Maximizing water productivity from winter cereal crops in California

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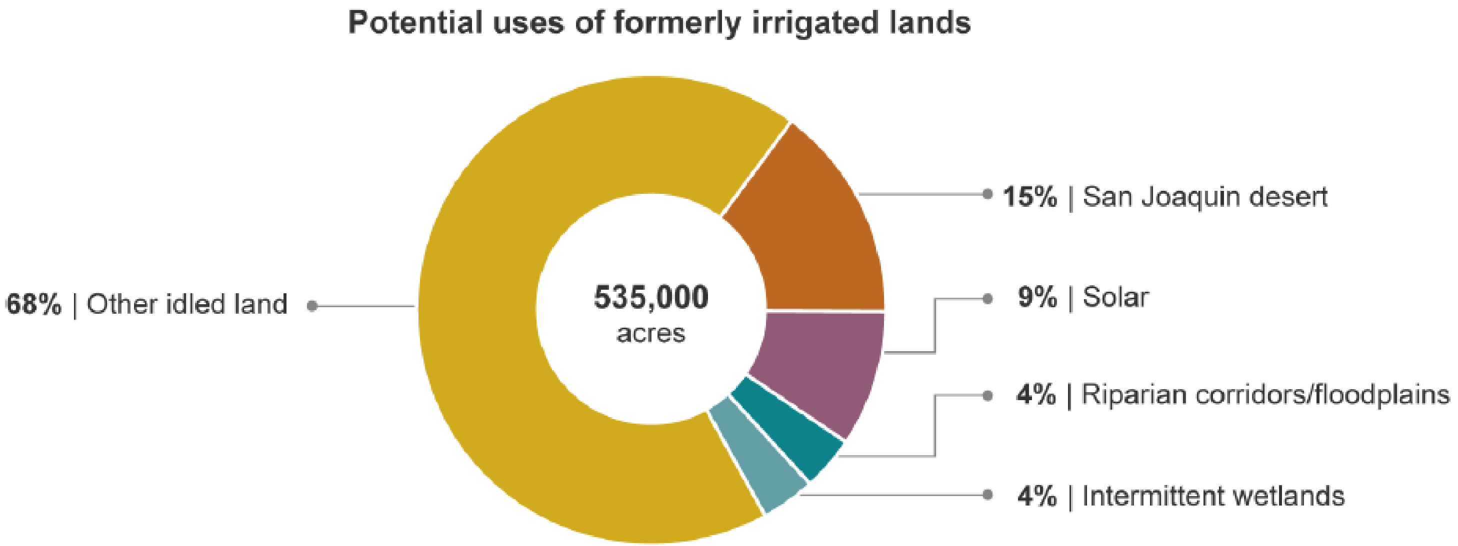
Context:

- 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



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.

Hanak, et al. 2019. Water and the Future of the San Joaquin Valley. Public Policy Institute of California. February 22, 2019. Accessed: 29 January, 2021:
https://www.ppic.org/publication/water-and-the-future-of-the-san-joaquin-valley/

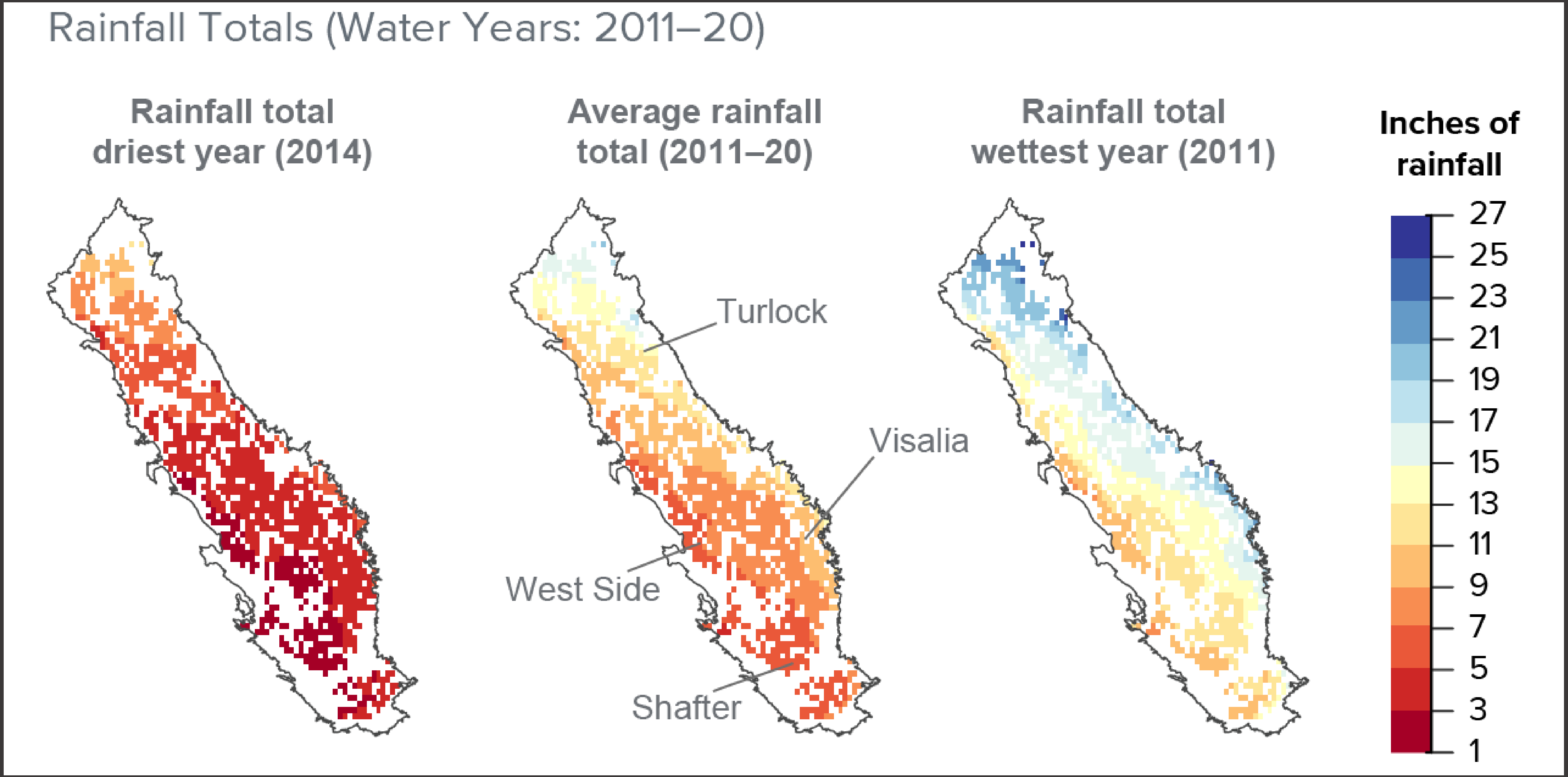
Objective:

