Water productivity of small grains in short water years

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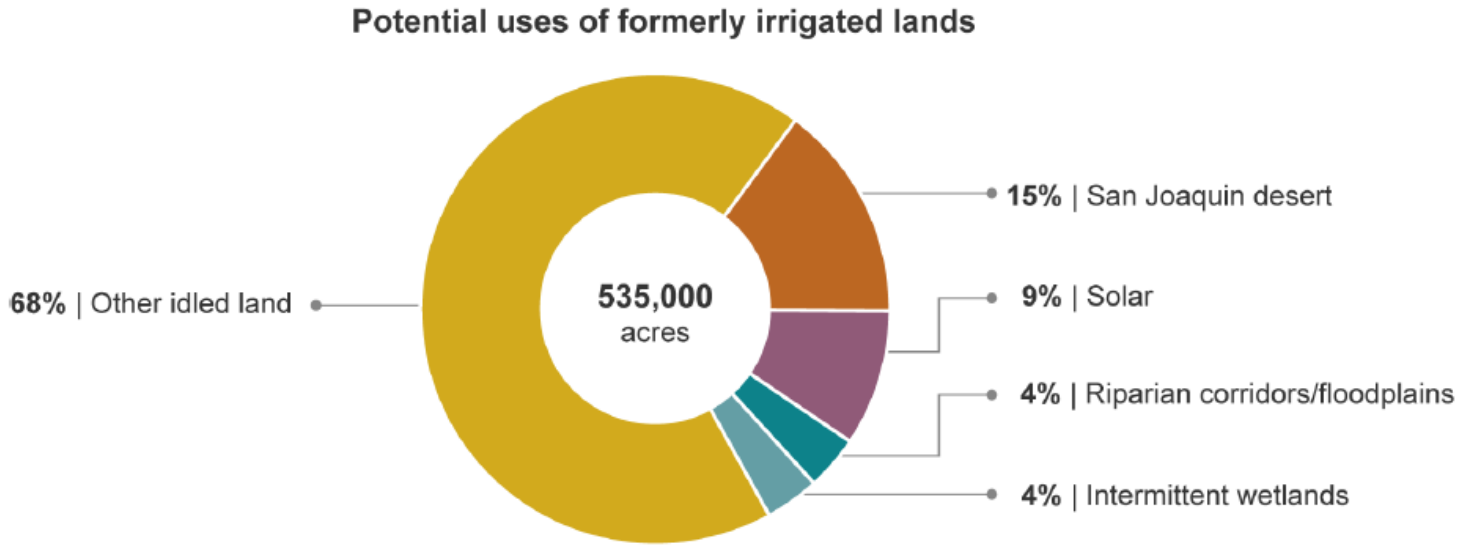
Context:

- 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



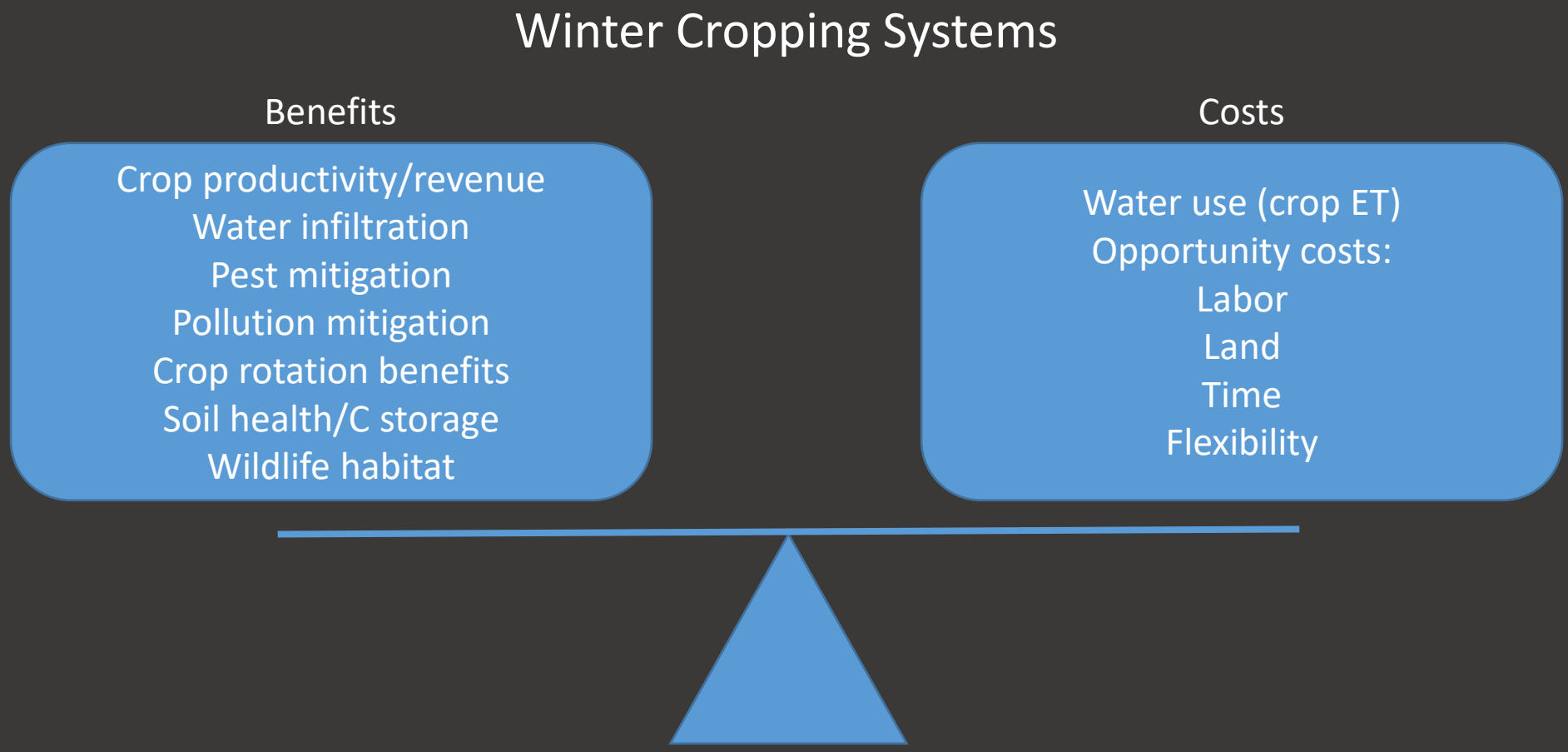
SOURCE: Author estimates. For details on sources and assumptions, see technical appendix Table E2.

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.

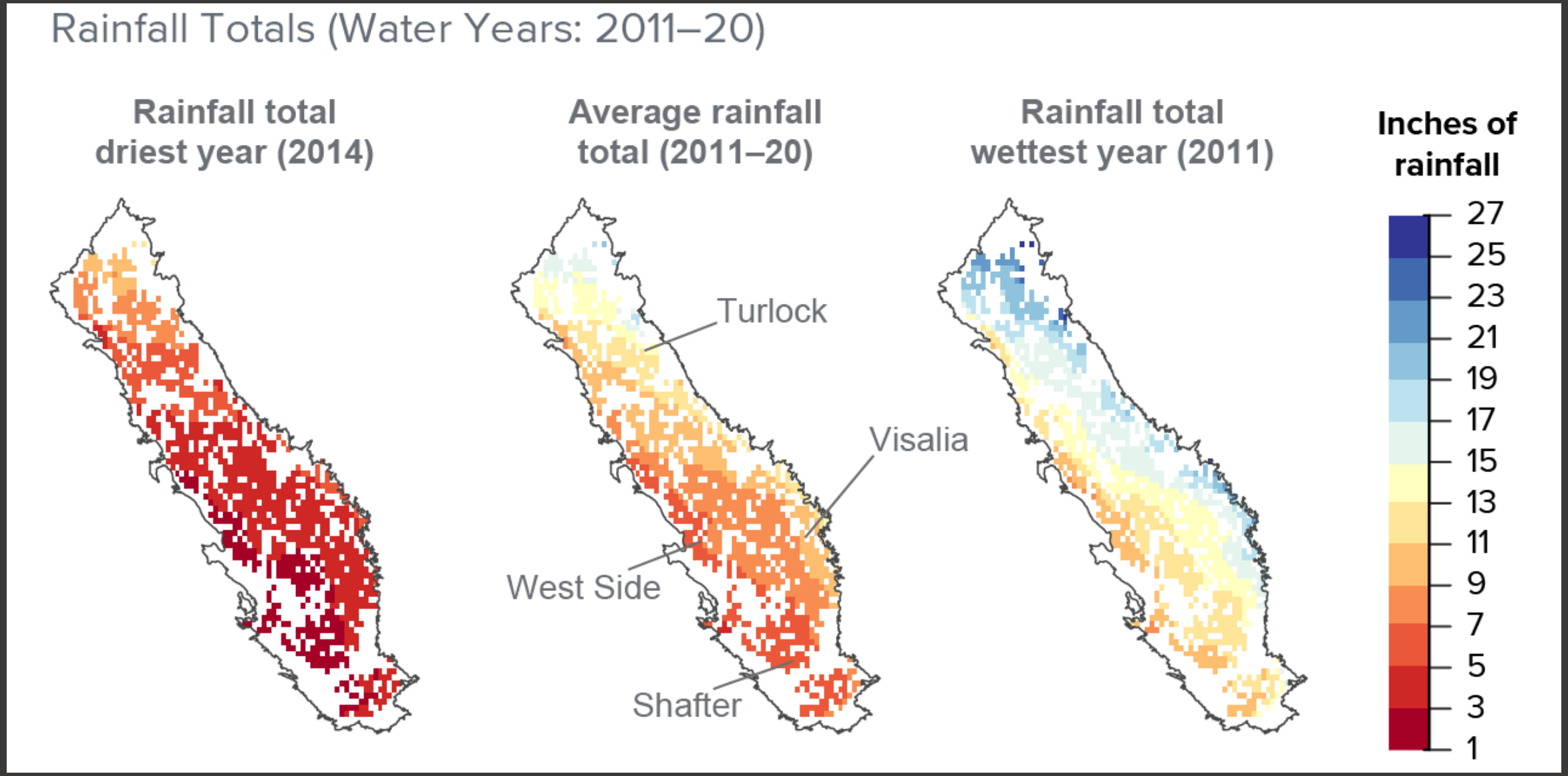
Hanak, et al. 2019. Water and the Future of the San Joaquin Valley. Public Policy Institute of California. February 22, 2019. Accessed: 29 January, 2021: https://www.ppic.org/publication/water-and-the-future-of-the-san-joaquin-valley/

