



# Maximizing water productivity from winter cereal crops in California

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2. UC Cooperative Extension

3. Public Policy Institute of California



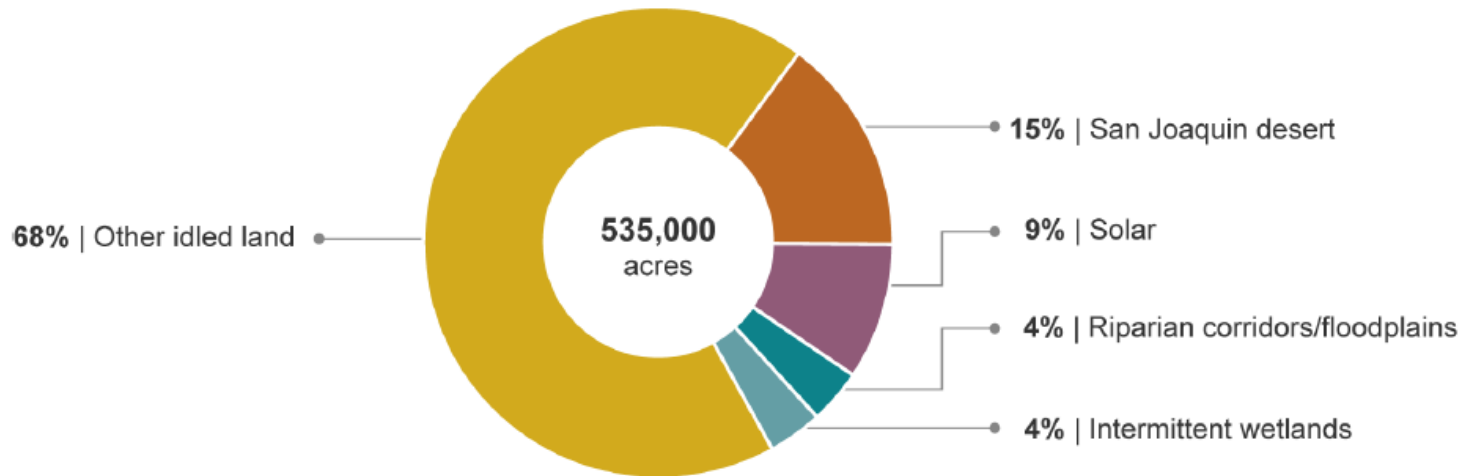
## Context:

- Increasing drought
- Sustainable Groundwater Management Act (SGMA)
  - Land use repercussions

**FIGURE 4.2**

Land coming out of production will greatly exceed the footprint of current planning processes

### Potential uses of formerly irrigated lands



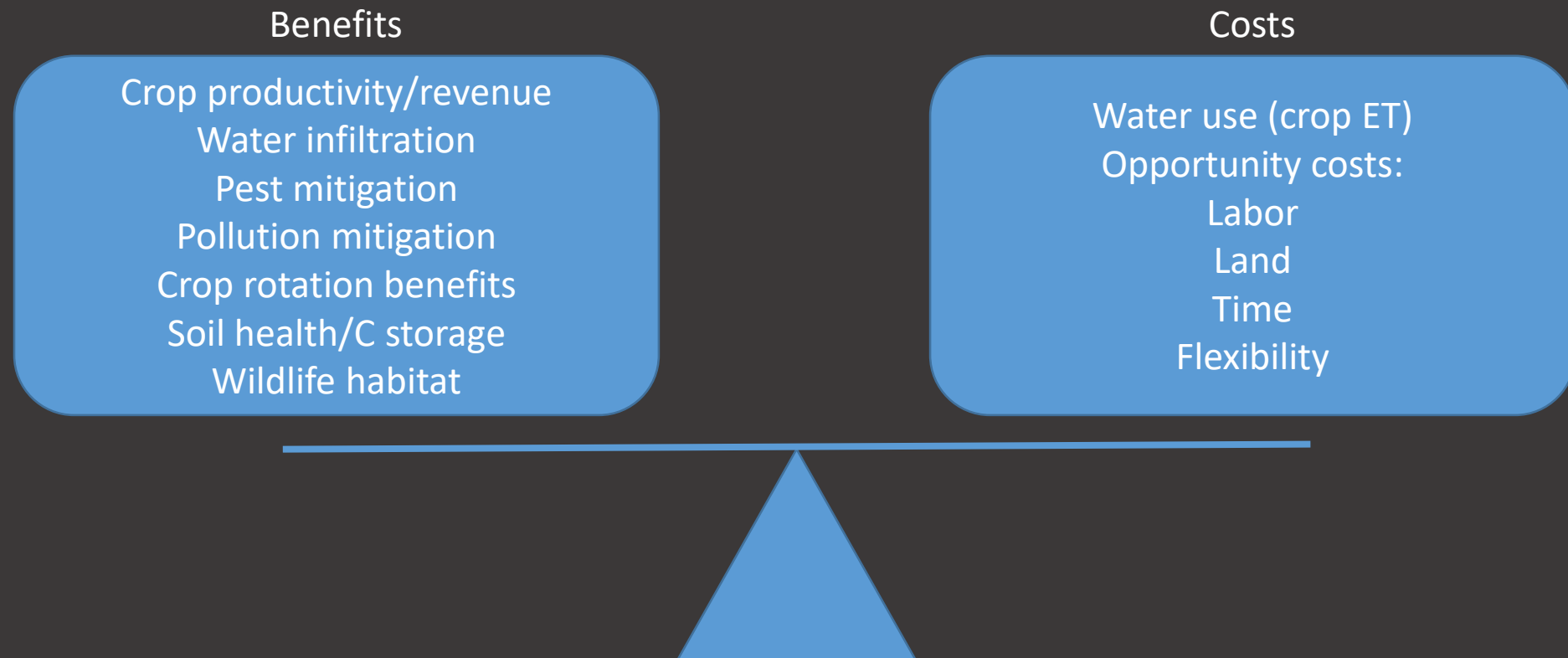
SOURCE: Author estimates. For details on sources and assumptions, see [technical appendix Table E2](#).

