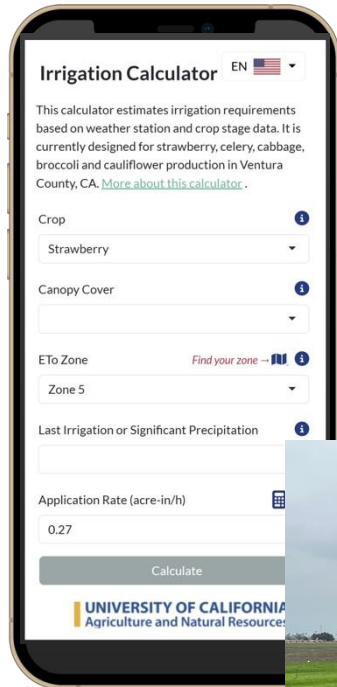


Decision Support Tools for Irrigation Management: Irrigation Calculator Updates and Weather Station Network Expansion



Andre Biscaro,
Irrigation and Water Resources Advisor
UC ANR, Ventura County

Andy Lyons,
IGIS, UC ANR

Ben Faber,
UC ANR Ventura

Irrigation Water Costs Are Rising While Availability is Declining

**CALIFORNIA DEPARTMENT OF
WATER RESOURCES**

Water Basics

What We Do

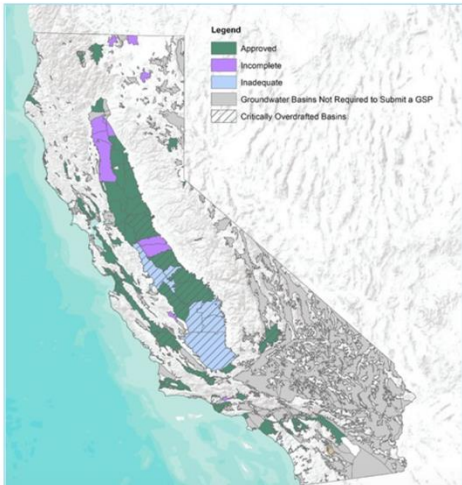
Programs

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**GSP**
GSP Reporting System

University of California
Agriculture and Natural Resources

**Active and Standby
Division of Drinking Water Wells
2007-2017**

Nitrate (as N)

- > 10 mg/L (CA MCL) (854)
- All Sampled Wells (11,906)

Regional Board Boundaries

County Boundaries

Scale: 0 15 30 60 90 120 Miles

Prepared by the State Water Board, September 2022.

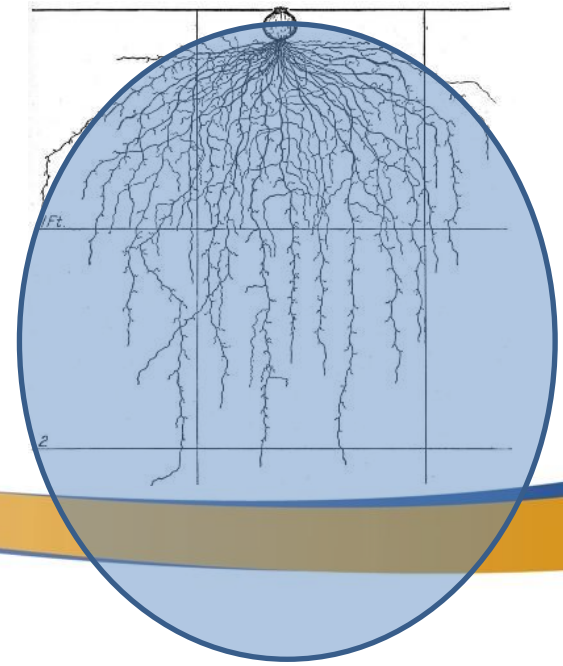
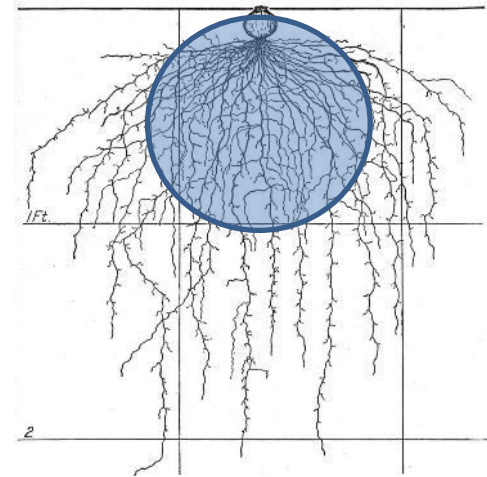
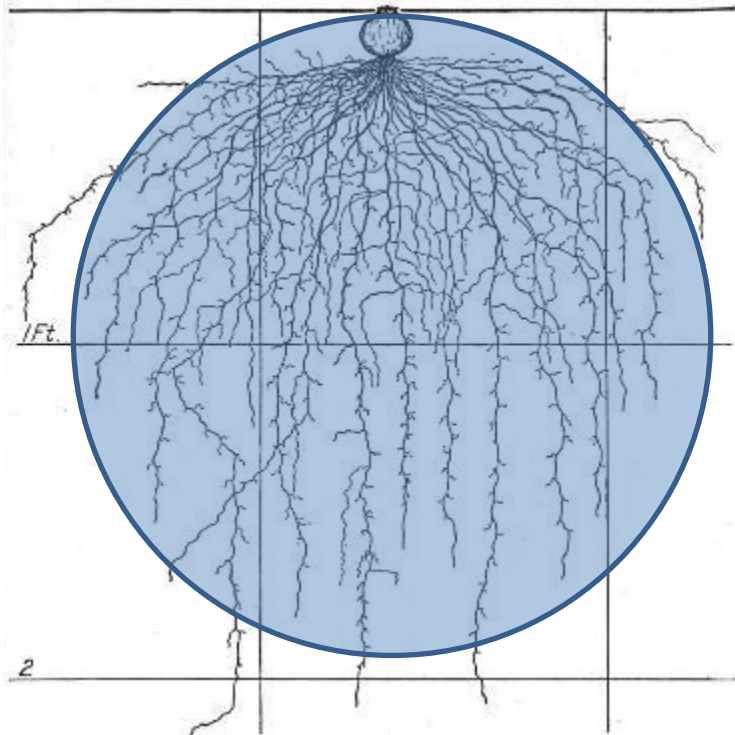
CALIFORNIA'S WATER BOARDS
California Regional Water Quality Control Boards

