Grape Water Management to Achieve Production and Quality Goals

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UC CE University of California Agriculture and Natural Resources Cooperative Extension

How to Make Irrigation Decisions?

- Dr. Larry Williams, UC Davis

- *When should one initiate irrigations at the beginning of the season?*
- *How much water should one apply?*
- How does the design of your irrigation system affect the ability to irrigate your vineyards?
- Are there deficit irrigation practices to minimize production loss and maximize fruit quality?

Measure First!

- Flow meter
- Pressure sensor

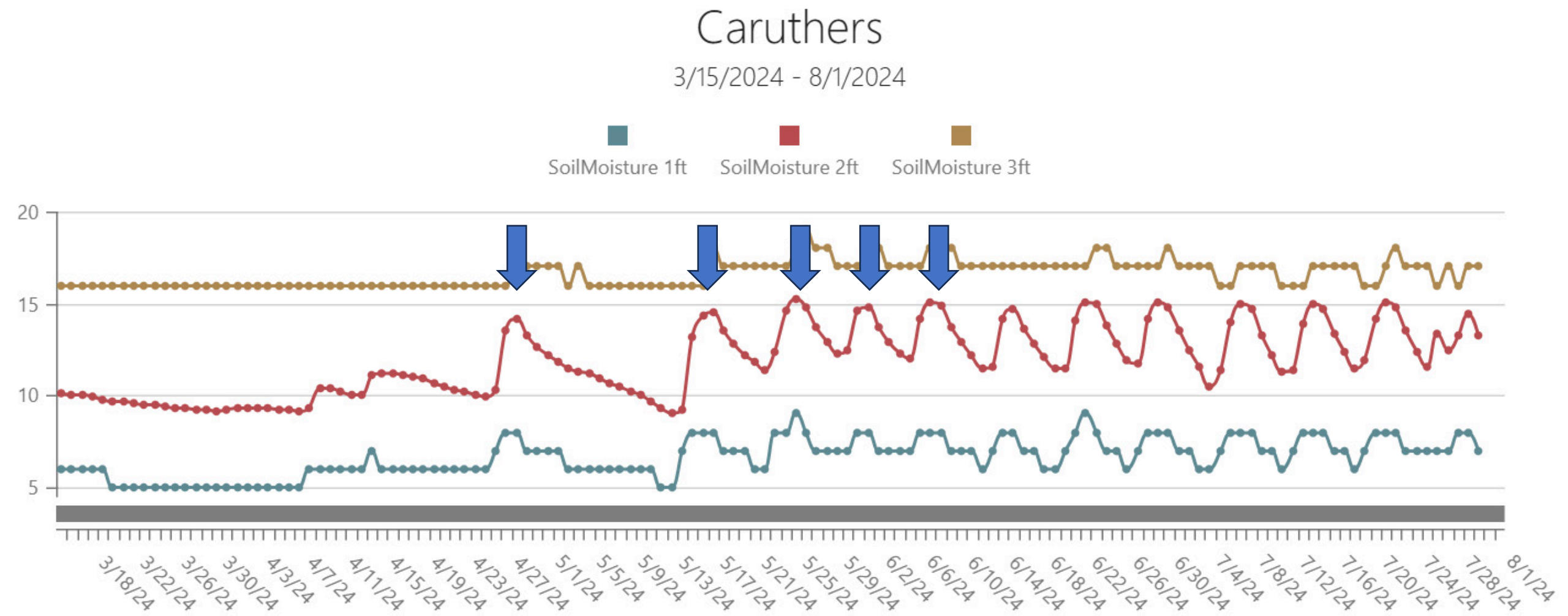
Grapevine Irrigation Management Tools

- When to start irrigation:
  - ✓ Soil based: tensiometer, capacitance sensor
  - ✓ Plant based: visual, pressure bomb, plant sensor
- How much to irrigate:
  - ✓ Soil based: soil water balance
  - ✓ Weather or ET based: CIMIS
  - ✓ Remote sensing based: IrriSat and OpenET
- Decision support APP: CropManage

When to Start?

Soil Based Tool

Soil Based Tool



Plant Based Tool

Increasing Water Stress

1

•Active shoot growth
•Tendrils reach past growing tip
•Basal tendrils turgid
•LWP > -8 bars

2

•Slowing shoot growth
•Tendrils even with growing tip
•Basal tendrils turgid
•LWP -9 to -11 bars

3

•Ceased shoot growth
•Leaves extend past growing tip
•Basal tendrils turgid to slightly droopy
•LWP -12 to -13 bars

4

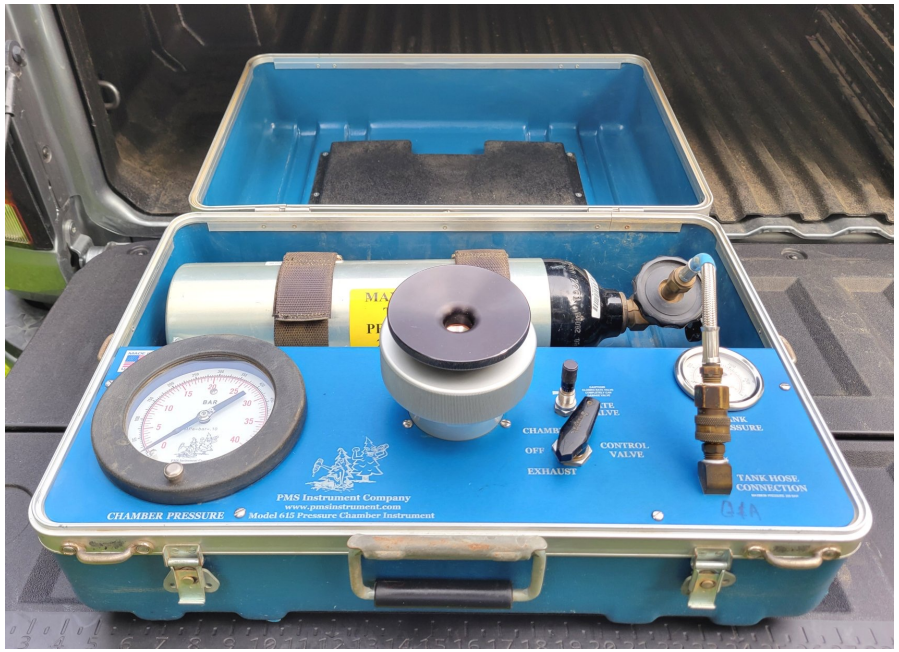
•Dead or missing shoot tip
•Basal tendrils droopy or falling off
•Leaf-petiole angle becomes smaller
•LWP -14 to -15 bars

Greater levels of water stress

•Basal leaves turn yellow, dry up and fall off
•Leaf-petiole angle becomes smaller
•Fruit may shrivel
•Leaf water potential < -15 bars

LWP: Midday Leaf Water Potential

Grapevine Water Potential



How to Use Midday Leaf Water Potential?