Objective:

- Quantify winter cereal forage and grain production under rainfed and deficit-irrigated production strategies in the San Joaquin Valley.



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

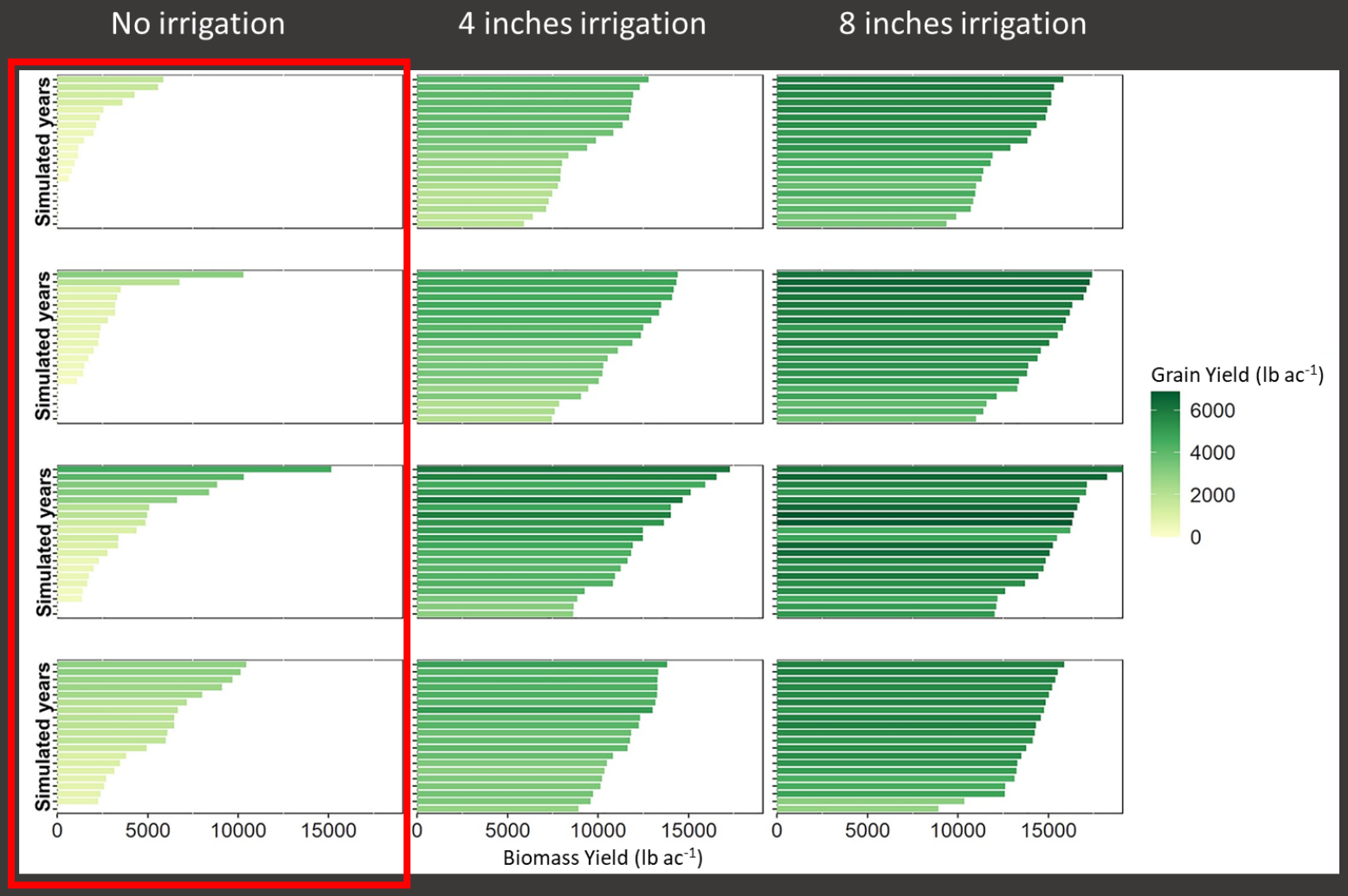