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

Winter Cropping Systems

Benefits	Costs
Crop productivity/revenue Water infiltration Pest mitigation Pollution mitigation Crop rotation benefits Soil health/C storage Wildlife habitat	Water use (crop ET) Opportunity costs: Labor Land Time Flexibility

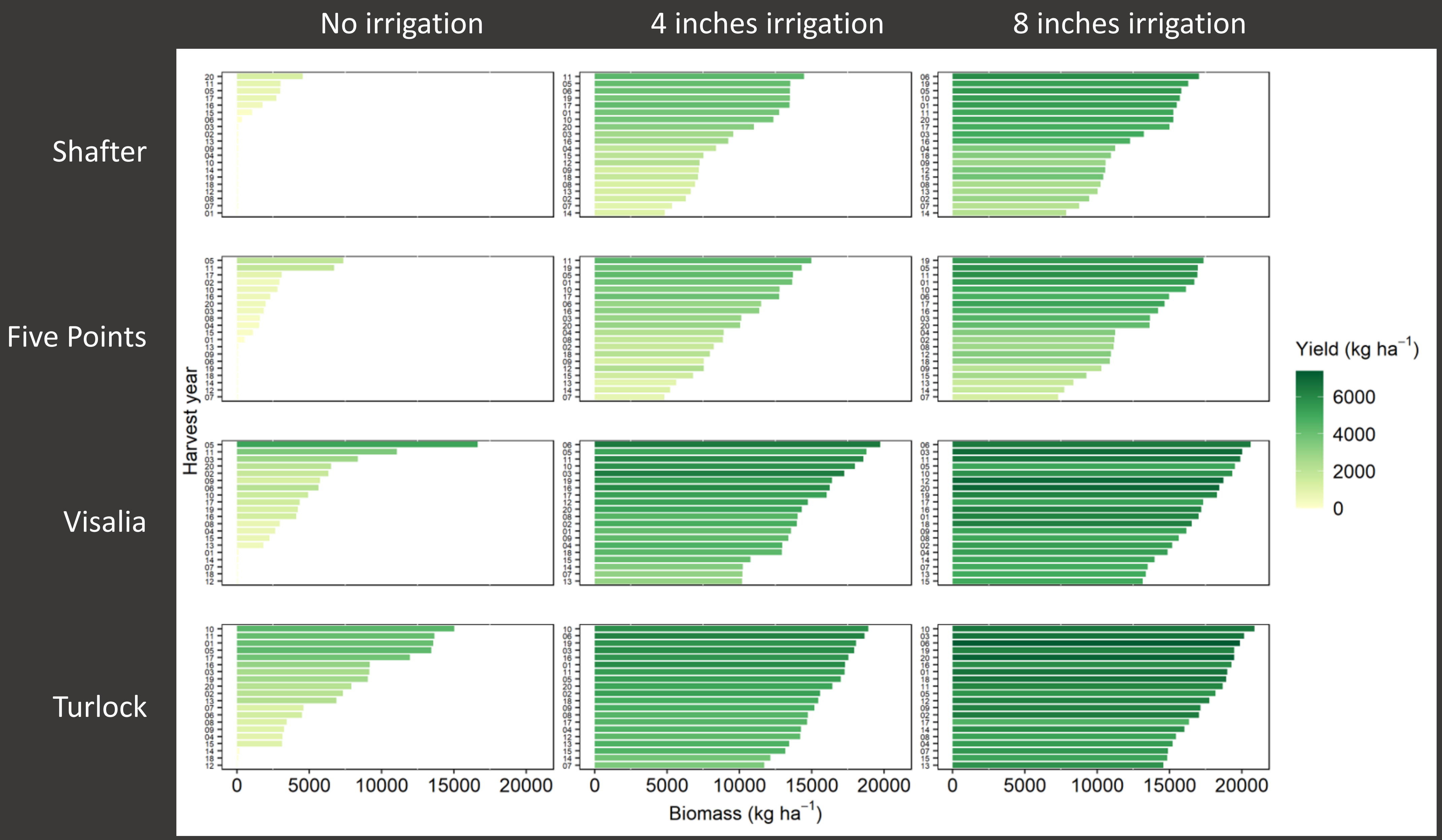
Precipitation is highly variable across space and time in the San Joaquin Valley