NOTES: This figure assumes that 535,000 acres of irrigated cropland will be idled by 2040 under SGMA. This is the estimated land retirement if roughly one-quarter of the valley's historical groundwater deficit is filled by augmenting supplies (Chapter 2). If land idling needs to be larger—either because of a higher future water deficit or limited success in augmenting supplies—the area in “other idled land” would likely expand more than the other categories.

## Objective:

- Quantify feasibility of winter crop production under rainfed and deficit-irrigated production in the San Joaquin Valley.

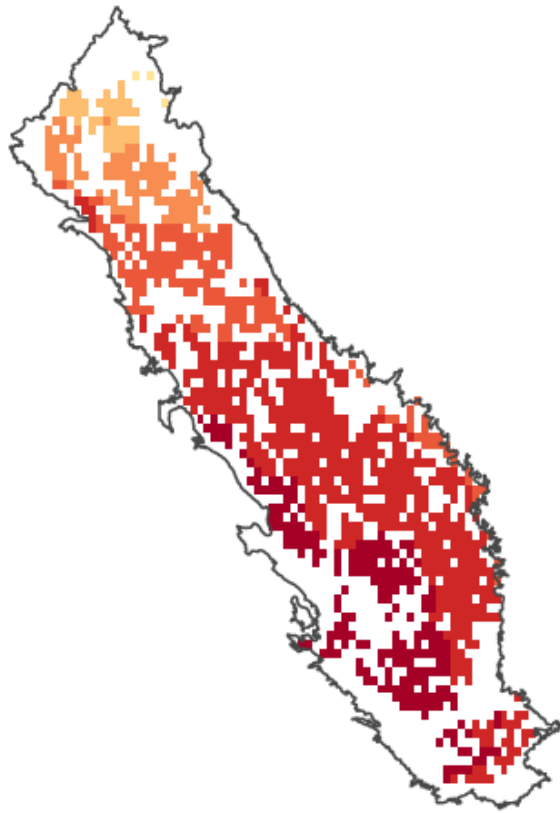
## Winter Cropping Systems



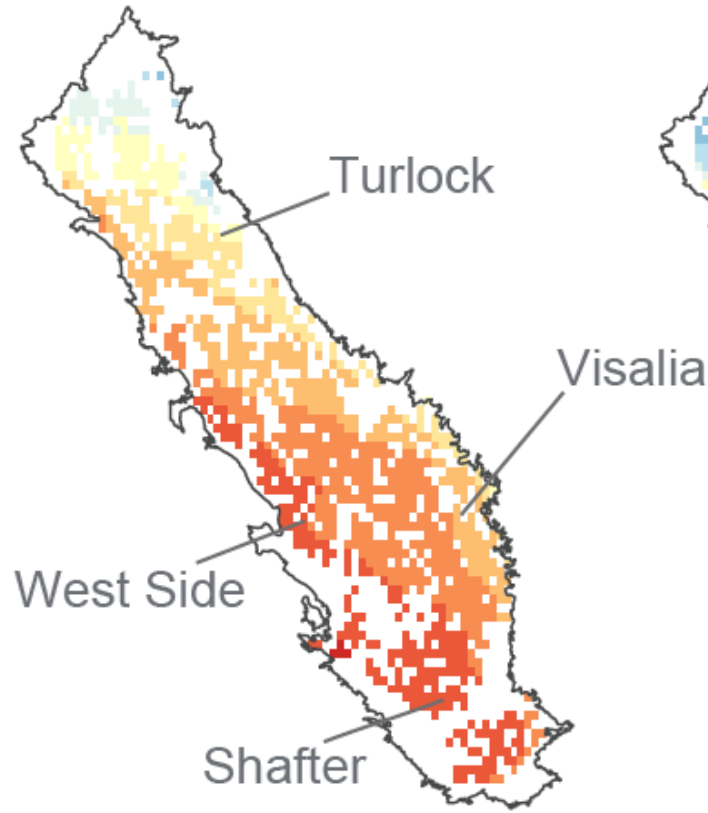
# Precipitation is highly variable across space and time in the San Joaquin Valley

## Rainfall Totals (Water Years: 2011–20)

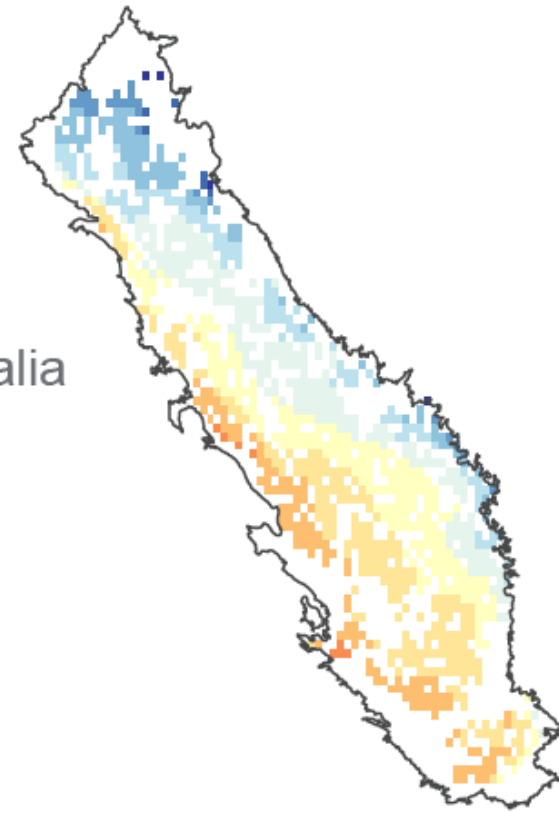
Rainfall total  
driest year (2014)