Source: U.S. Geological Survey National Map Information Center, CALSWQCB, Statewide Mapping Data, OpenStreetMap contributors

[illegible]

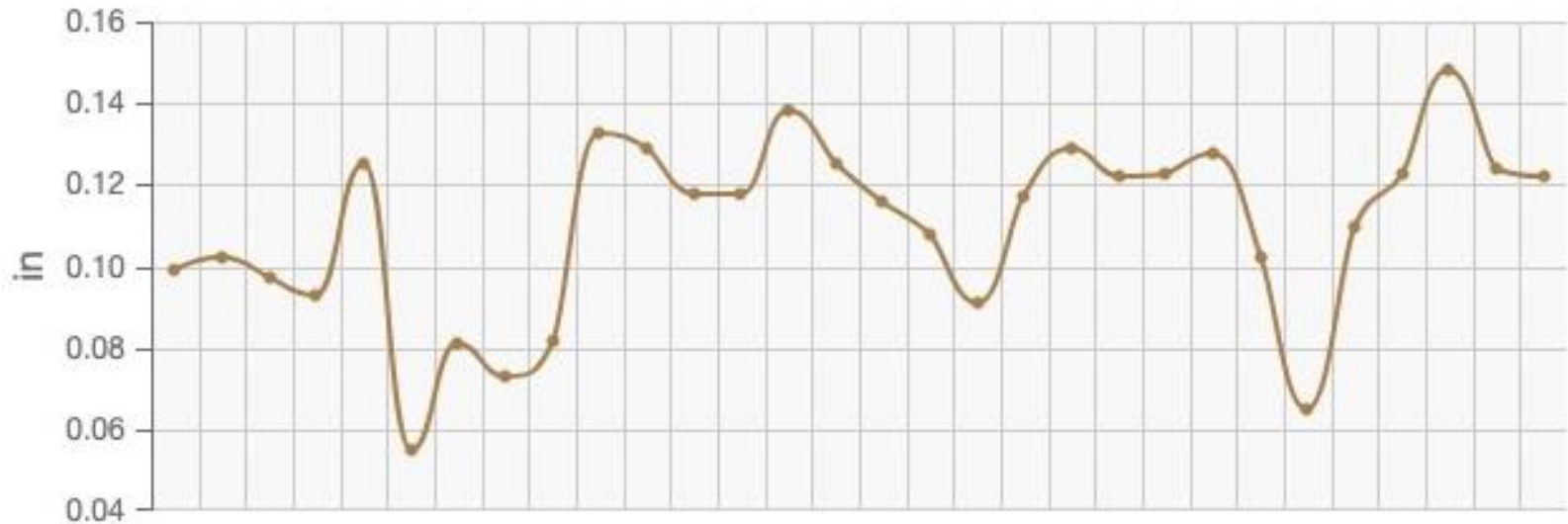
Inefficient irrigation

Ideal irrigation



Why is irrigation scheduling challenging?

Daily ETo data from the Beardsley Station

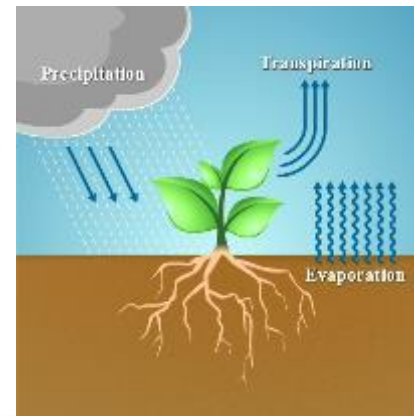
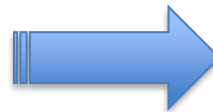


Irrigation Scheduling

1. Deciding when to irrigate



2. Deciding how much to irrigate



ET-Based Irrigation Method

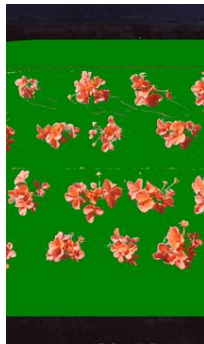
Kc (varies throughout the season)

ET_o



x

20%



60%



80%



Water
Recommen-
dation

A screenshot of a smartphone displaying the 'Irrigation Calculator' app. The interface includes a language selector at the top right, a descriptive paragraph about the calculator's purpose, and several input fields: 'Crop' (set to Strawberry), 'Canopy Cover' (empty), 'ETo Zone' (set to Zone 5), 'Last Irrigation or Significant Precipitation' (empty), and 'Application Rate (acre-in/h)' (set to 0.27). A 'Calculate' button is at the bottom, along with the University of California Agriculture and Natural Resources logo. Information icons (i) are present next to the Crop, Canopy Cover, ETo Zone, and Application Rate fields.