- Pressure Chamber: (14) Measuring Leaf & Stem Water Potential in Wine Grapes – YouTube
- More about pressure chamber: (14) Scheduling Irrigation with a Pressure Chamber Part 1 - YouTube

Vine Water Stress	Midday LWP (Bar)
No stress	< 10
Mild stress	10 - 12
Medium stress	12 - 14
Severe stress	14 - 16

How Much to Irrigate Weekly?

Weather and ET Based Tool

- Evapotranspiration (ET): ETc = ETo × Kc × Stress Factor
- CIMIS station: provide grass based ETo
- Crop ET Report: Weekly ET Reports | UC Agriculture and Natural Resources

Use Canopy Shade to Calculate Kc

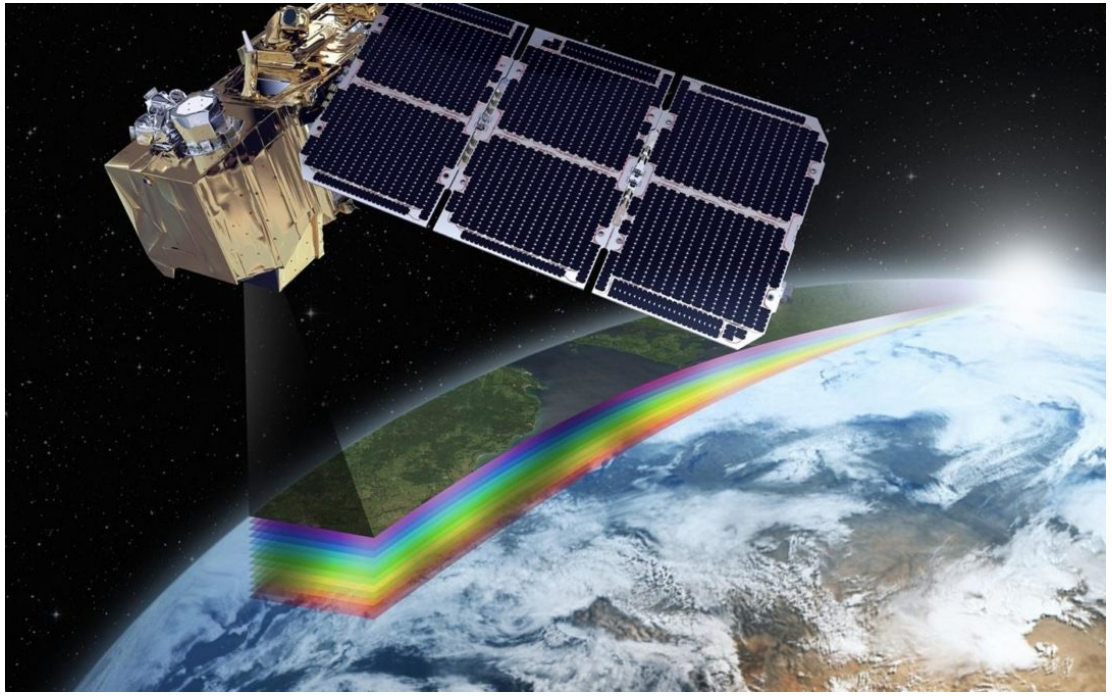
- Paso Panel: Crop Coefficients - Paso Panel - County of San Luis Obispo (ucanr.edu)

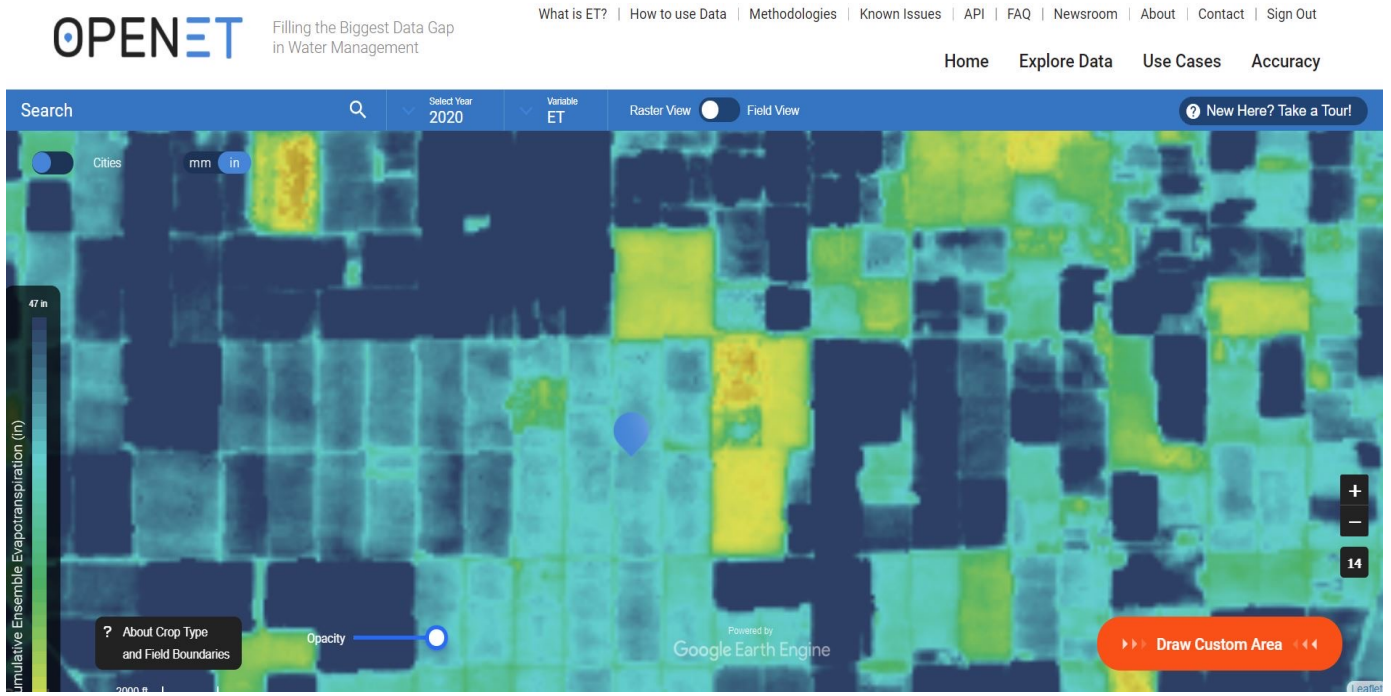
$$Kc=(0.017 \times \text{Shaded percentage of field} \times 100)$$

