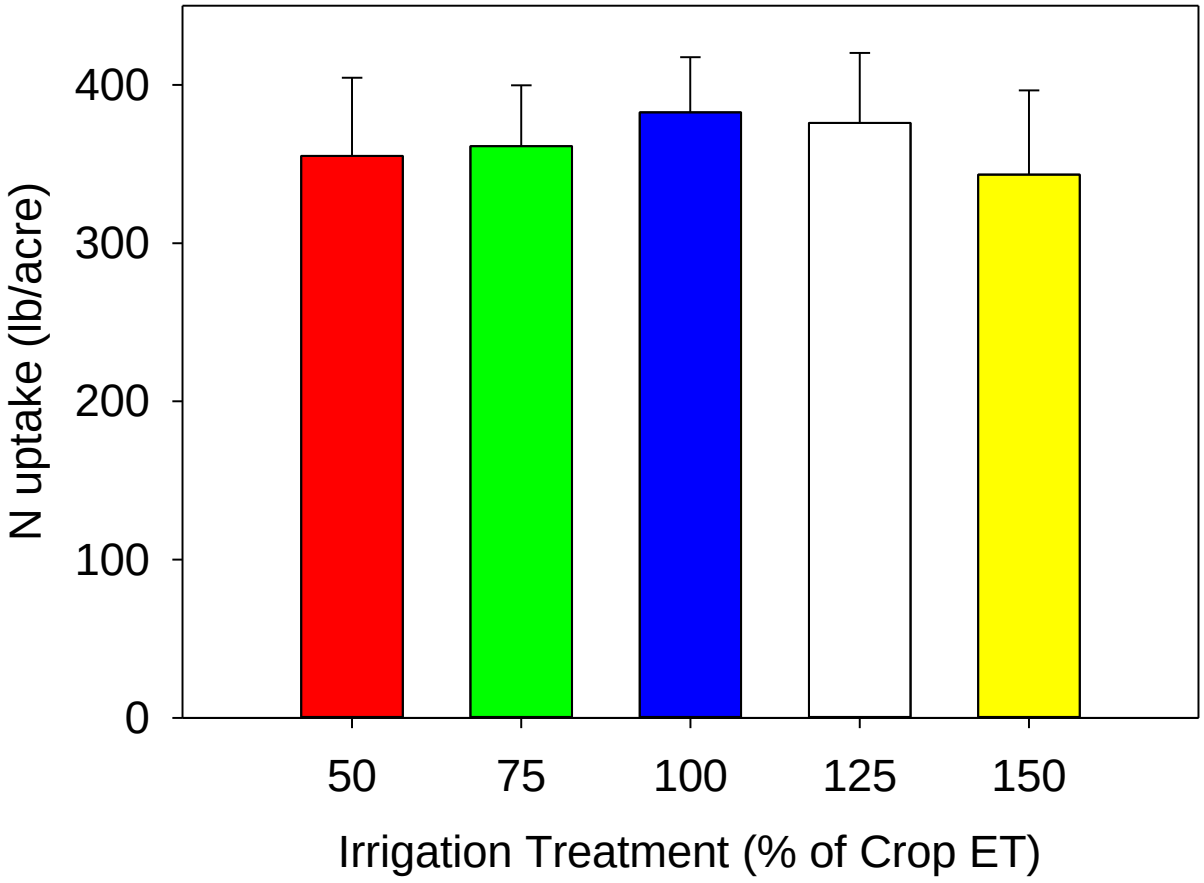


Fresh and dry above ground biomass yield was maximized under the 100% ET treatment (avg. of 2 years)





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



Summary of Rec. and Findings (red cabbage)

- **Yield and quality of cabbage can be optimized with drip irrigation**
- **CropManage ET recommendations optimized irrigation scheduling of red cabbage**
- **18 inches of applied water maximized yield and quality of carton harvest and 20 inches for bulk harvest (100% ETc)**
- **Higher yield than county average yield was achieved with 18-inches (100% ETc)**
- **Need to irrigate frequently to avoid moisture stress in sandy textured soils (2 to 3 times per week)**

Overall Summary

- **Weather-based irrigation scheduling provides good guidance on how much water to apply to cabbage and celery to optimize yield and maximize N use efficiency**
- **Tensiometers are the best way to monitor soil moisture in these crops and provide guidance on how often to irrigate**
- **CropManage is a free and easy-to-use tool for obtaining weather-based irrigation recommendations for vegetable production**

Acknowledgements

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Questions?