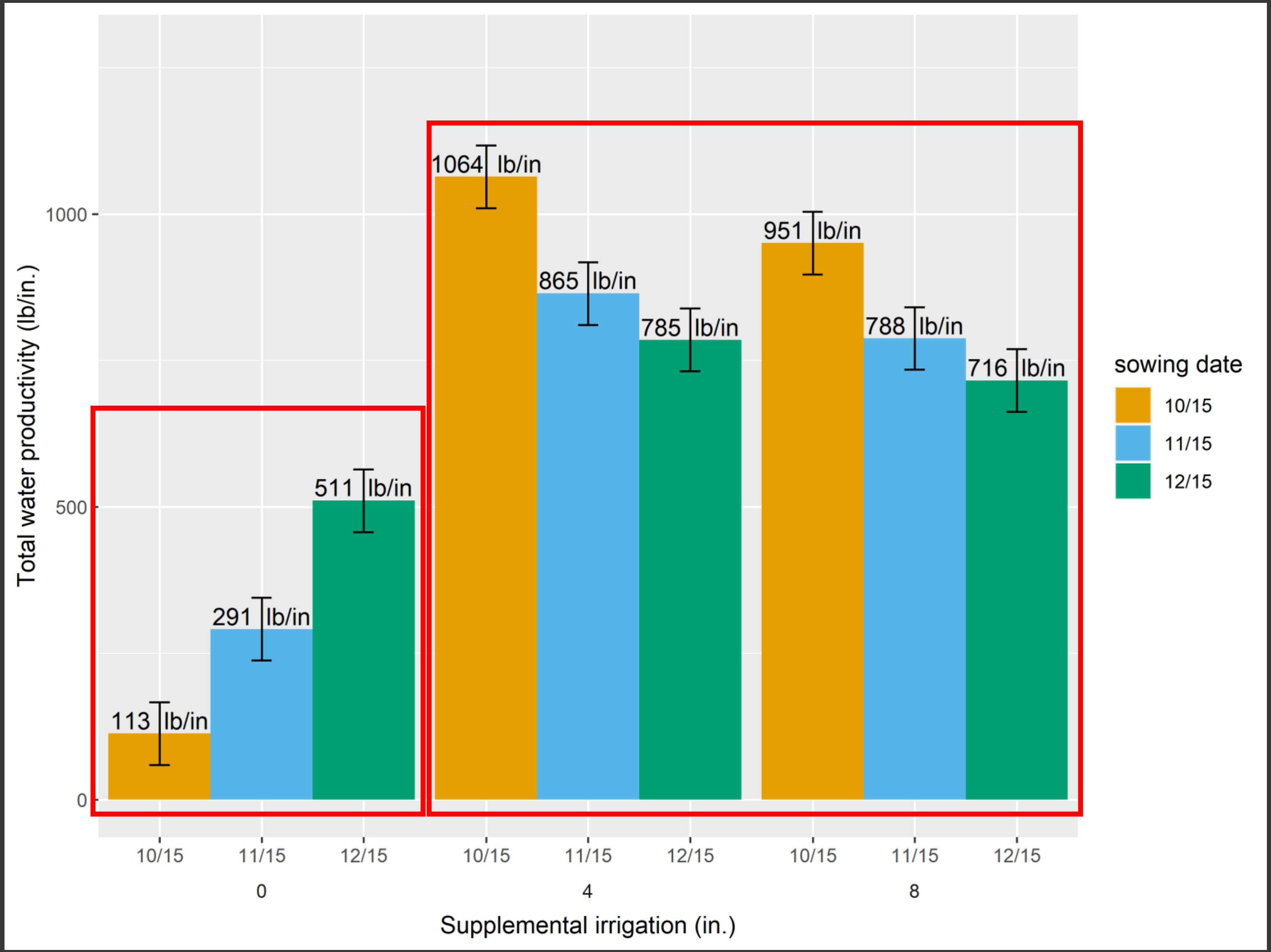
Methods:

- 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
Harvest year
Biomass (kg ha^{-1})
Yield (kg ha^{-1})
6000
4000
2000
0
0
5000
10000
15000
20000



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.