English and Spanish

Crop

Adjusts the crop coefficient

Chooses weather station

Collects ETo data since last irrigation

Converts volume to time

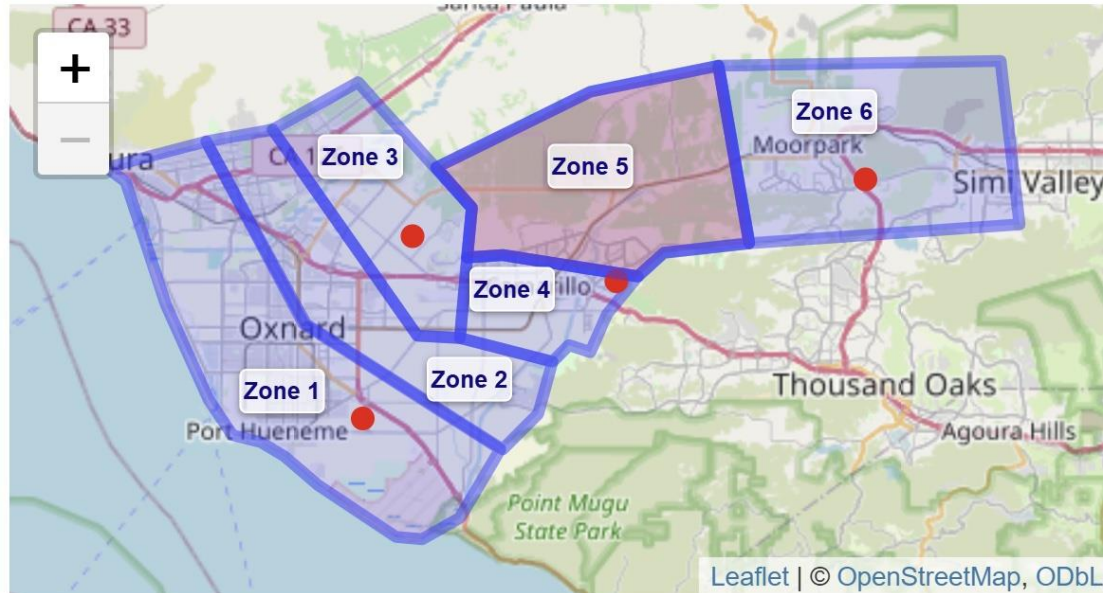
✓ Distribution Uniformity: 85%

✓ Leaching Fraction: 10%

Crops:
strawberry, celery,
cabbage, broccoli,
cauliflower and avocado
(different link)

ETo Zones Map

Below are the ETo Zones for Ventura. Click on a zone to use it. The red dots are weather stations.



Cancel

Use this zone



Exercise 1:

- Strawberry
- Canopy: 30-40%
- ETo Zone 1
- Last irrigation: Aug 15
- Application rate: 0.27 in/h (64in, 3 tapes, 0.5gpm/100ft)

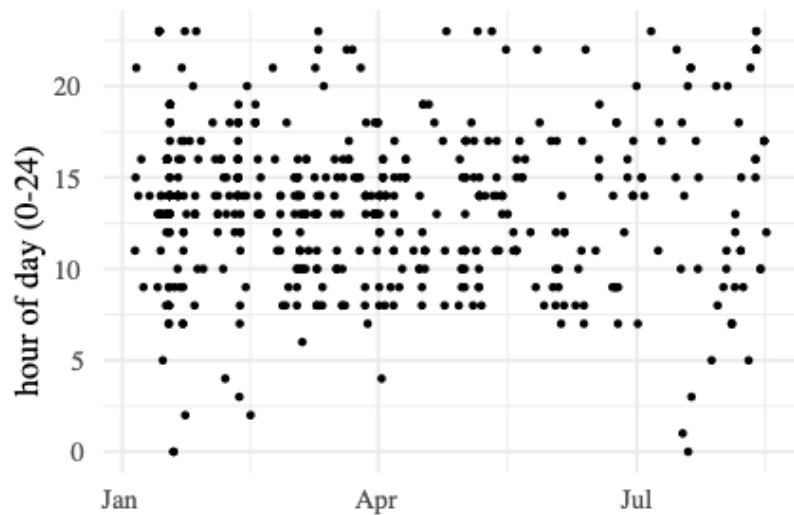


Exercise 2:

- Broccoli
- Canopy: 70-80%
- ETo Zone 3
- Last irrigation: Aug 14
- Application rate: 0.1 in/h (40in, 1 tape, 0.34gpm/100ft)