Remote Sensing Based Tool

- IrriSAT
- OpenET

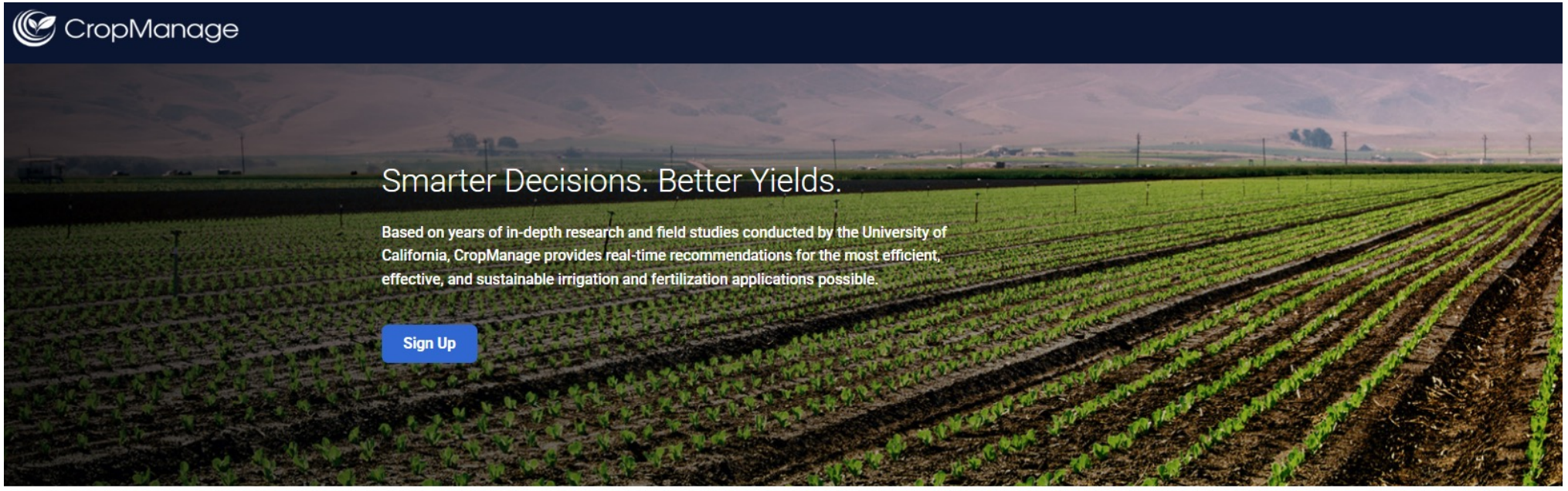
} Provide Kc and ETc





Decision Support Tool

- CropManage: Online decision support APP



Benefits to Growers

Based on a few simple inputs, CropManage can provide any level of irrigation and fertilization decision support in order to validate or improve your existing operation' production—and increase your overall confidence.

20% to 40% Reduction in Water and Fertilizer With Same Yields

CropManage is ground-truthed in more than 30 field trials and has produced consistent, or in many cases, improved crop yields.

Supports Irrigation AND Fertilization Recommendations

CropManage combines irrigation and fertilization recommendations that, when used together, significantly improve yields while reducing costs.

UC ANR CropManage

- CropManage: Decision support APP which tells you ETc and guides you how to irrigate:
  - ✓ Location specific with google map platform
  - ✓ How much to irrigate weekly: ETc = ETo × Kc × Stress Factor
  - ✓ Add stress factor to apply deficit irrigation
  - ✓ Can add soil moisture sensors to set up checking points
  - ✓ Future: Add pressure bomb readings
- Might be added to Powdery Mildew Index weather station network

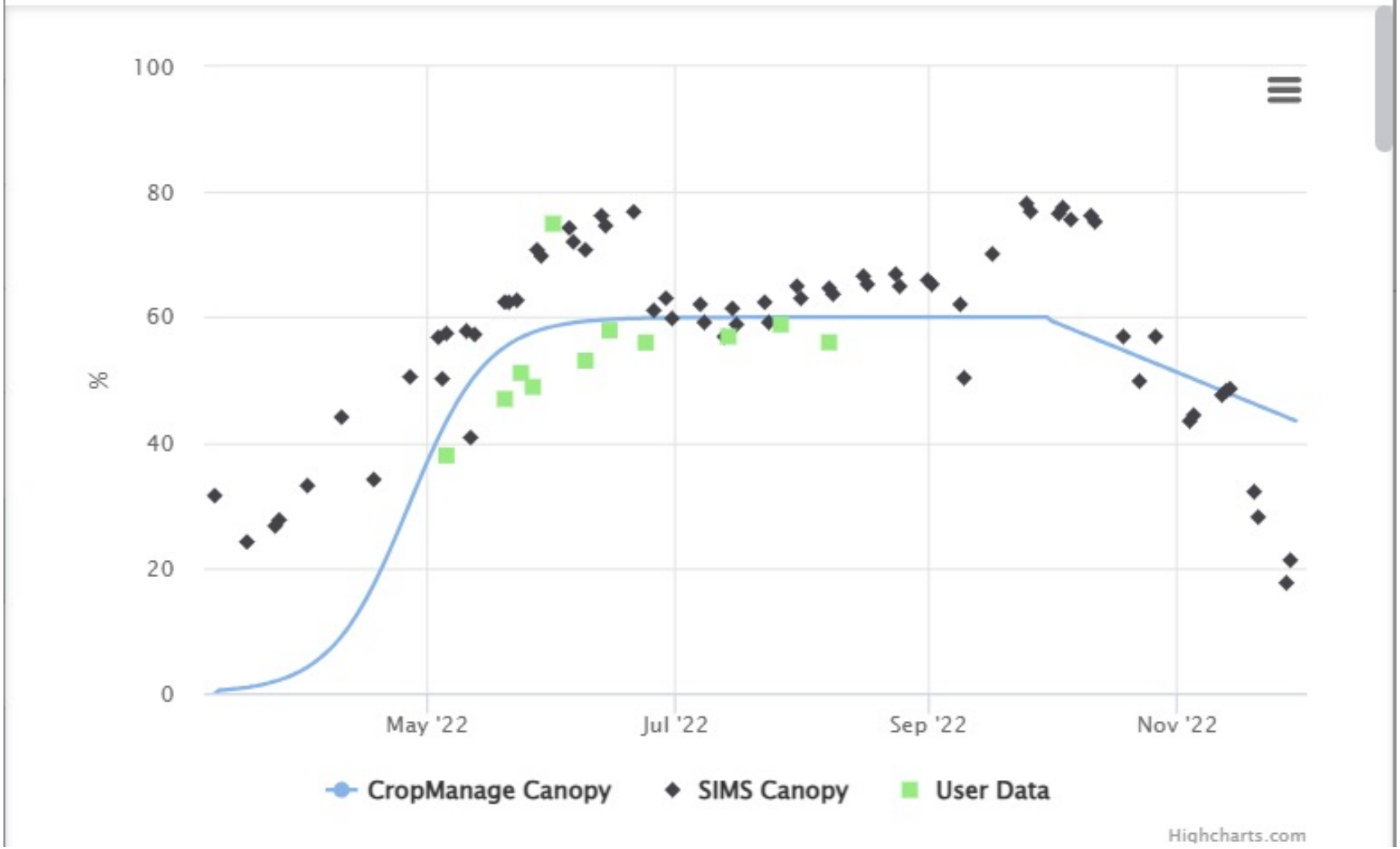
CropManage

- Weather station
  - ✓ Datalogger
  - ✓ Cellular modem
  - ✓ Flow meter
  - ✓ Solar panel
  - ✓ Battery
  - ✓ Soil moisture sensor (optional)
  - ✓ Temperature sensor (optional)