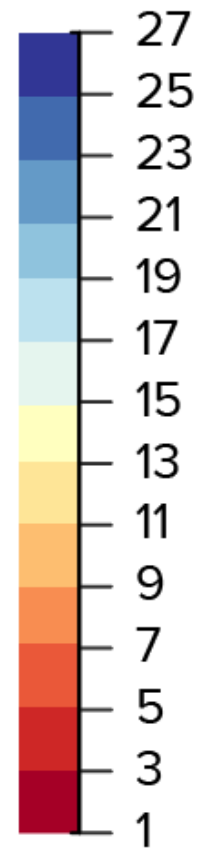
Average rainfall  
total (2011–20)



Rainfall total  
wettest year (2011)



Inches of  
rainfall



## Methods:

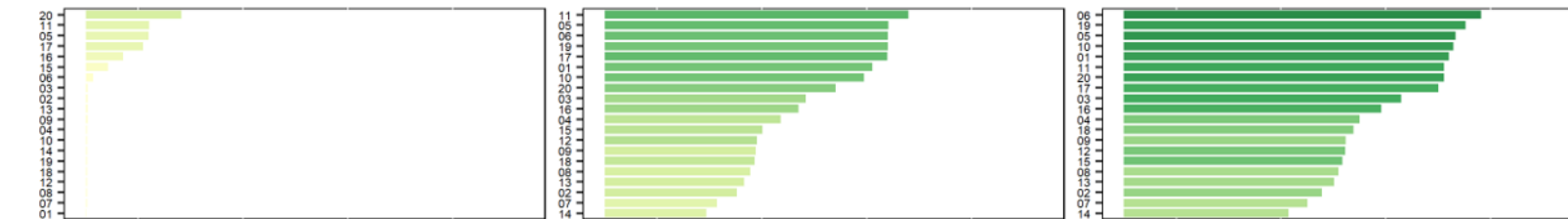
- Calibrate APSIM crop model and use it to estimate the effects of irrigation amount and planting timing on crop and water productivity under rainfed and deficit irrigation scenarios.
- Determine probability of crop success under rainfed and deficit irrigation scenarios for locations in the San Joaquin Valley with limited surface water availability.