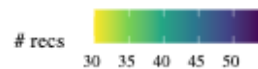
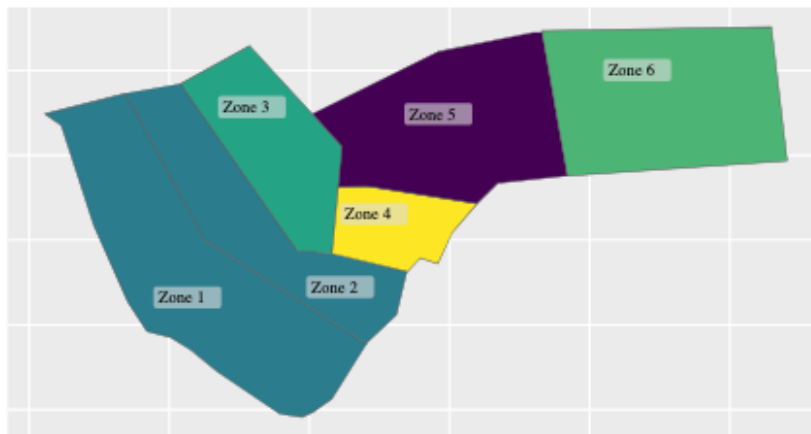
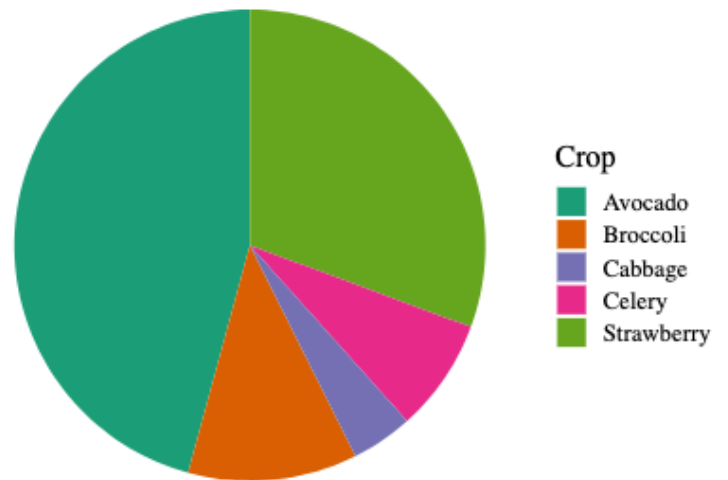
Sessions by Date and Time