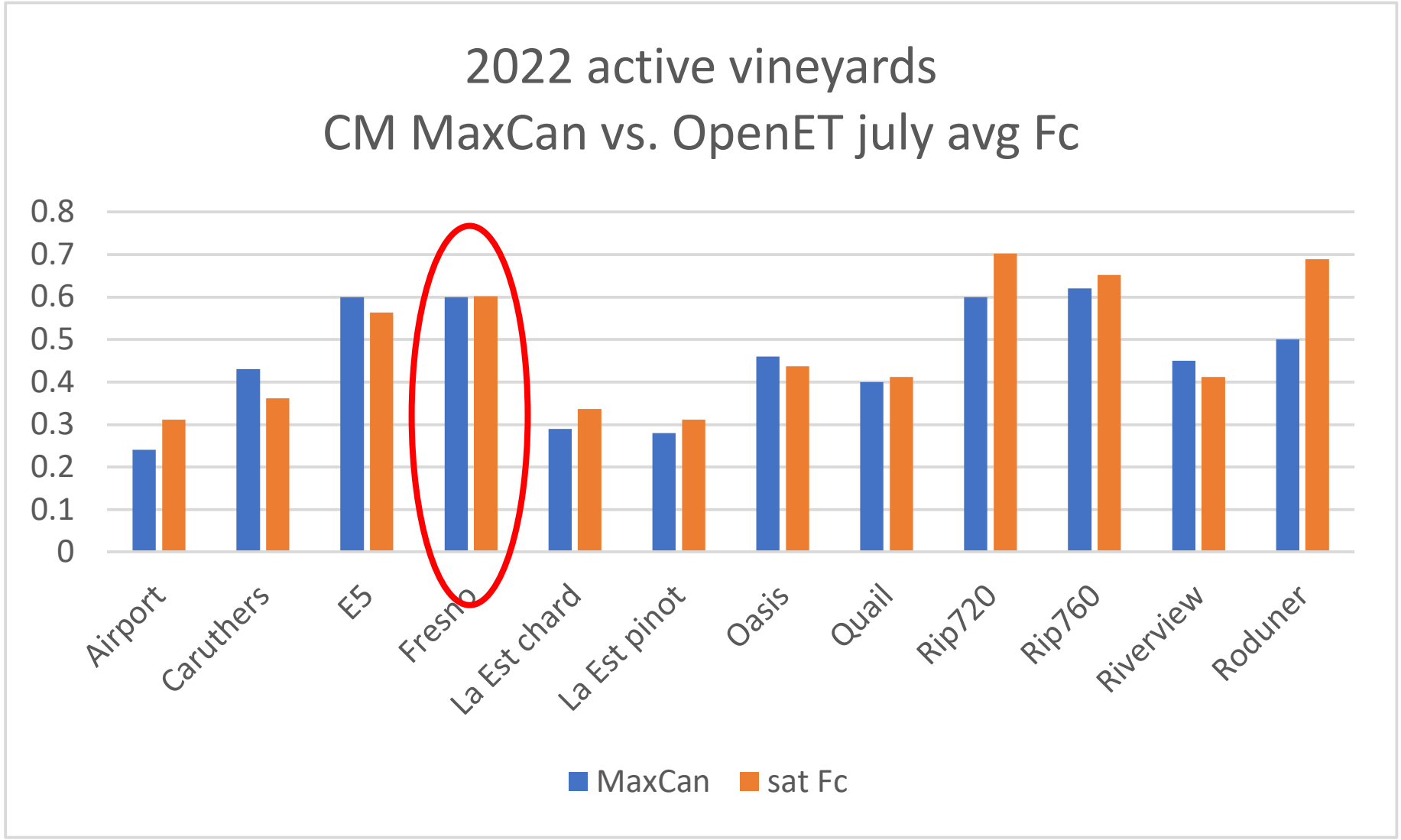
Groundtruth Canopy Cover from CropManage