No irrigation

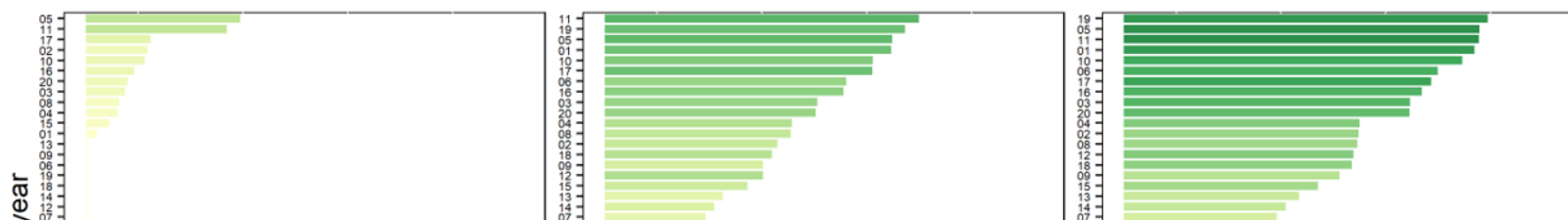
4 inches irrigation

8 inches irrigation

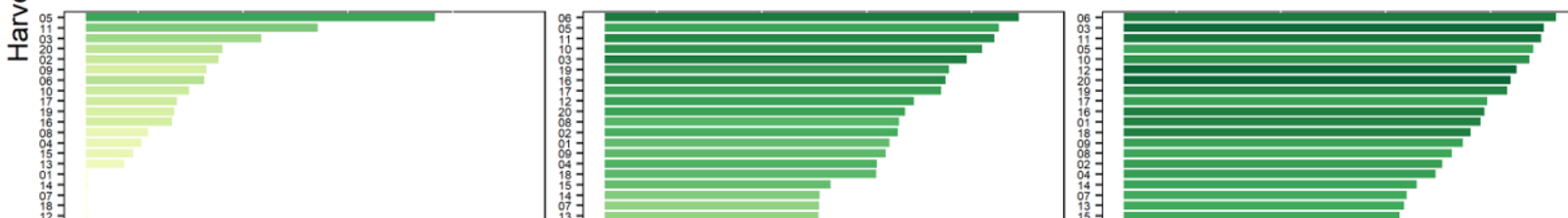
Shafter



Five Points



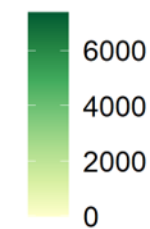
Visalia

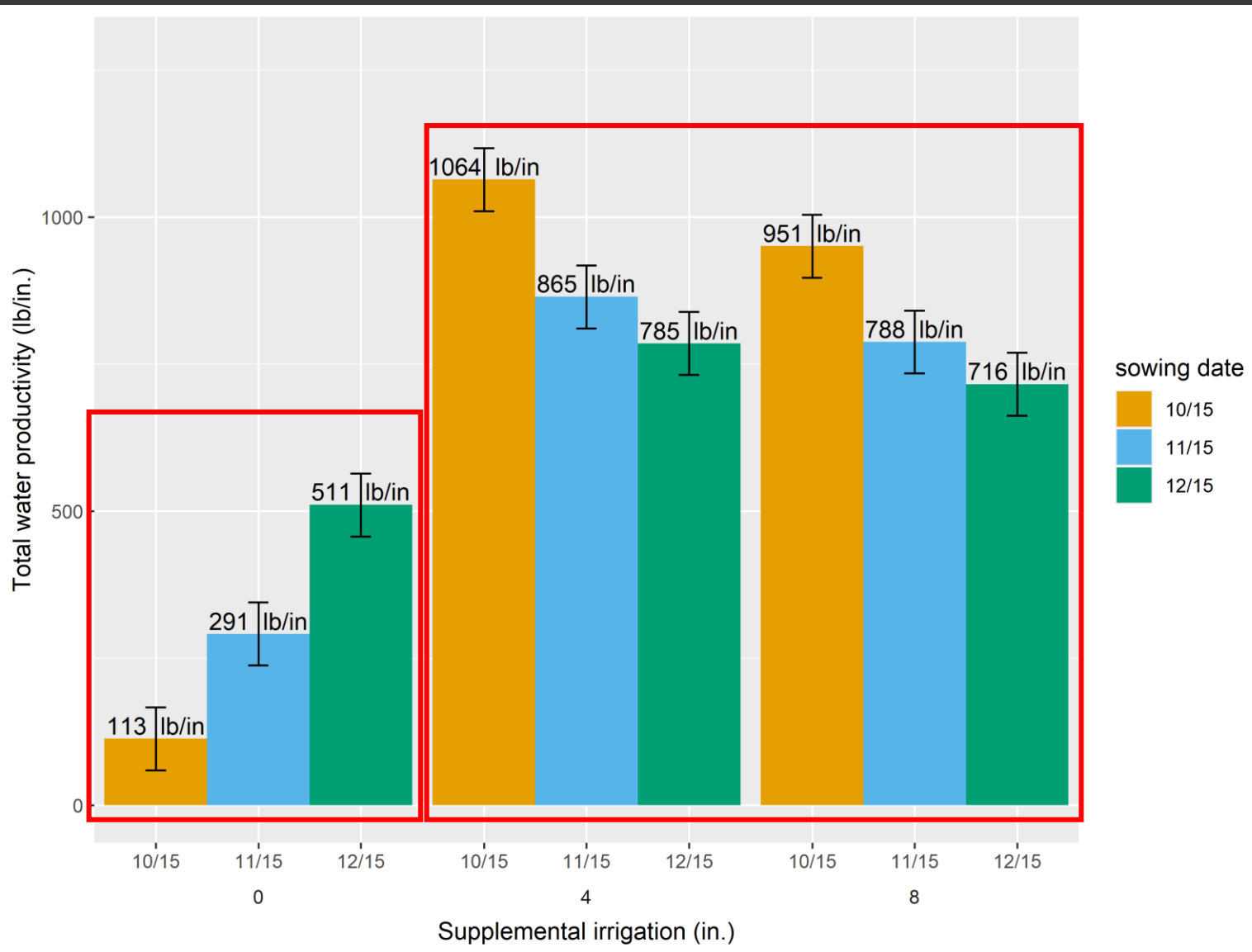


Turlock



Yield (kg ha<sup>-1</sup>)