January 1 - August 16, 2026

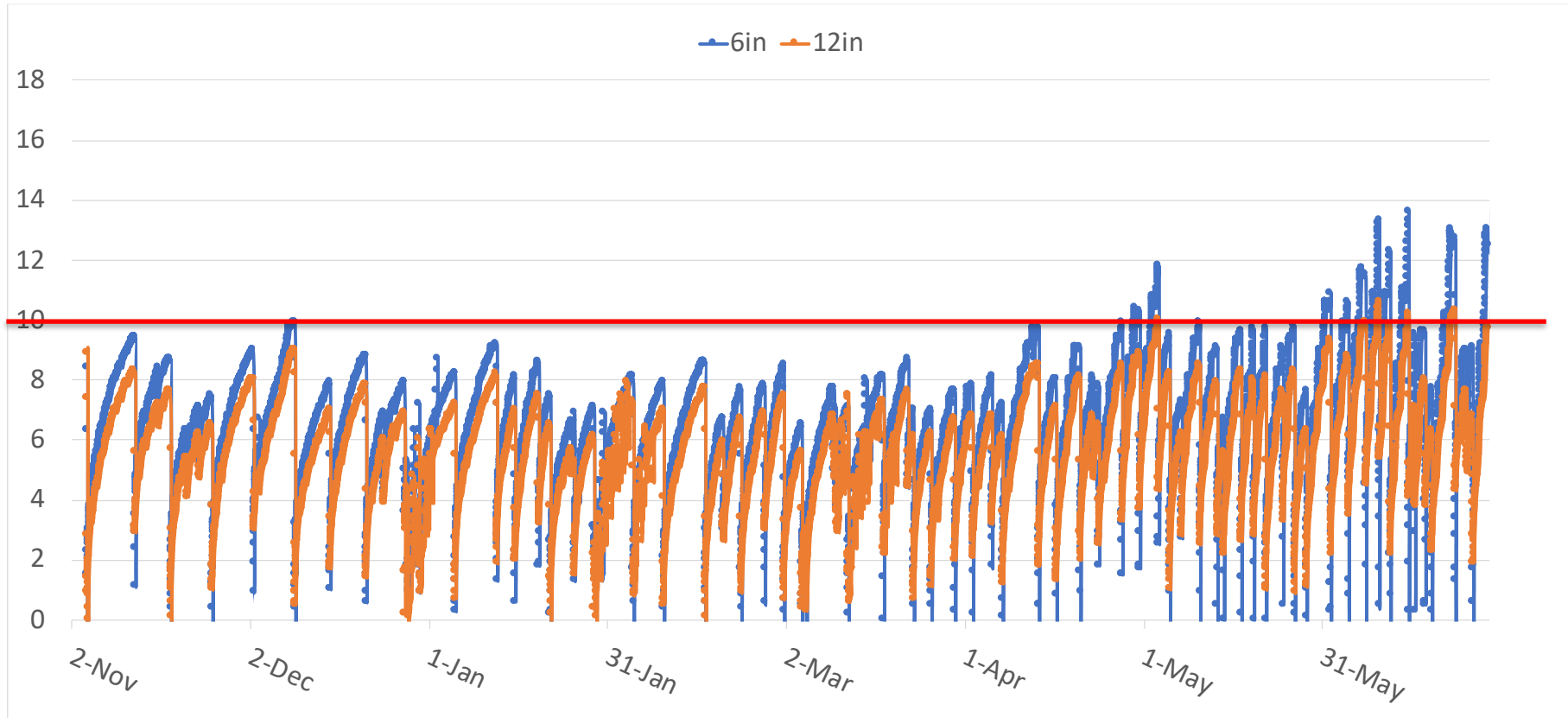


Recommendations by Crop

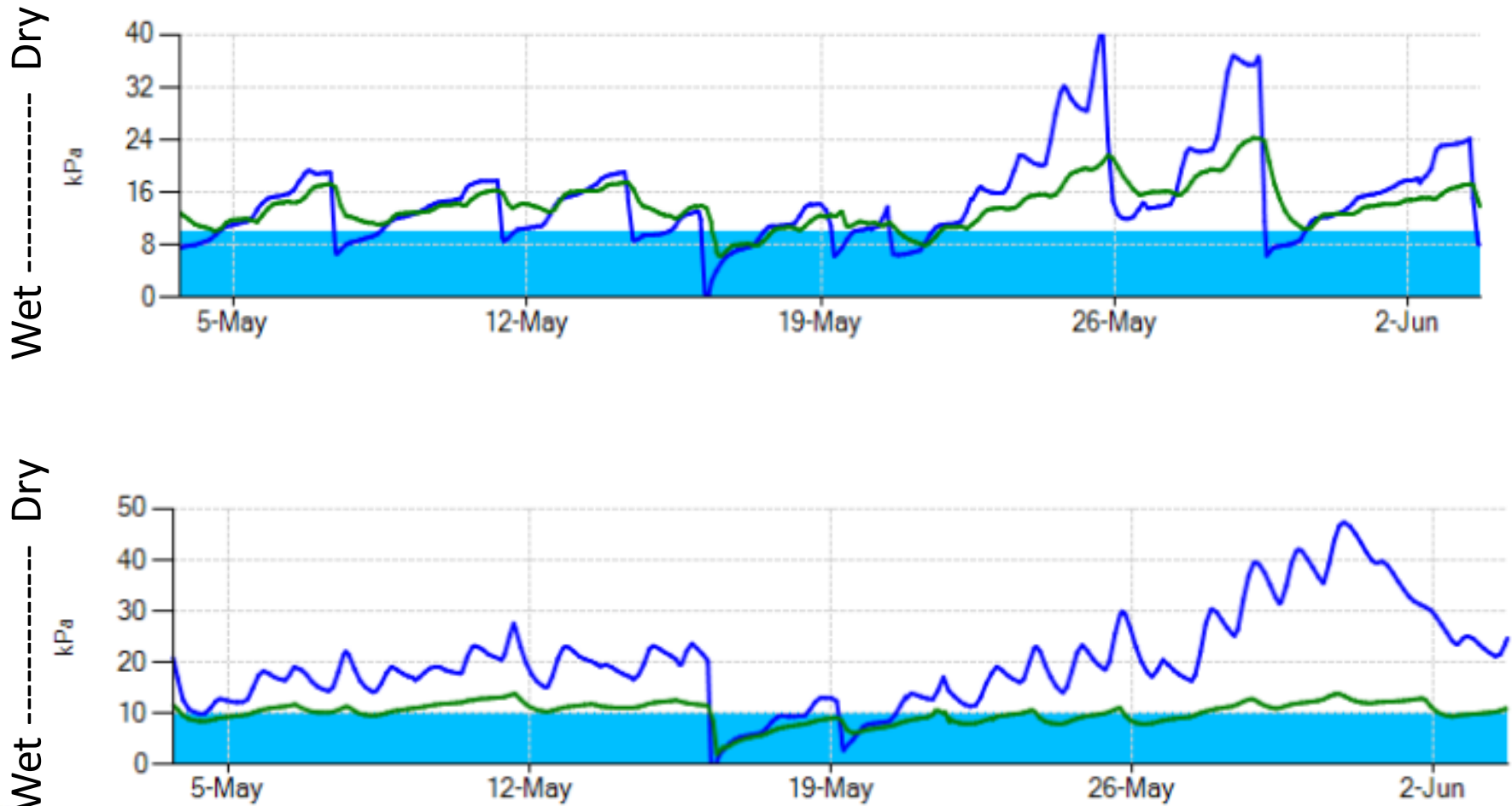
January 1 - August 16, 2026



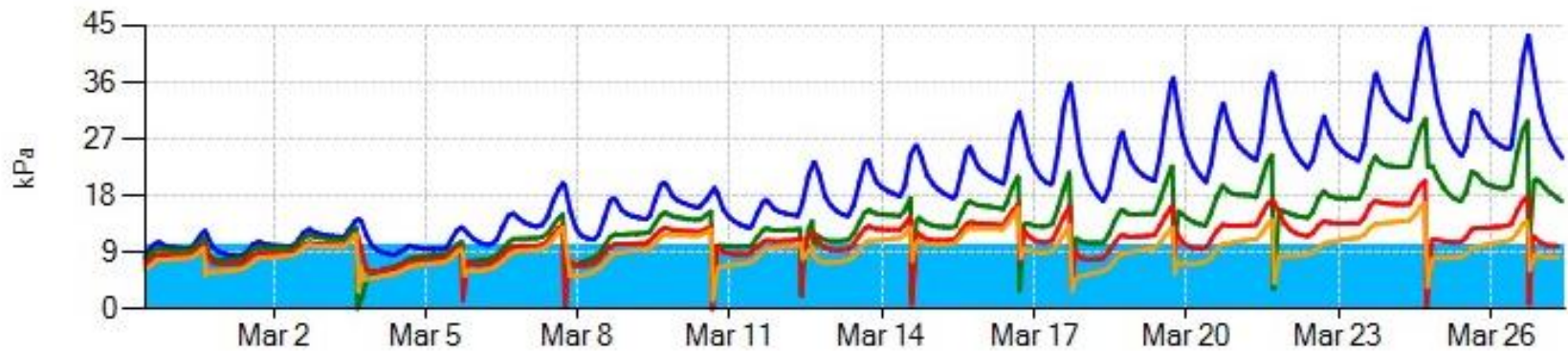
Soil Moisture (kPa)