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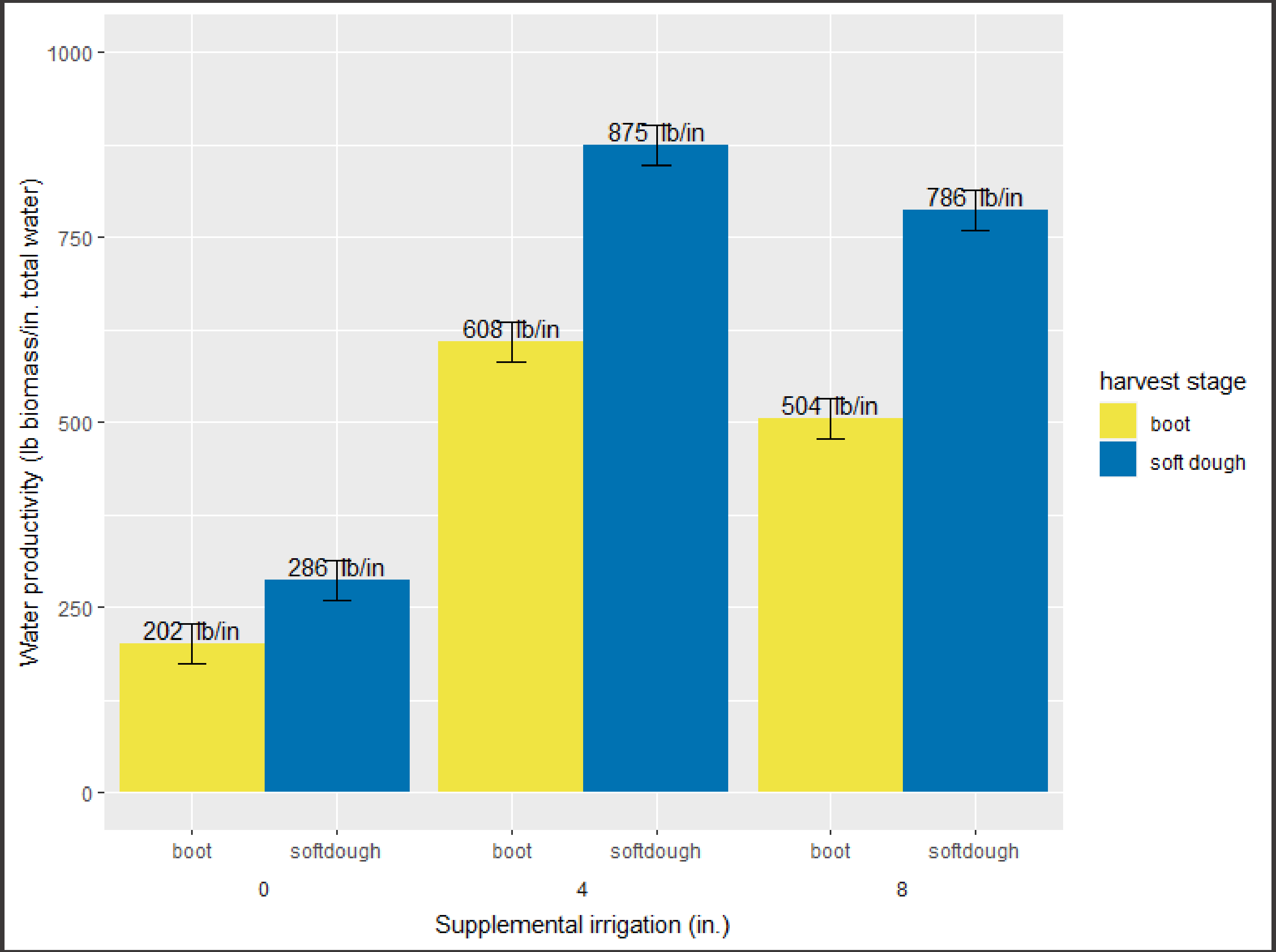
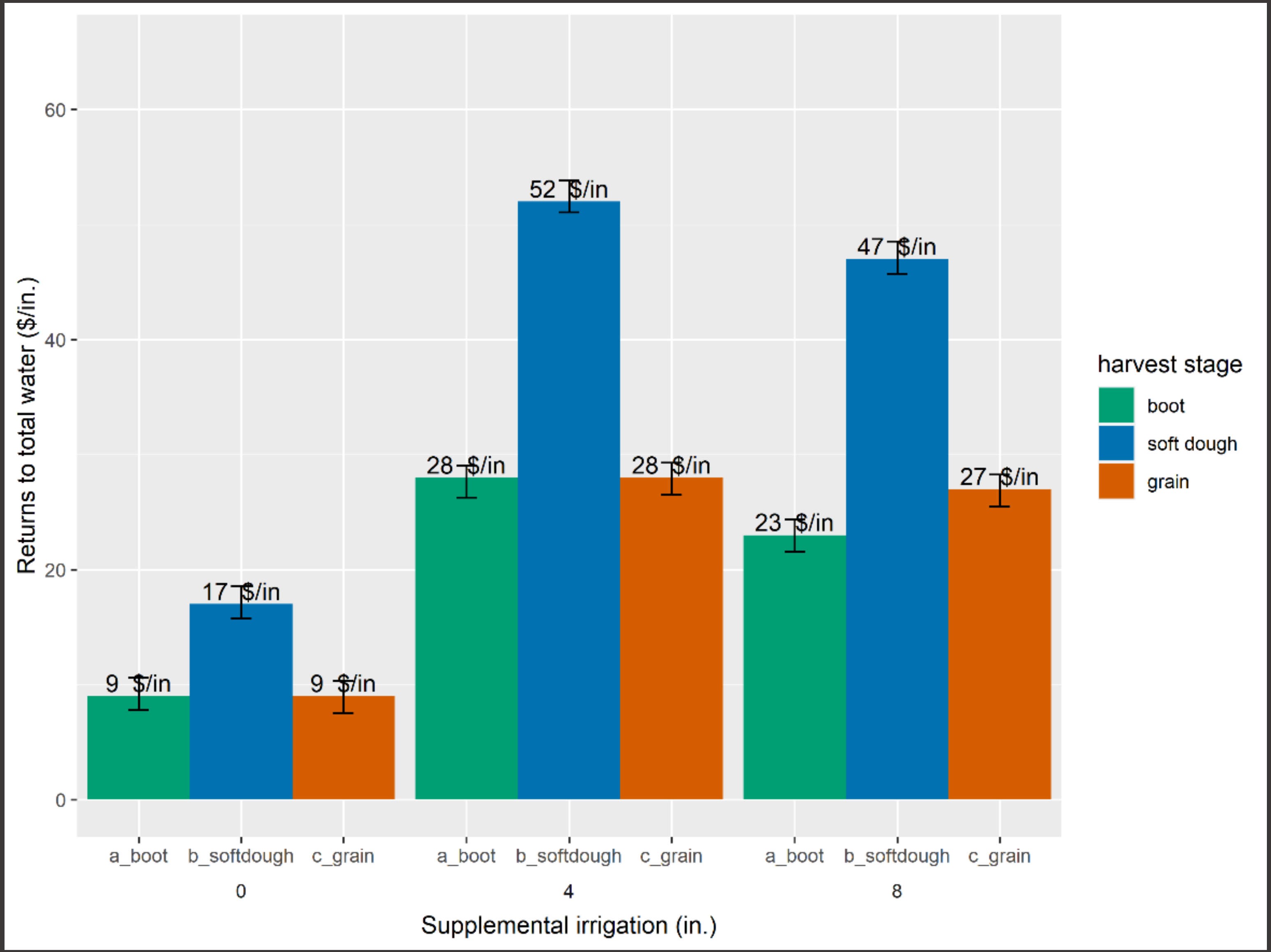