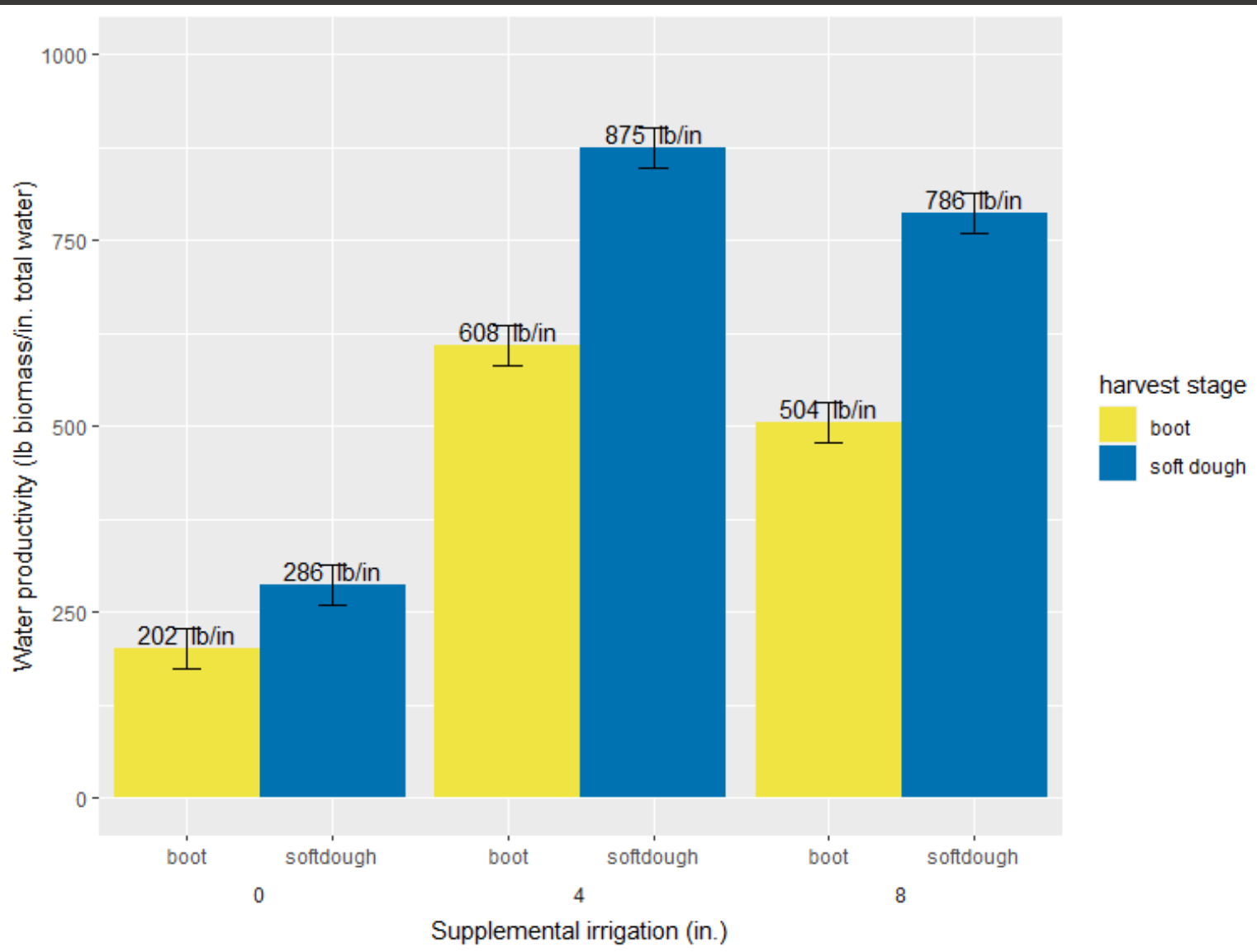


not irrigated

4 inches irrigation

8 inches irrigation

- If no irrigation is applied, planting later in the fall/early-winter increases the probability of crop establishment success.
- If irrigation is applied, crops planted earlier in the fall have higher yield potential and higher water productivity.



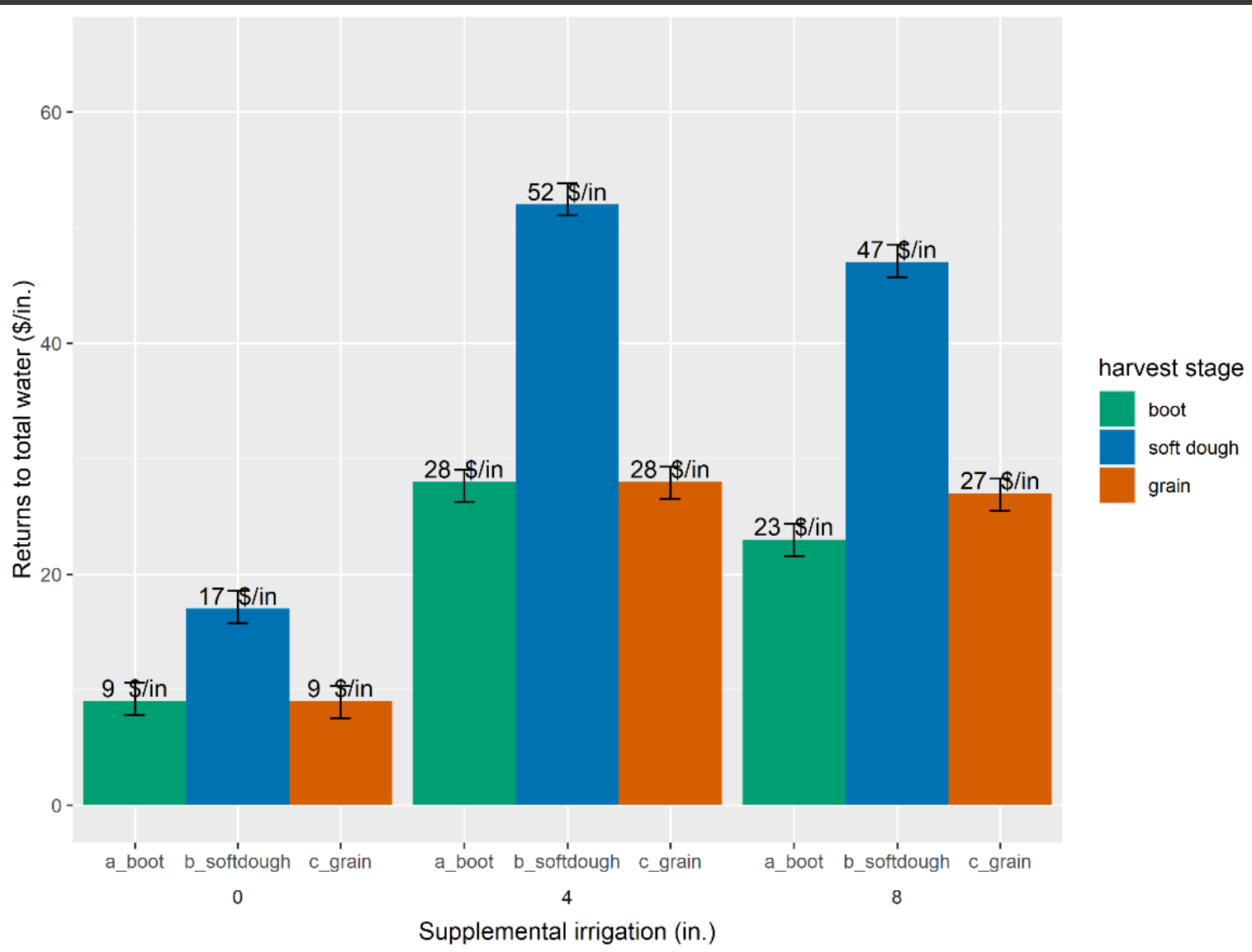
not irrigated

4 inches irrigation

8 inches irrigation

- Regardless of the amount of irrigation applied, forages harvested at soft dough stage have the highest water productivity and the highest returns to total water consumption at average prices.
- Evaporation is a larger portion of evapotranspiration (ET) for boot-stage forages than for soft dough forages.