- Kc is related to canopy cover

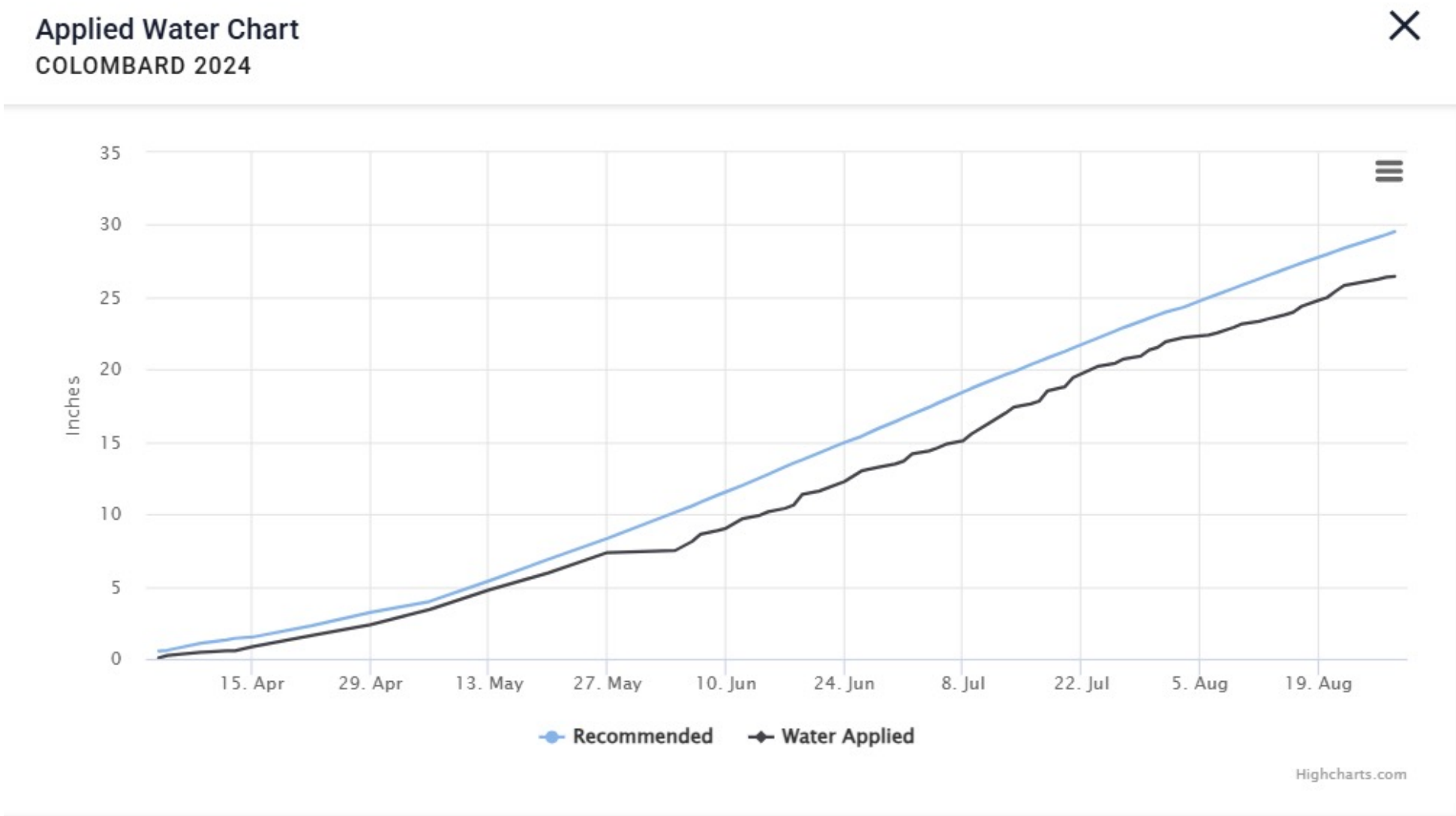
Fresno Block 5 2022 Canopy Curve



Max Canopy Cover



CropManage Recommends vs Grower Practices



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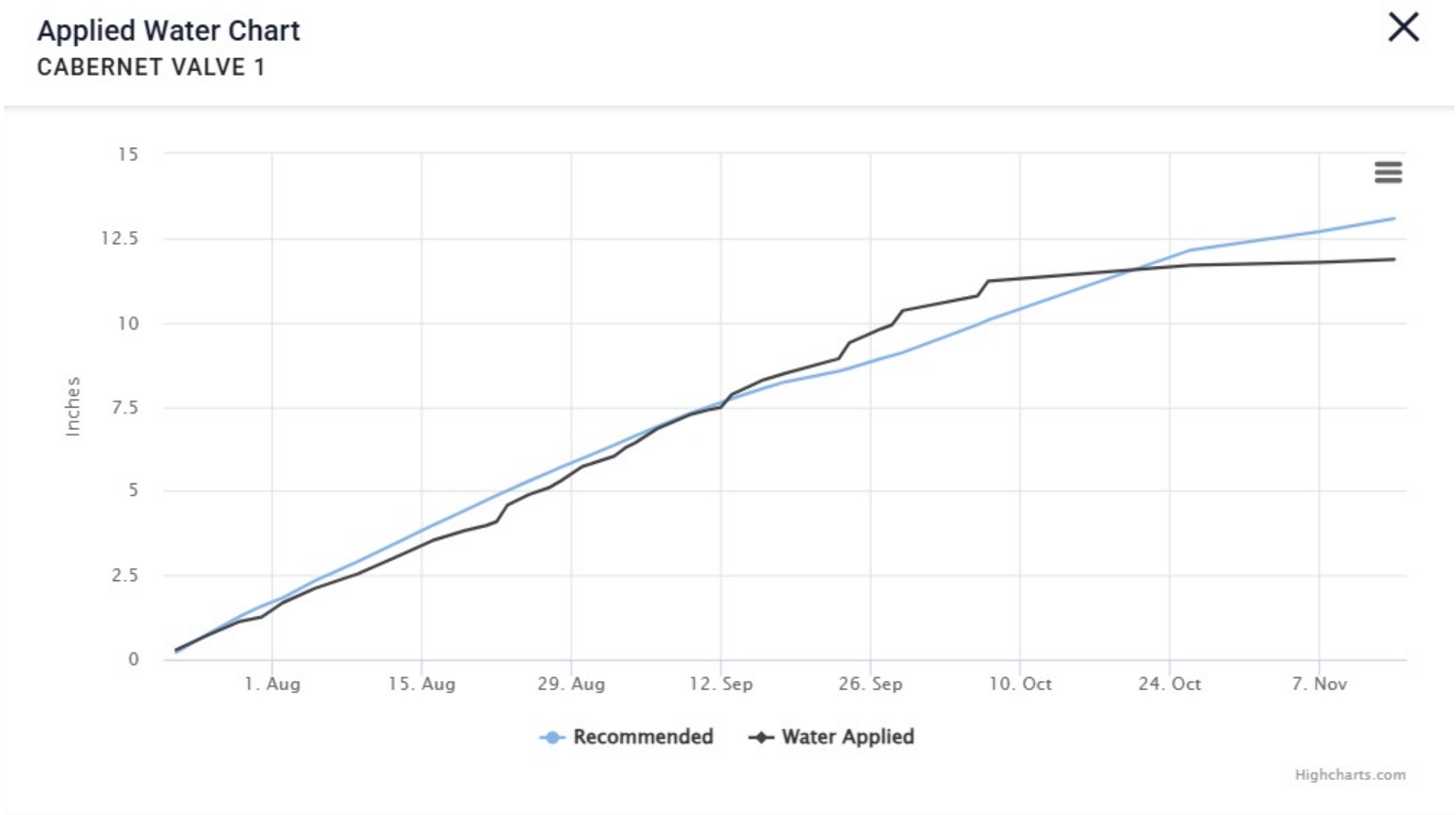