not irrigated 4 inches irrigation 8 inches irrigation

- 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.

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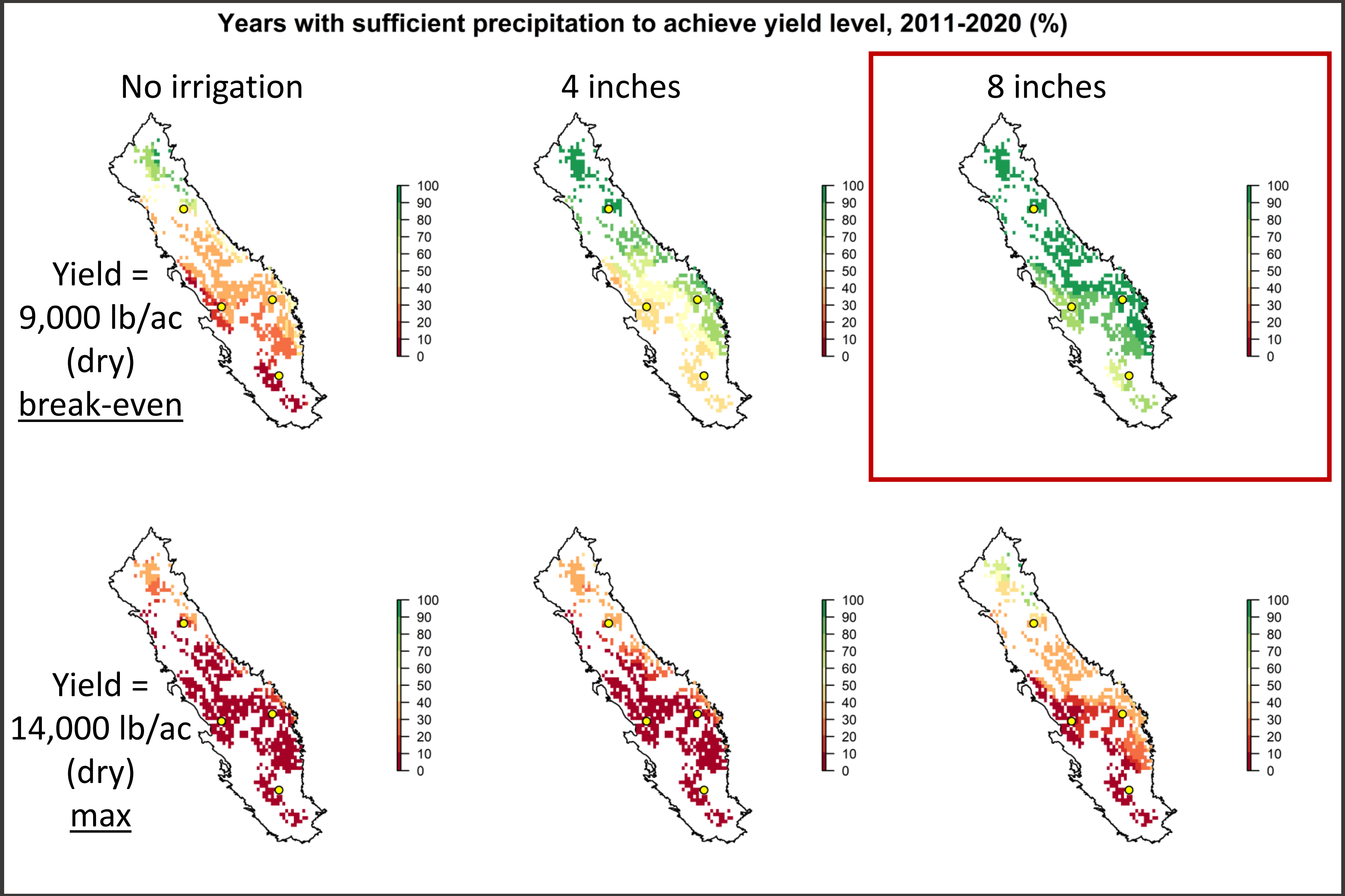