not irrigated

4 inches irrigation

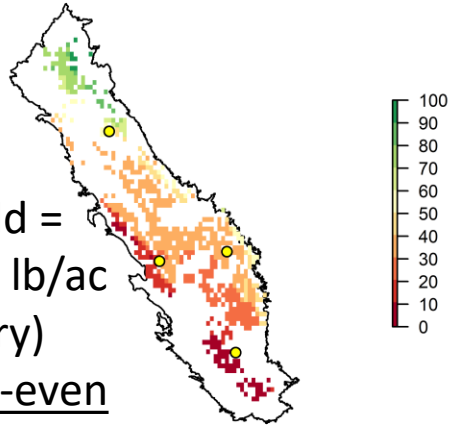
8 inches irrigation

- Regardless of the amount of irrigation applied, forages harvested at soft dough stage have the highest water productivity and the highest returns to total water consumption at average prices.
- Evaporation is a larger portion of evapotranspiration (ET) for boot-stage forages than for soft dough forages.
- Under deficit-irrigation, grain yields are typically water-limited and do not maximize water productivity or returns.

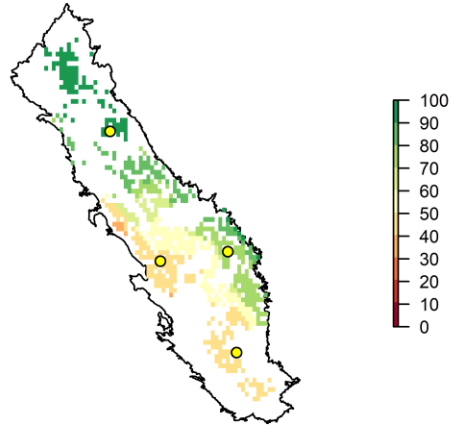
Years with sufficient precipitation to achieve yield level, 2011-2020 (%)

No irrigation

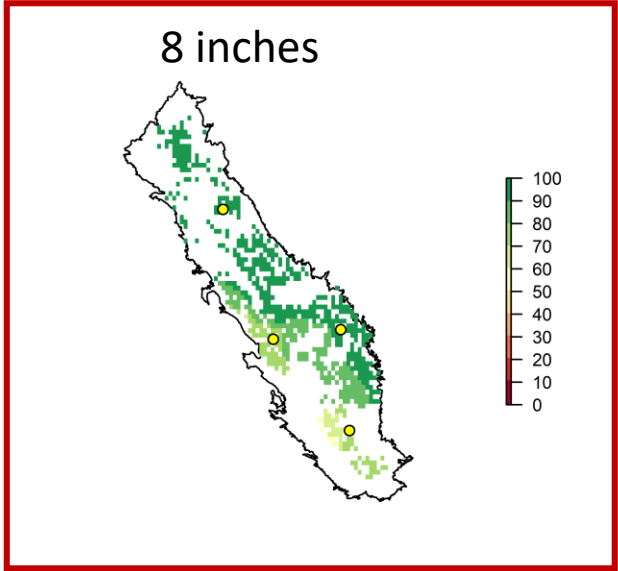
Yield =  
9,000 lb/ac  
(dry)  
break-even



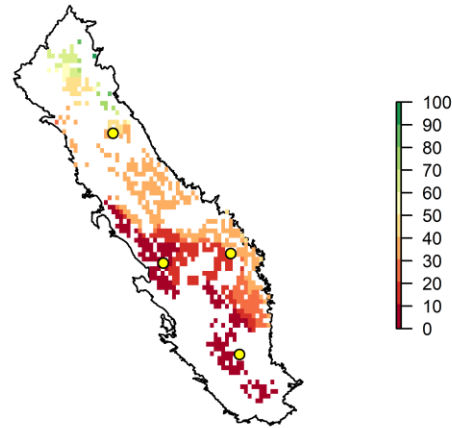
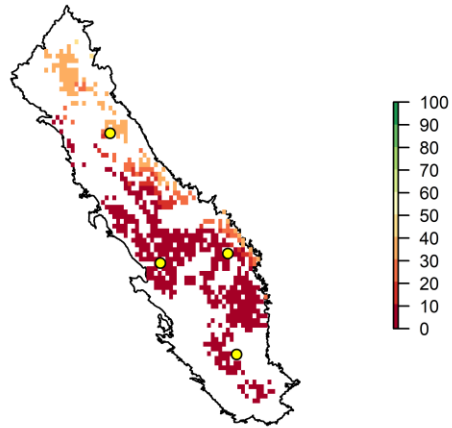
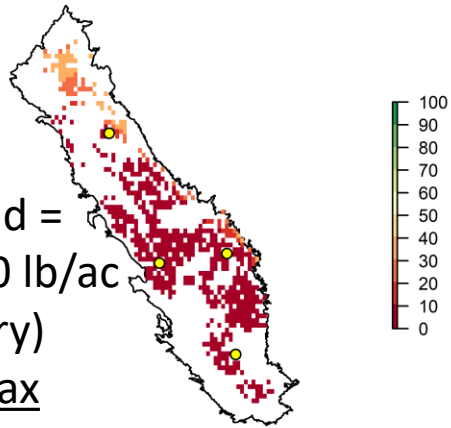
4 inches



8 inches



Yield =  
14,000 lb/ac  
(dry)  
max



- Targeted early-season irrigation greatly expands the feasibility of winter forage production in the SJV
- 58% of acreage with limited surface water (i.e.  $\leq 2$  ac-ft/yr) can reliably (i.e. 100% of years) achieve break-even yield levels with targeted irrigations totaling 8 inches.