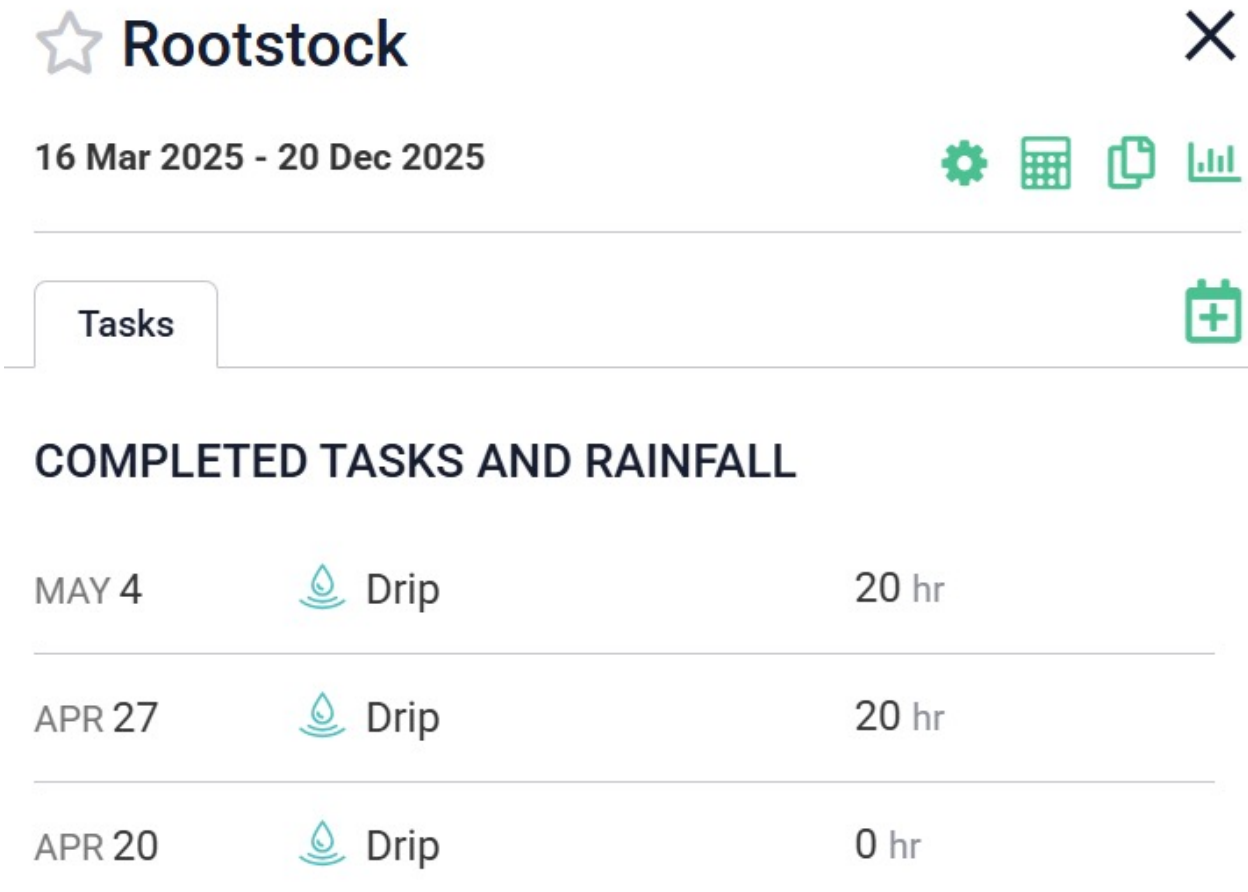
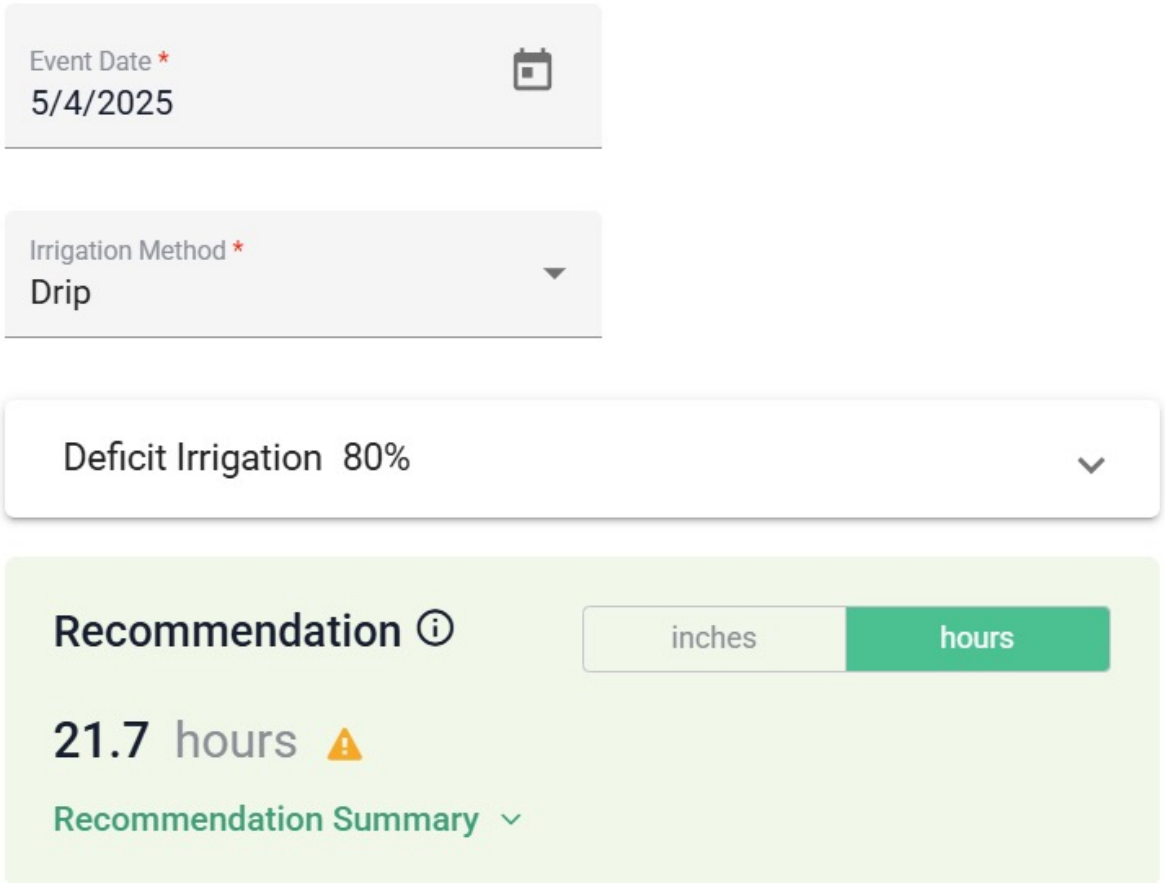


Use CropManage to Schedule Weekly Irrigation





Use CropManage to Apply Deficit Irrigation

- Apply deficit irrigation to manage:
  - ✓ Yield
  - ✓ Disease
  - ✓ Fruit quality
  - ✓ Save water