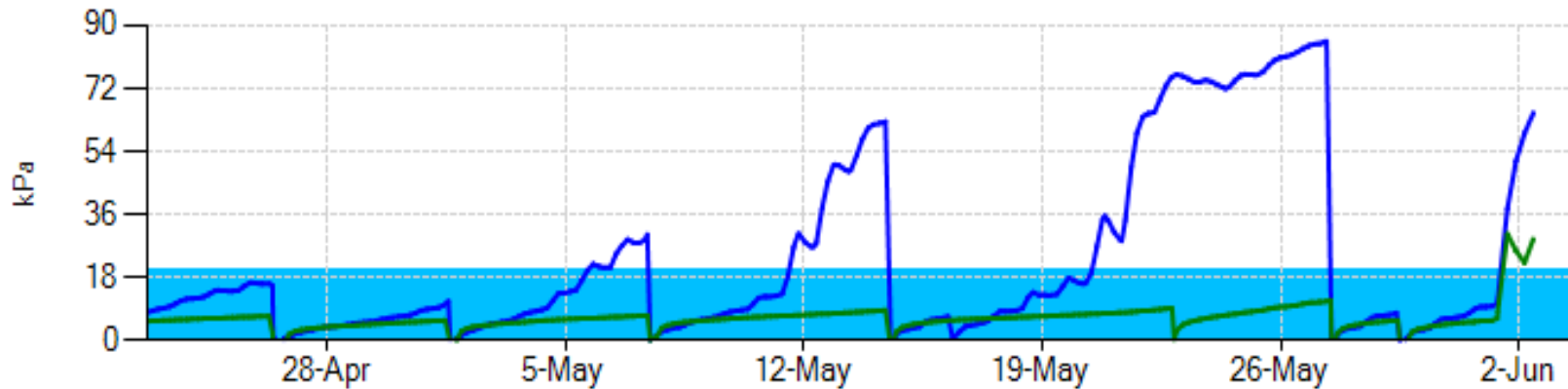
Soil Moisture, Strawberry



Soil Moisture, Strawberry



Soil Moisture, Celery



Symptoms of Macrophomina Charcoal Rot

Wilting and necrosis of older outer leaves first, leading to entire plant collapse



Low soil moisture induces disease development

Plant Disease • 2025 • 109:1268-1279 • <https://doi.org/10.1094/PDIS-05-24-1131-RE>

Role of Soil Moisture in Disease Development of Charcoal Rot of Strawberries Caused by *Macrophomina phaseolina*

Lindsey Pedroncelli,¹ Andre Biscaro,² and Alexander I. Putman^{1,*}

¹Department of Microbiology and Plant Pathology, University of California, Riverside, CA 92521, U.S.A.

²University of California, Division of Agriculture and Natural Resources, Cooperative Extension Ventura County, Ventura, CA 93003, U.S.A.

Abstract

Charcoal rot, caused by the soilborne fungus *Macrophomina phaseolina*, is one of the most economically important diseases affecting strawberry (*Fragaria × ananassa*) production in California. Previous studies on nonstrawberry hosts have shown that proper soil moisture management can limit pathogen colonization of plants and decrease disease severity. We performed field and greenhouse studies for two seasons with the objective of investigating the role of soil moisture in disease development and management of charcoal rot of strawberries. Bare-root transplants of cultivars Monterey and Fronteras were inoculated or not inoculated and maintained at a high, optimal, or low soil moisture level using tensiometers. Randomly selected plants from each treatment were sampled for pathogen colonization every 4 weeks after planting, and all plants were visually rated for disease severity every 2 weeks after symptom onset. In both seasons, low soil moisture significantly

increased charcoal rot mortality among inoculated plants compared with optimal soil moisture by 16 and 24 percentage points, respectively. In the first season, mortality was significantly lower in the high- compared with the optimal-soil-moisture treatment. Colonization of crowns was increased by low soil moisture among inoculated plants in the first season, but soil moisture did not influence root colonization in either year of the study. In the greenhouse, charcoal rot severity was highest in the low-soil-moisture treatment. These results indicate that soil moisture has a limited influence on colonization of strawberries by *M. phaseolina* and that maintaining optimal soil moisture can help prevent excess charcoal rot mortality.

Keywords: cultural control, fungal pathogens, plant stress and abiotic disorders

Strawberry (*Fragaria × ananassa*) is an important crop in California. Production acreage averaged 15,419 ha and the farm gate value averaged \$2.4 billion annually from 2020 to 2023 (CDFA 2020, 2021, 2022, 2023). California accounts for nearly 90% of domestic strawberry production, and from 2020 to 2023 exports averaged \$441.5 million annually, making California a global leader in strawberry production (CDFA 2020, 2021, 2022, 2023).

In 2006, California strawberry growers observed an increase in the number of plants collapsing and dying. Plants were stunted and the older, outer leaves of the plant wilted and became necrotic while the inner, younger leaves of the plant remained green and alive.

*Corresponding author: A. I. Putman; aiputman@ucr.edu

Author contributions: Conceptualization: L.P. and A.I.P.; Methodology: L.P., A.B., and A.I.P.; Formal Analysis: L.P. and A.I.P.; Investigation: L.P.; Resources: A.I.P.; Data Curation: L.P. and A.I.P.; Writing – Original Draft Preparation: L.P.; Writing – Review and Editing: L.P., A.I.P., and A.B.; Supervision: A.I.P.; Project Administration: L.P. and A.I.P.; Funding Acquisition: A.I.P.