## Summary:

- Approximately 8 inches of fall/early-winter irrigation is sufficient to achieve 4-5 ton (dry) or greater cereal forage yields in most of the San Joaquin Valley.
- If taking a deficit-irrigation approach to winter cereal forage production:
  - early-planting and soft dough harvests maximize crop and water productivity
- Purely rainfed crops have limited probability of success in most locations. In this scenario, planting later into the fall/early-winter increases the probability of crop success.

# Additional Resources

Exploring the Potential for Water-Limited Agriculture in the San Joaquin Valley

Caitlin Peterson, Cameron Pittelkow, and Mark Lundy, with research support from Joy Collins

REPORT PDF

Supported with funding from the S. D. Bechtel, Jr. Foundation, the California Strategic Growth Council's Climate Change Research Program with funds from California Climate Investments, the Morgan Family Foundation, and the US Department of Agriculture, Office of Environmental Markets

Key Takeaways

RELATED CONTENT  
Technical Appendix →

RELATED EVENT  
Farmland in Transition: The San Joaquin Valley →

TABLE OF CONTENTS

<https://www.ppic.org/publication/exploring-the-potential-for-water-limited-agriculture-in-the-san-joaquin-valley/>

Welcome to UC Small Grains Research & Information

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Variety Selection  
Nutrient Management  
General Production  
Pest Management  
PRIMARY CONTACTS

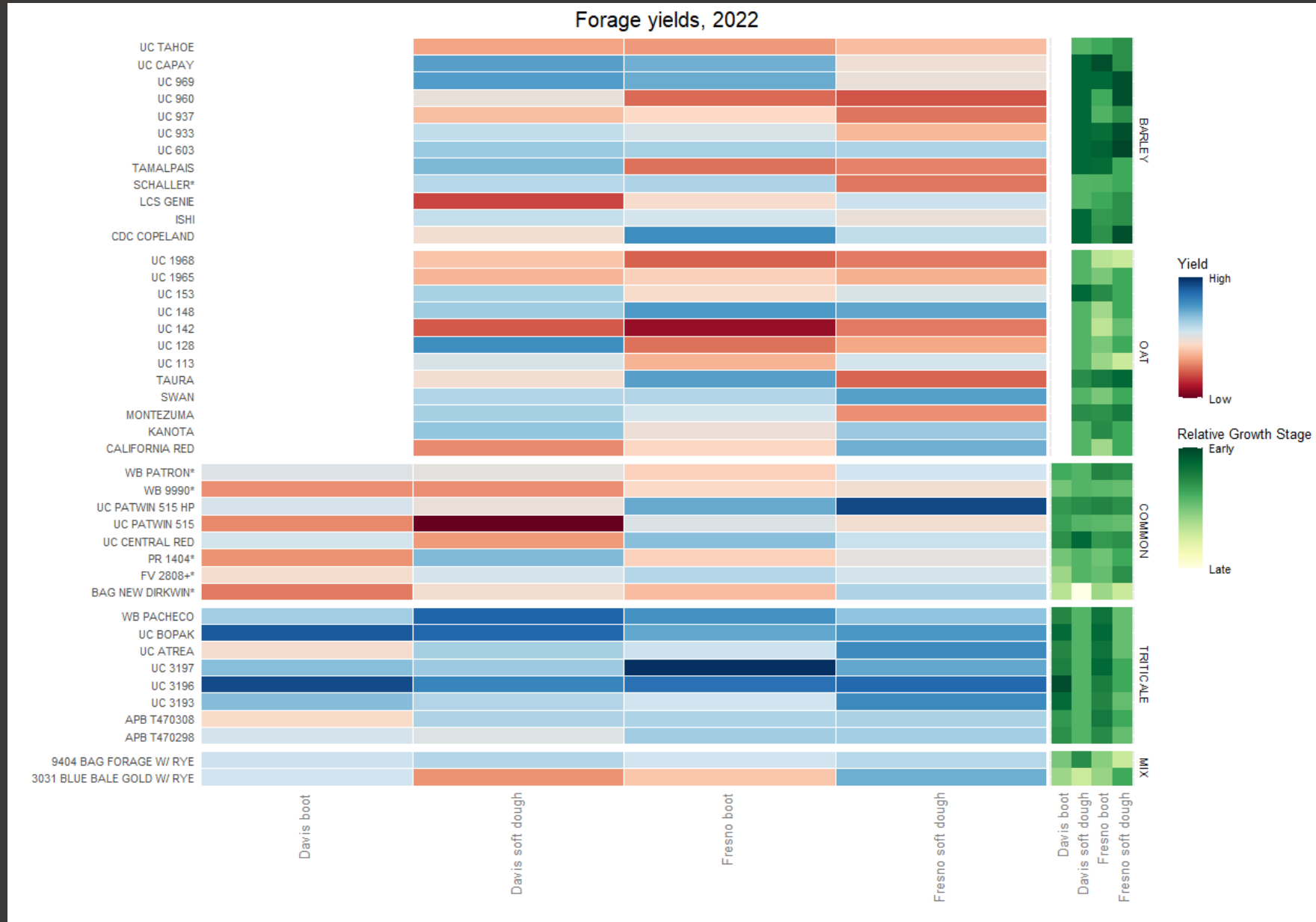
**Preliminary yield results from fall-planted 2021-22 small grain variety trials**  
Preliminary grain and forage yield results for our fall-planted common wheat, triticale, durum wheat and barley trials are now available on the UC Small Grains Research and Information Center...