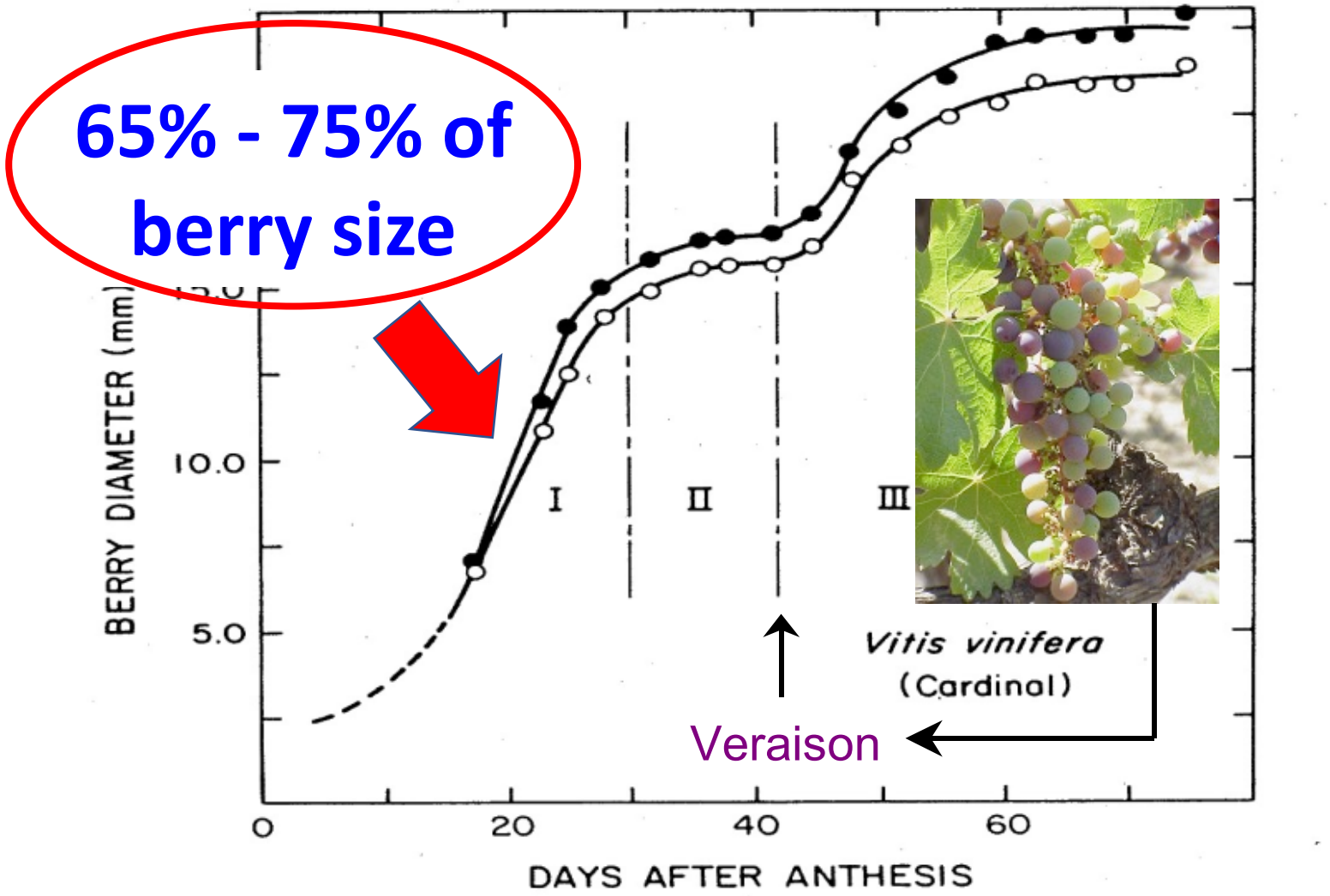
Why Deficit Irrigation?

- It depends on your production goal:
  - ✓ Yield
  - ✓ Quality
  - ✓ Disease management
- Overall, berry size/yield is maximized with applied water at **80%** of ETc (Dr. Larry Williams, UC Davis)

How to Deficit Irrigation?

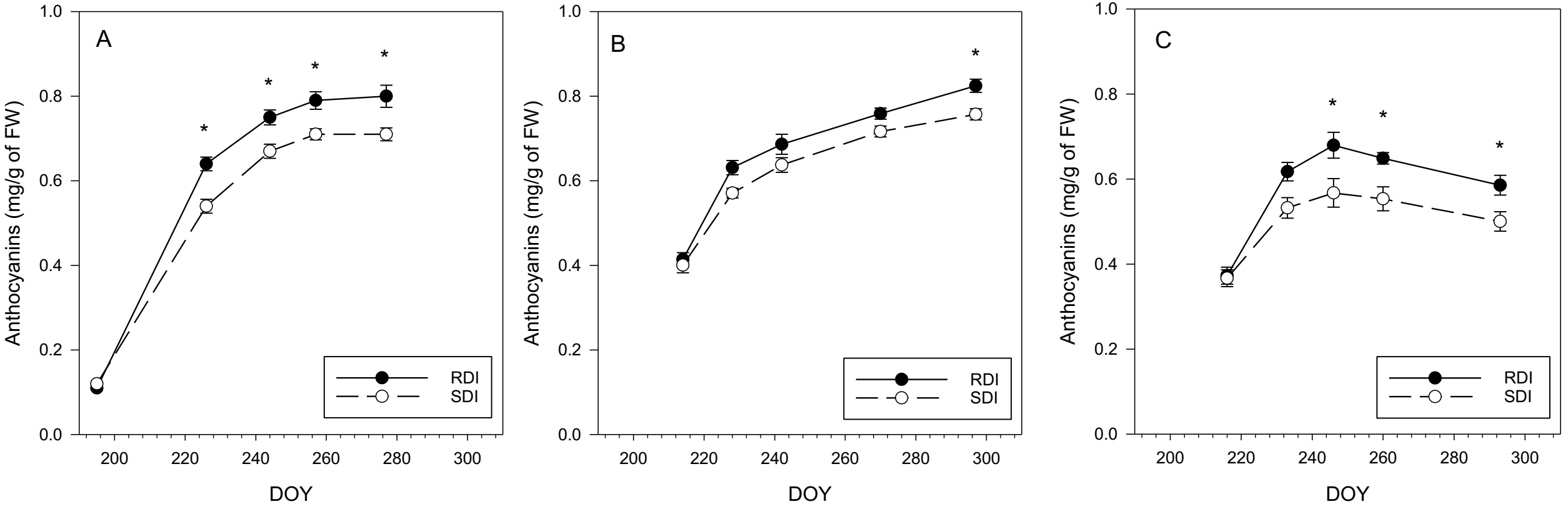
- No water stress before bloom
- Pre-veraison water deficit
  - Significant impact on berry size/yield and canopy growth, and generally beneficial for quality: *smaller berry with higher skin/pulp ratio*
- Post-version water deficit
  - Minimal impact on berry size/yield and canopy, and still beneficial for quality: *plant growth regulator, e.g., ABA?*