- Targeted early-season irrigation greatly expands the feasibility of winter forage production in the SJV
- 58% of acreage with limited surface water (i.e. ≤ 2 ac-ft/yr) can reliably (i.e. 100% of years) achieve break-even yield levels with targeted irrigations totaling 8 inches.

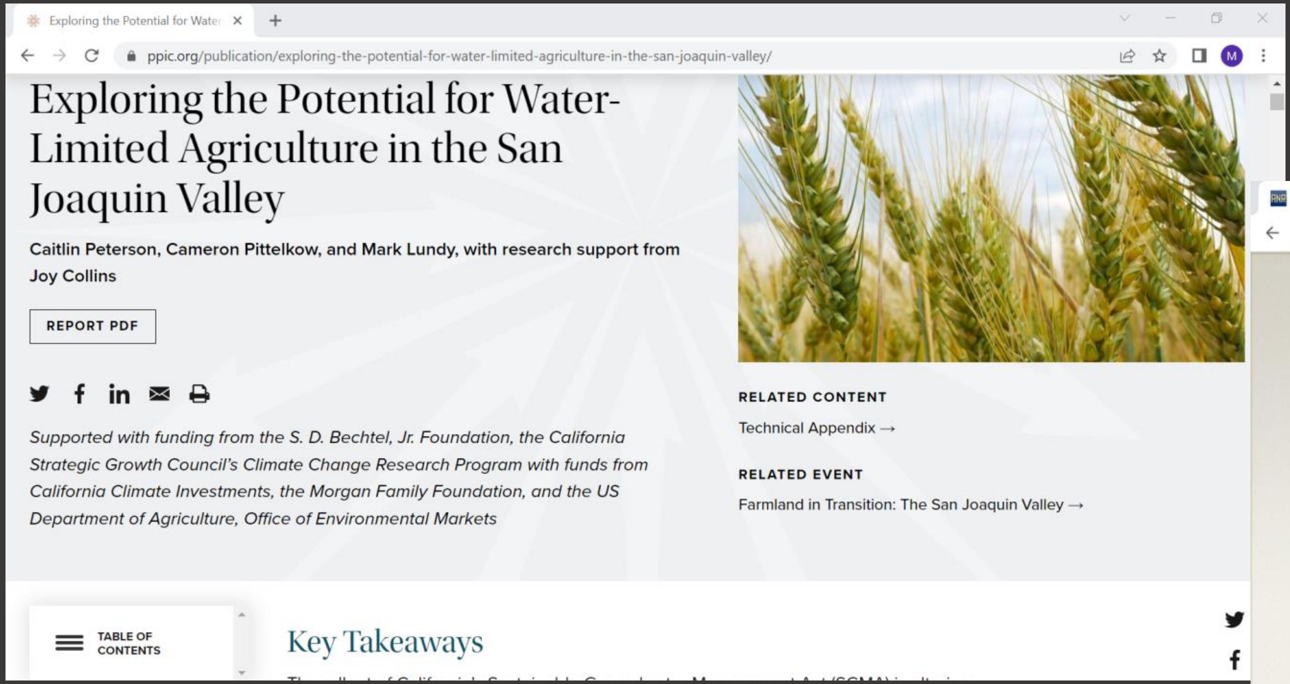
Summary:

- 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



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

https://smallgrains.ucanr.edu/

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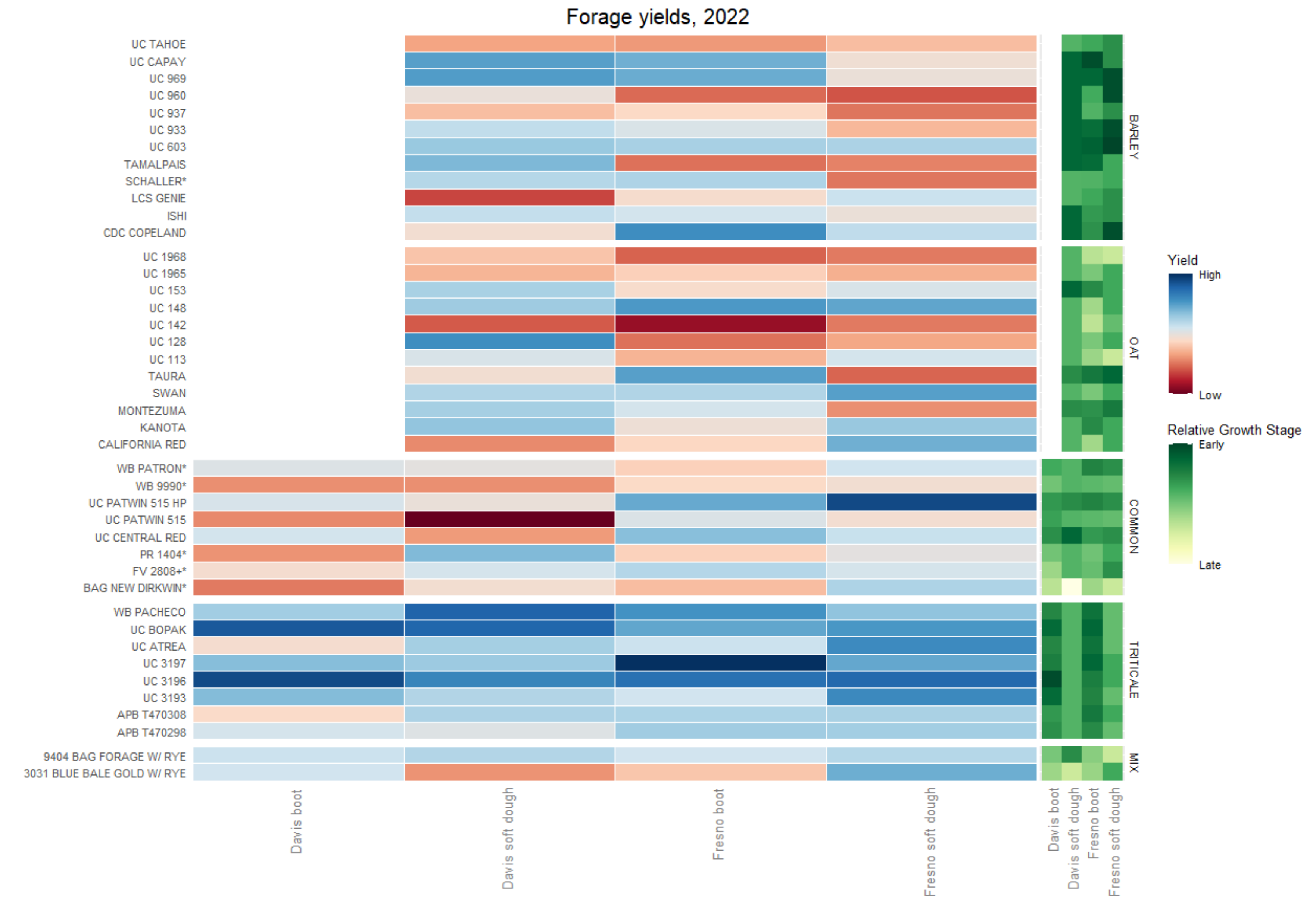
Additional Resources



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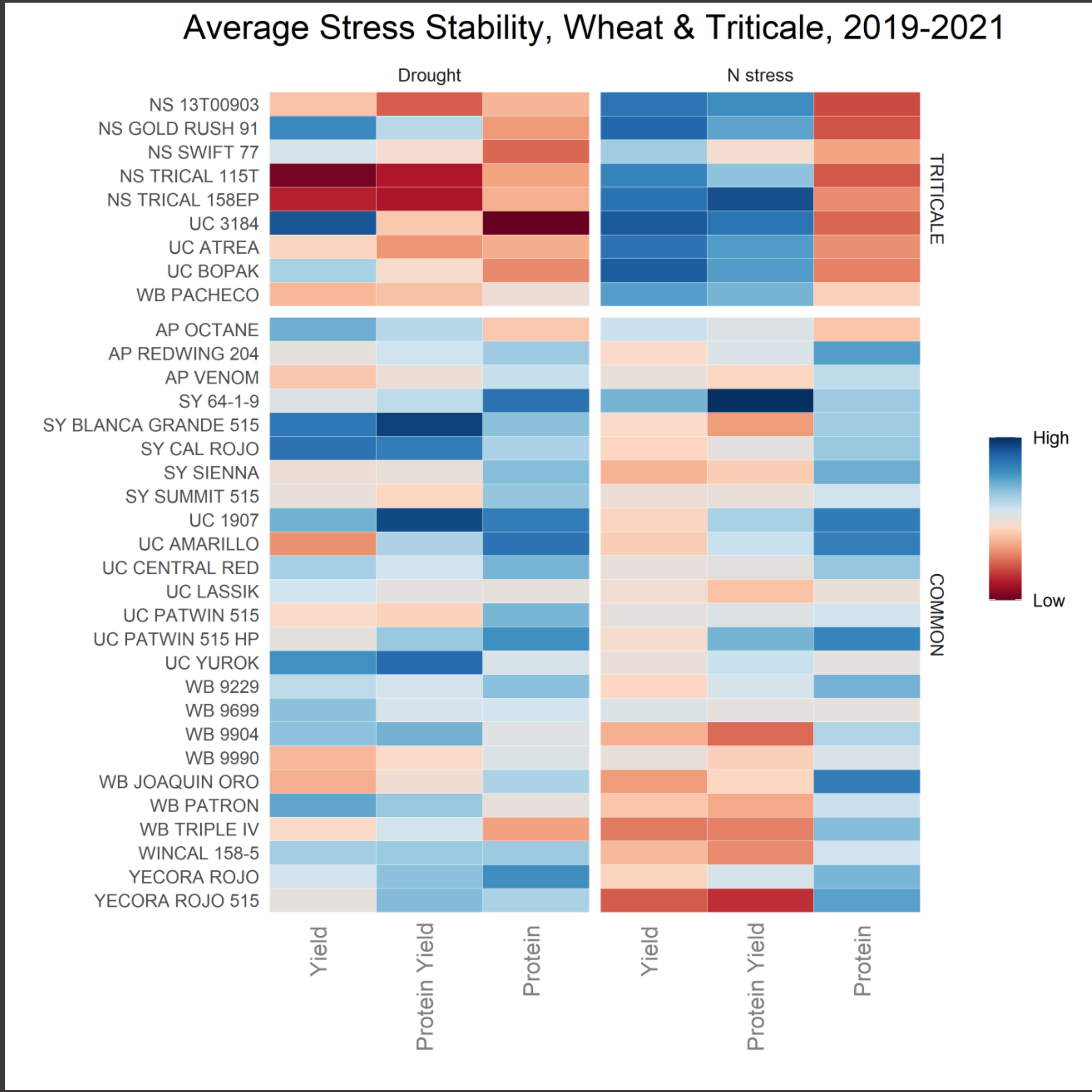