**May 17th: 2022 UC Davis Small Grains and Alfalfa/Forages Field Day**  
The 2022 UC Davis Small Grains and Alfalfa/Forages Field Day will be held: May 17th, 8:00 a.m. – 1:00 p.m. with tours of Small Grains Breeding plots to follow in the afternoon  
LOCATION: Department of Plant Sciences Field Facility, UC...

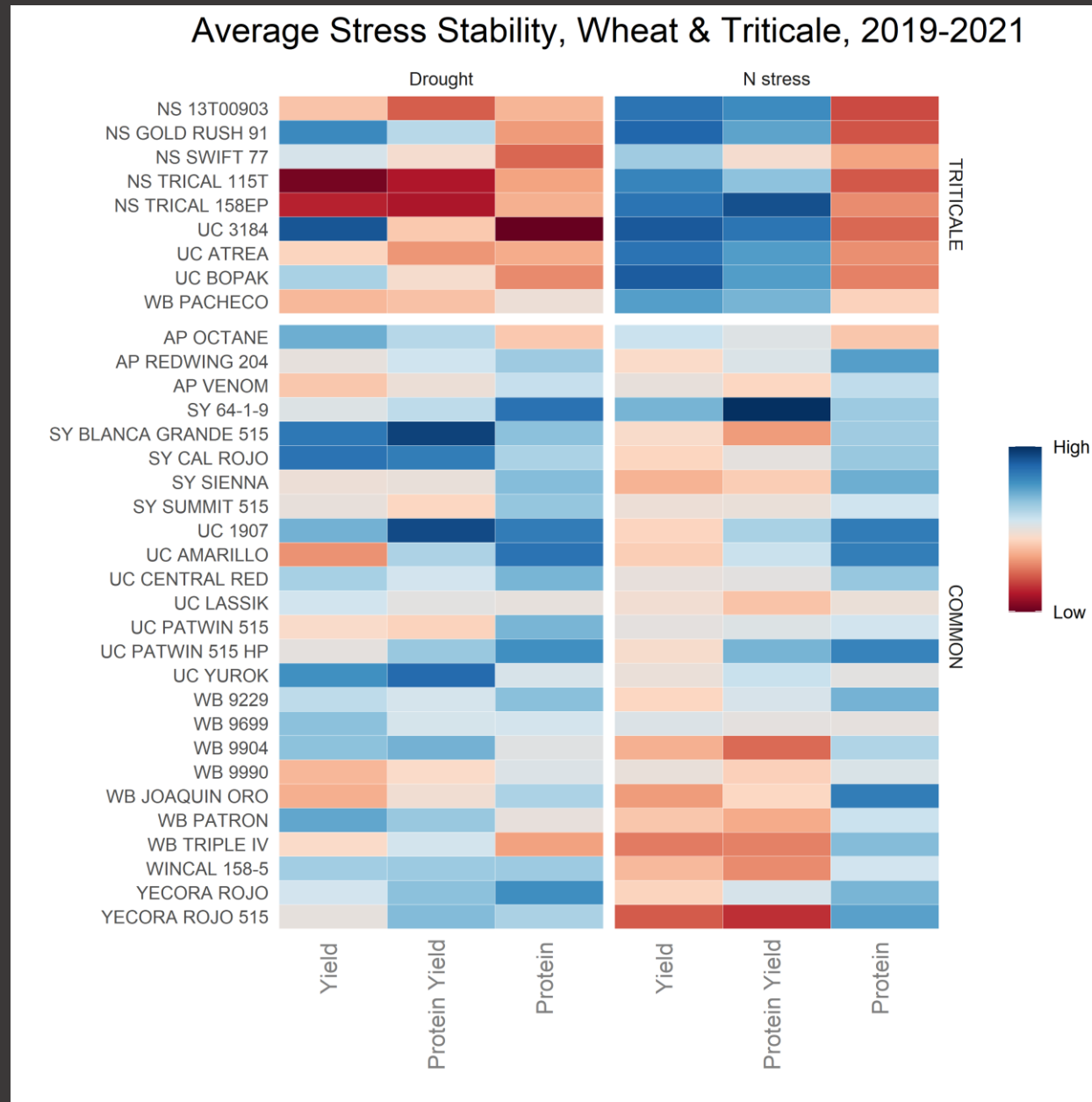
**Small Grains in California**  
Small grains include wheat, barley, oats and triticale. Wheat, oats and barley are grown for grain and forage while triticale is primarily grown as forage. Wheat is the predominant small grain crop in California, where it is grown on over 500,000 acres. Although relatively low in value compared to many California crops, small grains serve as

<https://smallgrains.ucanr.edu/>

# Additional Resources



# Additional Resources



# Thanks!

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Grain Cropping Systems  
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UC Small Grains RIC  
<https://smallgrains.ucanr.edu/>

UC Small Grains Blog  
<https://ucanr.edu/blogs/smallgrains/>