When the crown of the plant was cut open, dark orange to brown discolored decay was observed (Koike 2008). These are symptoms of charcoal rot, a disease that began to affect California strawberry production following the phaseout of methyl bromide as a preplant fumigant (Koike et al. 2013). Since the first report in Orange County, California, in 2005 to 2006 (Koike 2008; Koike et al. 2013), charcoal rot has been reported in all major strawberry production regions throughout the state, as well as Florida and several other countries, making charcoal rot of strawberries a global concern (Avilés et al. 2008; Hajlaoui et al. 2015; Koike et al. 2013; Mertely et al. 2005; Qamar et al. 2019; Sánchez et al. 2013; Zveibil and Freeman 2005).

There are very few widely effective strategies to manage charcoal rot. Crop rotation, anaerobic soil disinfestation, and biological controls are promising approaches but often do not suppress disease below economic thresholds and can be difficult to implement on a large scale. Planting disease-resistant cultivars is a strategy to manage many plant diseases; however, susceptibility of strawberry cultivars to charcoal rot varies greatly, and there are currently no highly resistant cultivars (Holmes et al. 2020). Strawberry growers throughout the state need new ways to manage this disease.

Charcoal rot, which may also be referred to as crown rot or root rot,

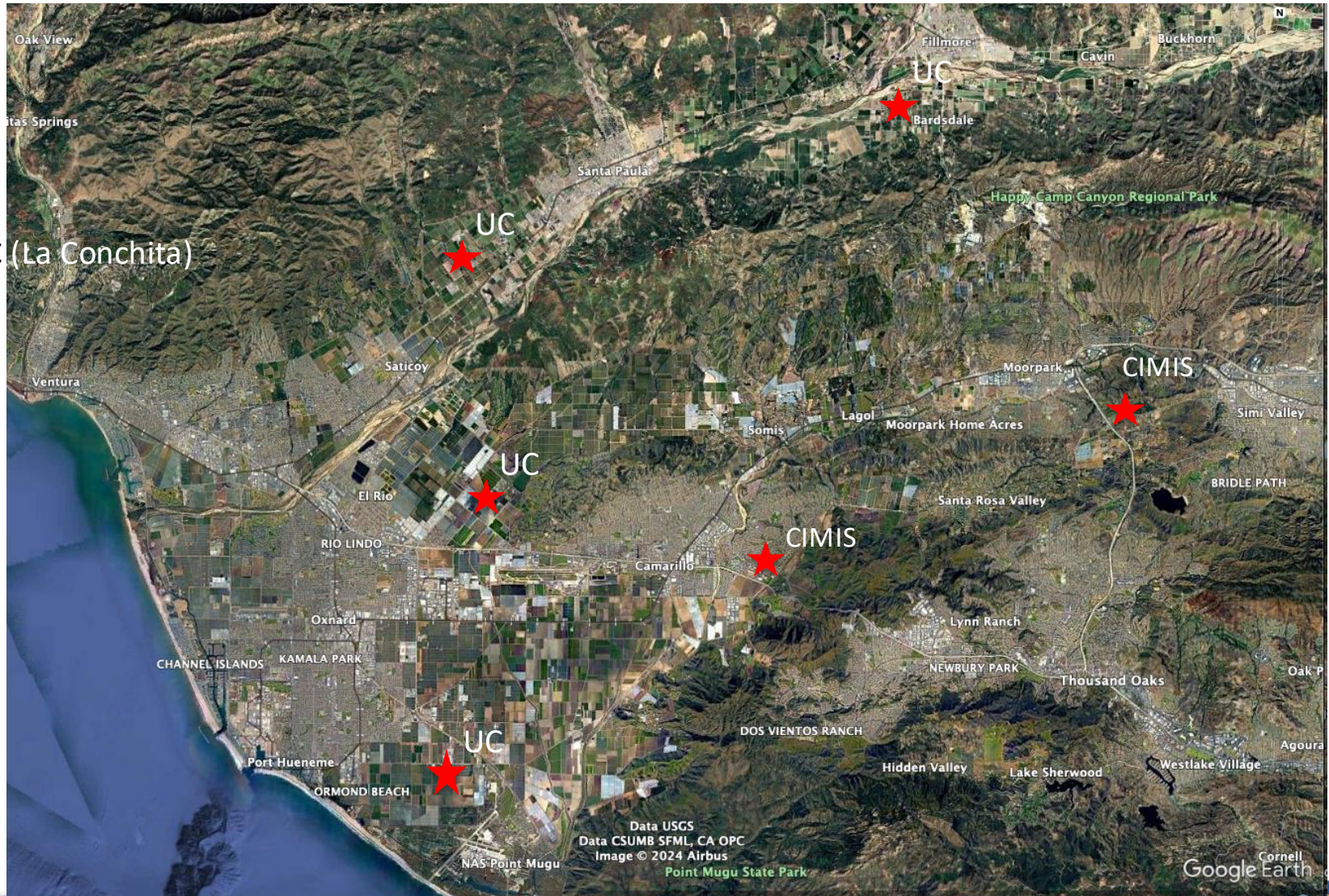
UC ANR Ventura Weather Stations

<https://ucanrventura.westernweathergroup.com/>



Ventura County ETo Stations

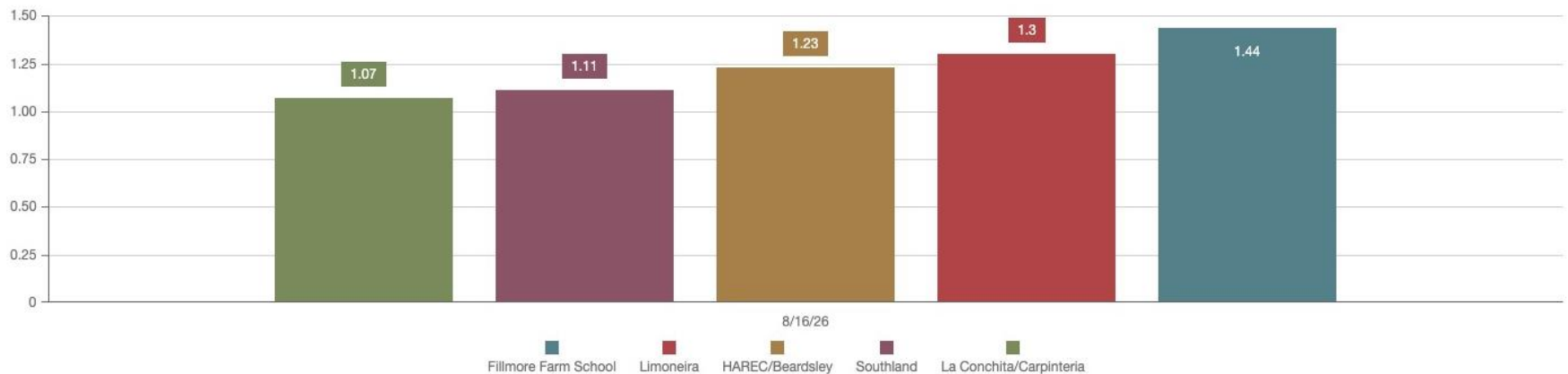
★ UC (La Conchita)

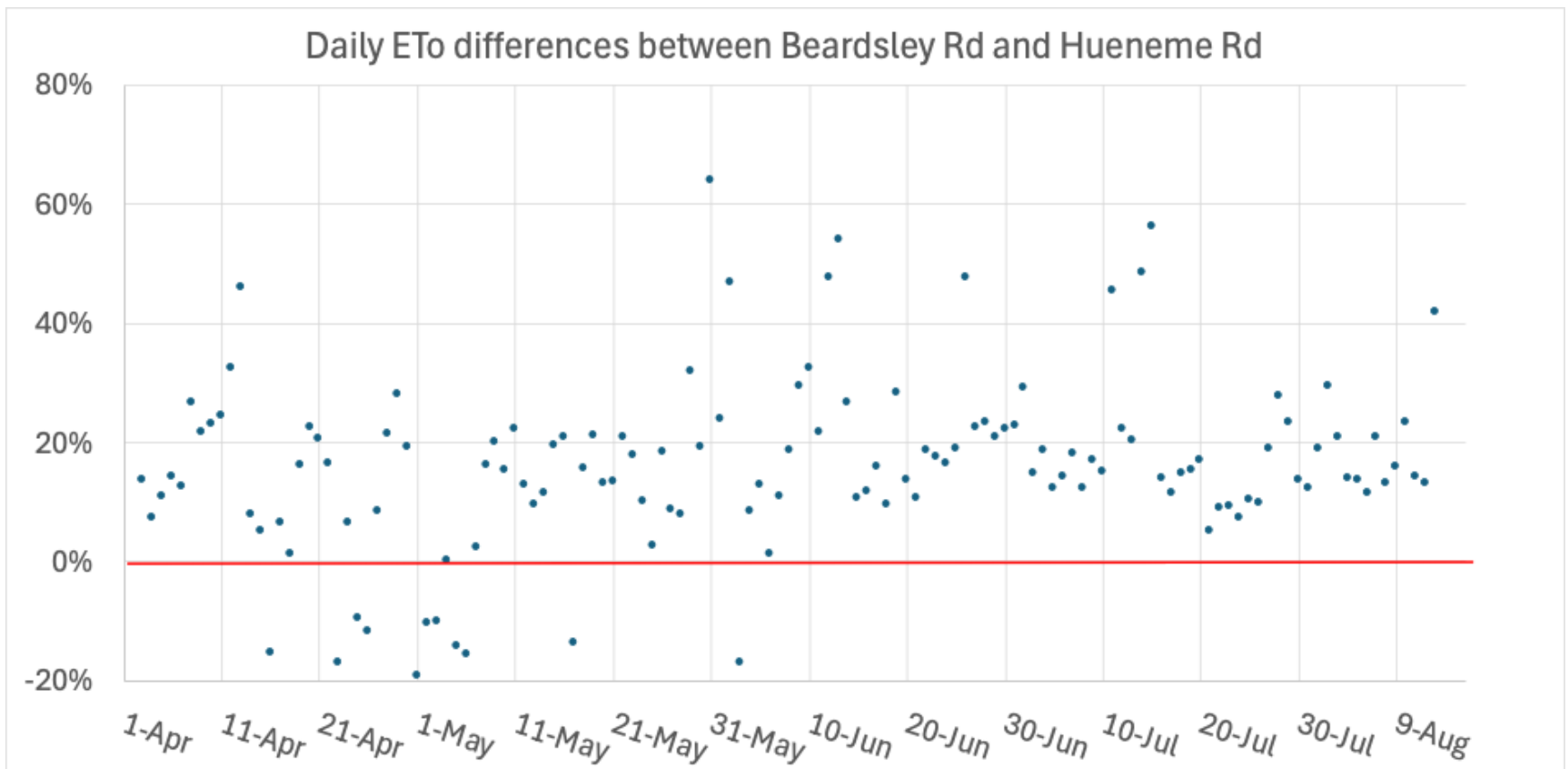


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7 Day ETo (in)
Weekly Total





- Average: Beardsley is 16% greater
- Beardsley is greater than 20% in 33.8% of the time
- Beardsley is greater than 40% in 7.5% of the time
- Hueneme is greater in only 8.3% of the days

Thank you!

Questions/comments?