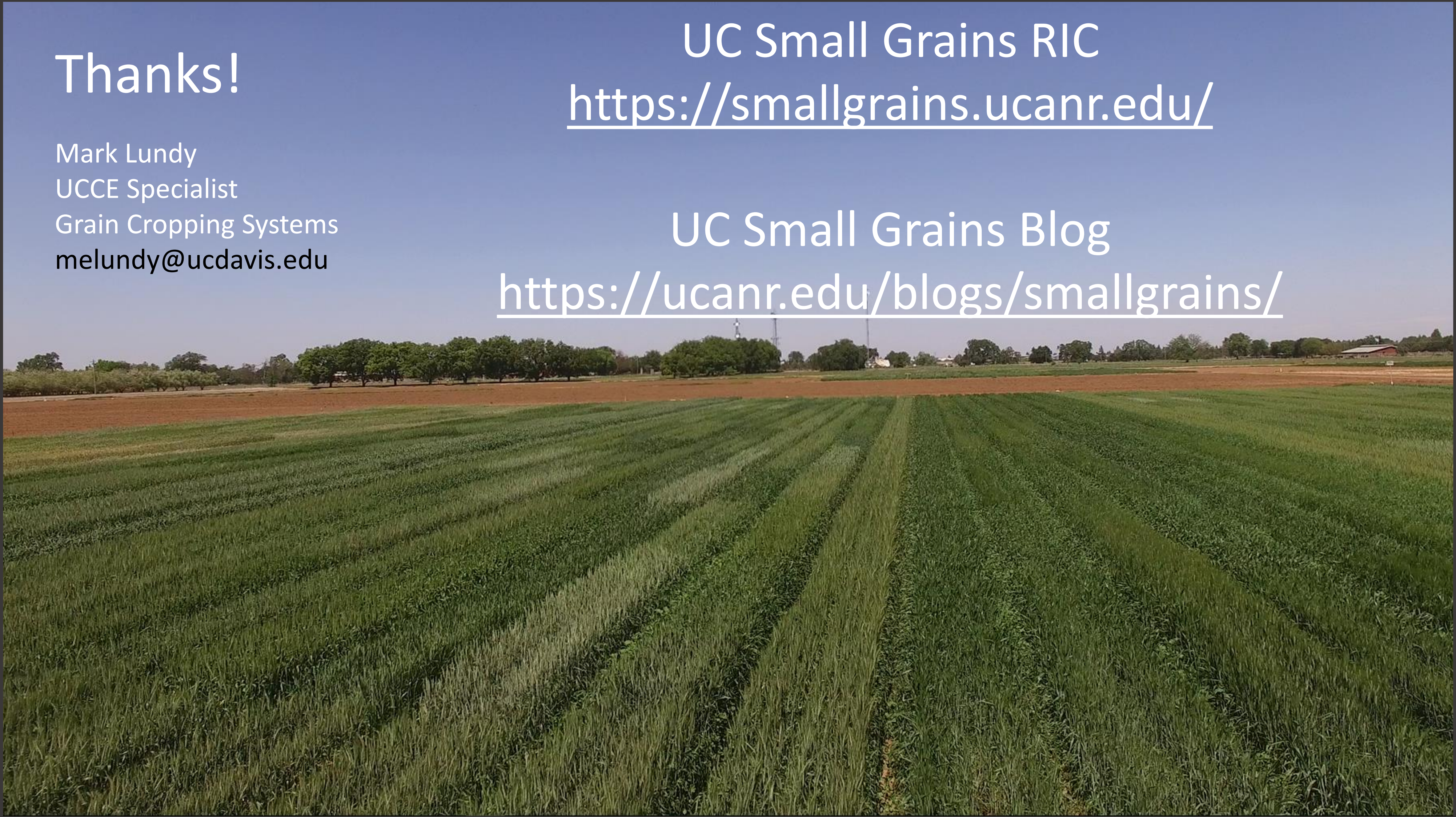

Thanks!

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UC Small Grains RIC
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