Water Deficit on Berry Size



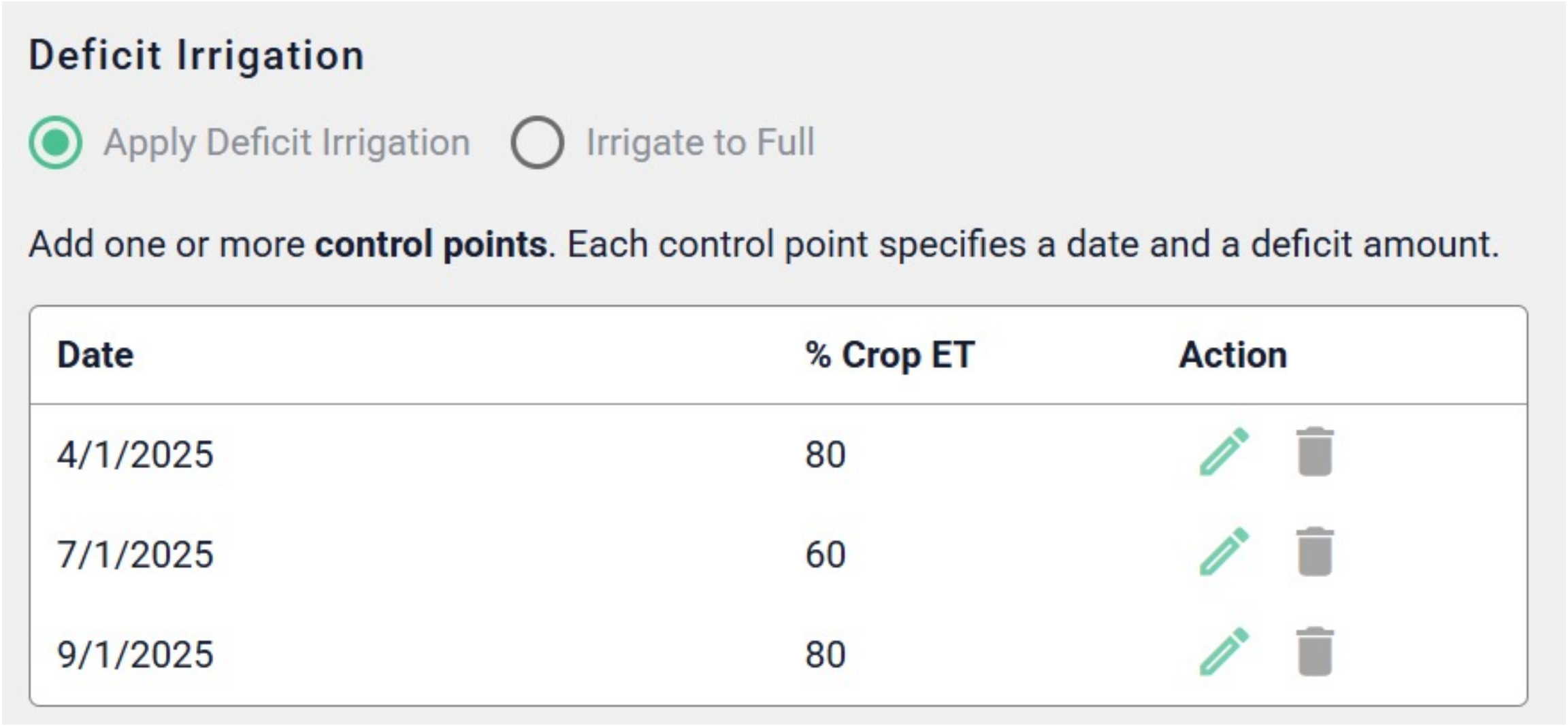
Pre-Veraison Water Deficit Improves Berry Color

- Pre-Veraison water deficit increased the Cabernet Sauvignon anthocyanins in all 3 years.

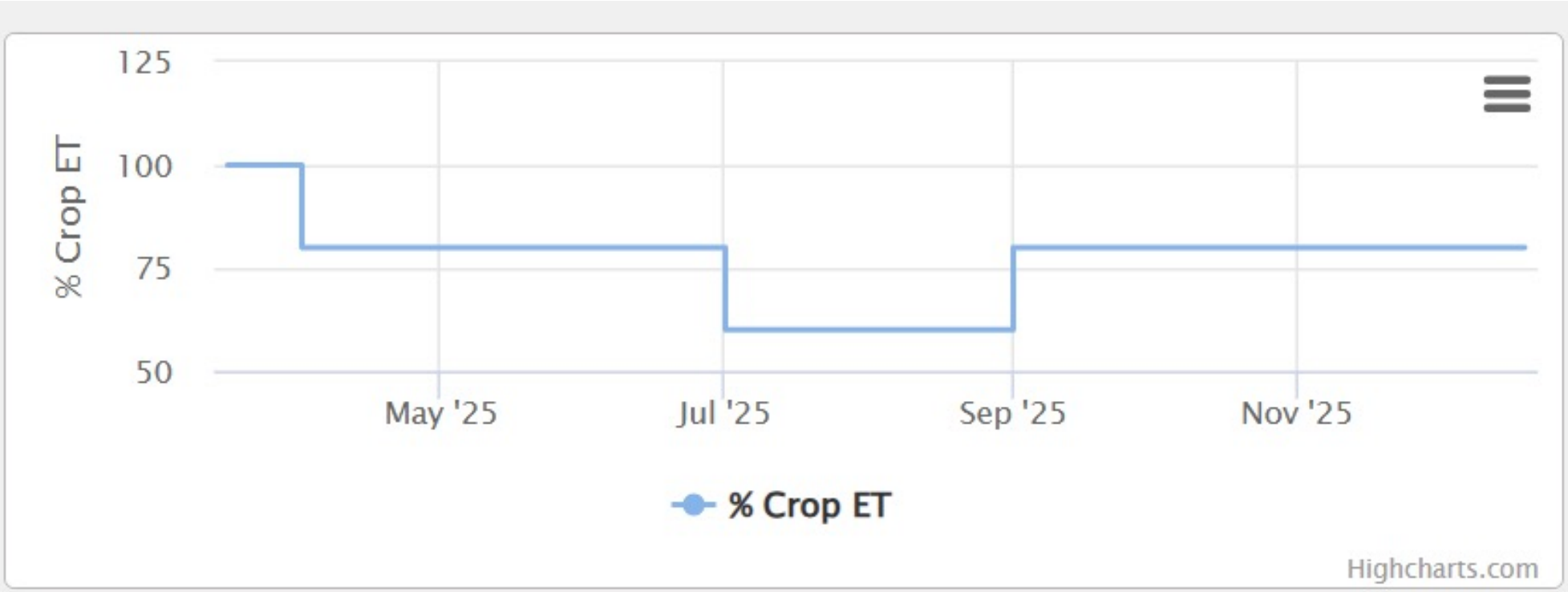


Asterisk in figure A, B, and C represents the significant differences according to the Tukey's HSD at p <0.05.

Use CropManage to Apply Percent of ET



Use CropManage to Apply Deficit Stage



Deficit Type

- ○ Point to Point
- ◉ Stage Based

UC ANR CropManage

- CropManage: Replace the irrigation worksheet
- Add soil moisture sensors and pressure bomb readings to set up checking points
- Not just an irrigation tool: also helps to manage nutrient and report, like N.
- Give a try and compare your numbers with what CropManage recommends

Acknowledgement

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Thank You!