Study 1:

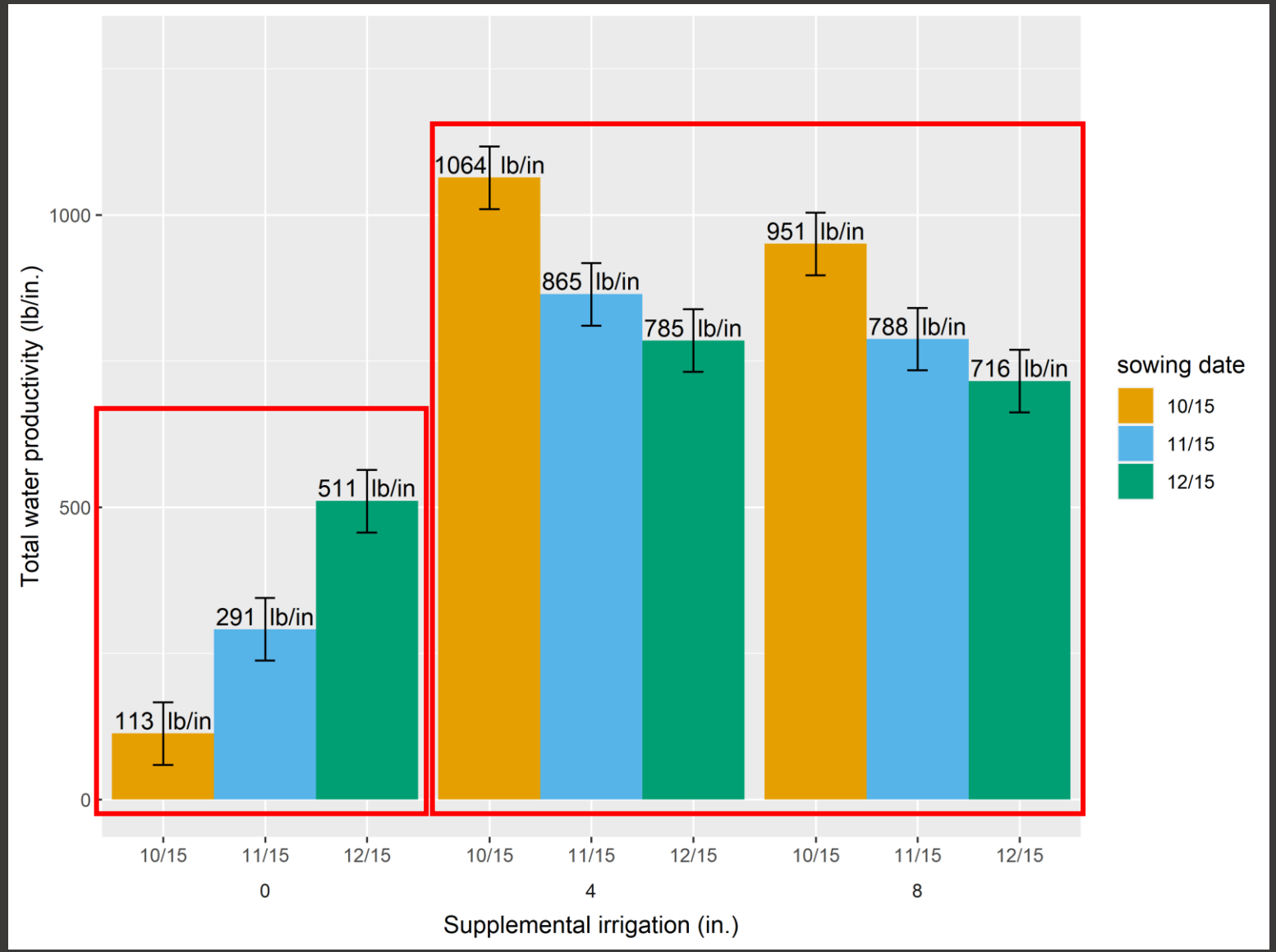
- Calibrate and use APSIM crop model to estimate the effects of irrigation amount and planting timing on crop and water productivity under rainfed and deficit irrigation scenarios.

- Determine probability of crop success under rainfed and deficit irrigation scenarios for locations in the San Joaquin Valley.

20-year simulation at locations with a range of rainfall totals in SJV

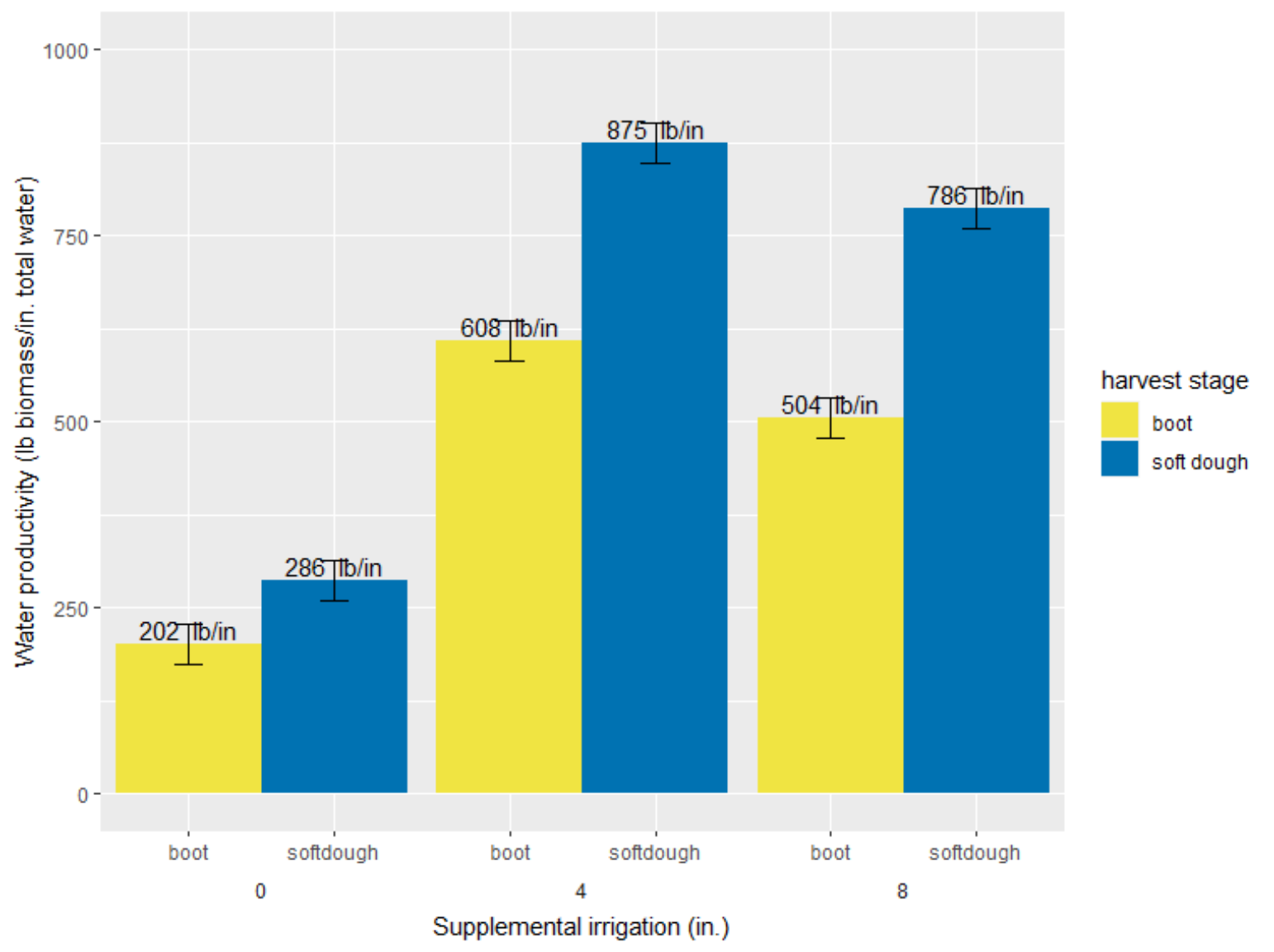


- When no irrigation is applied, probability of crop failure is high



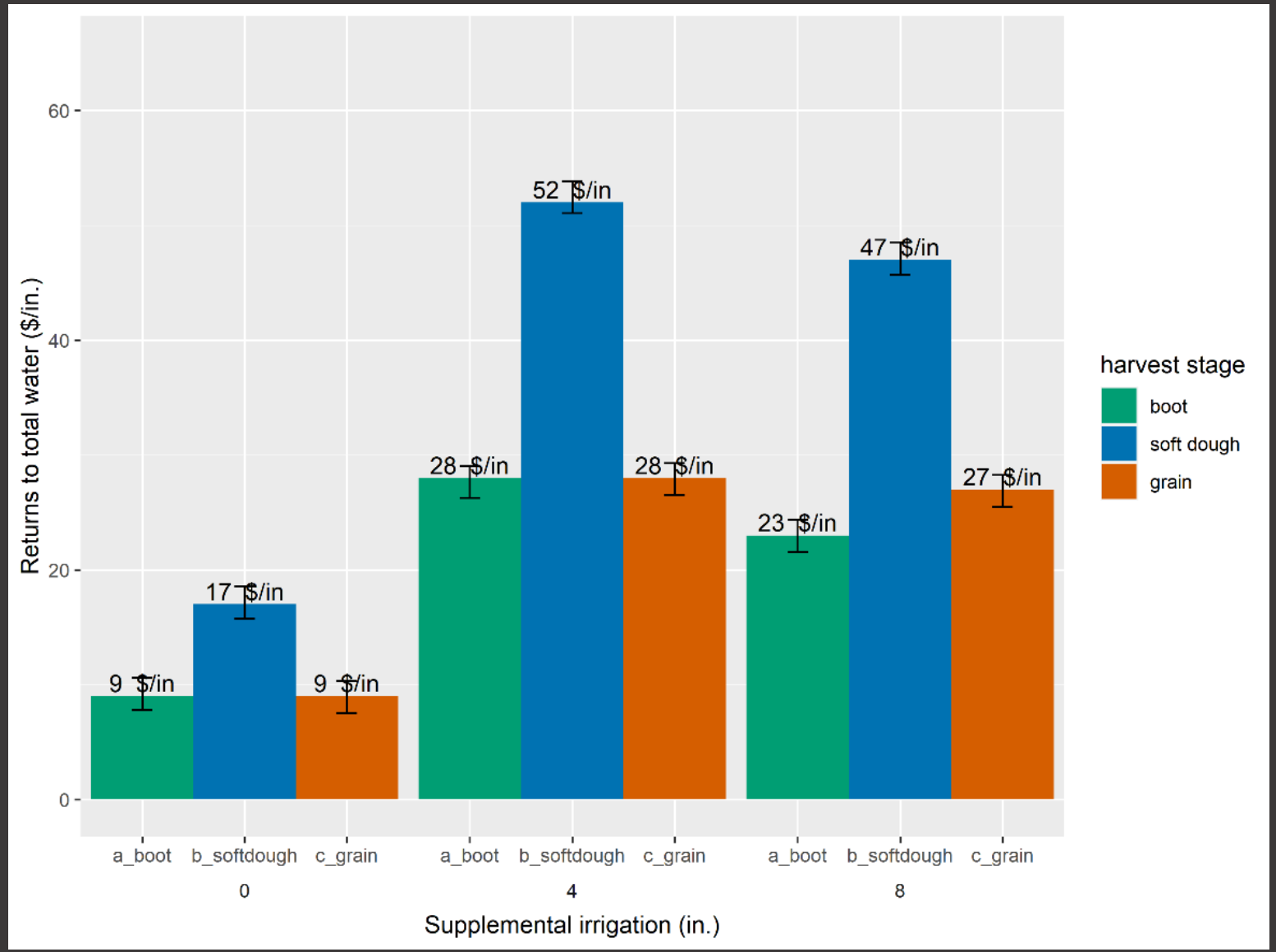
not irrigated 4 inches irrigation 8 inches irrigation

- If no irrigation is applied, planting later 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.



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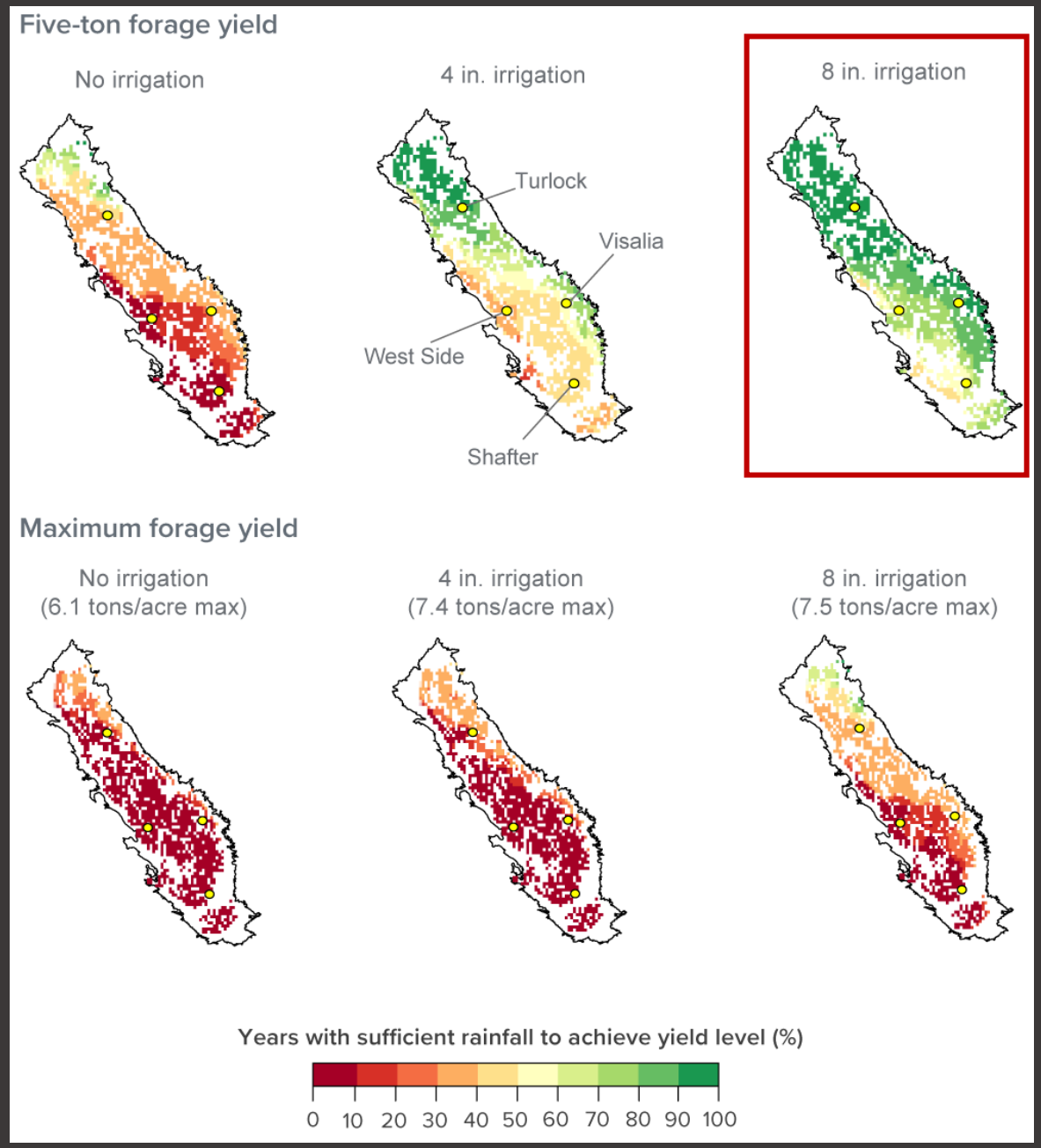
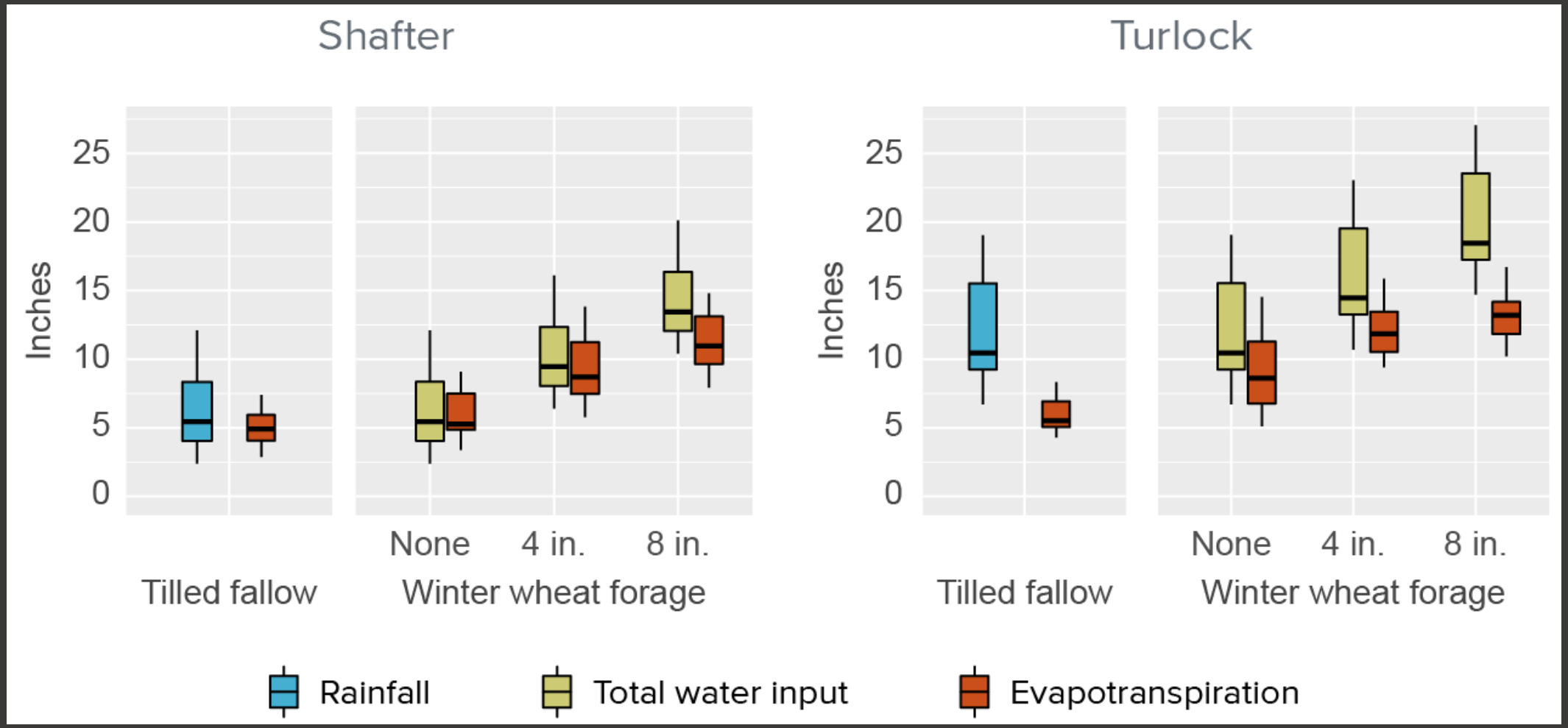
- Regardless of the amount of irrigation applied, forages harvested at soft dough stage have the highest water productivity and the highest returns to total water consumption at average prices.
- Evaporation is a larger portion of evapotranspiration (ET) for boot-stage forages than for soft dough forages.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



- Targeted early-season irrigation greatly expands the feasibility of winter forage production in the SJV

- 58% of acreage with limited surface water (≤ 2 ac-ft/yr) can reliably (100% of years) achieve break-even yield levels with targeted irrigations totaling 8 inches.

Fallow ground loses water too



Summary Study 1:

- 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.

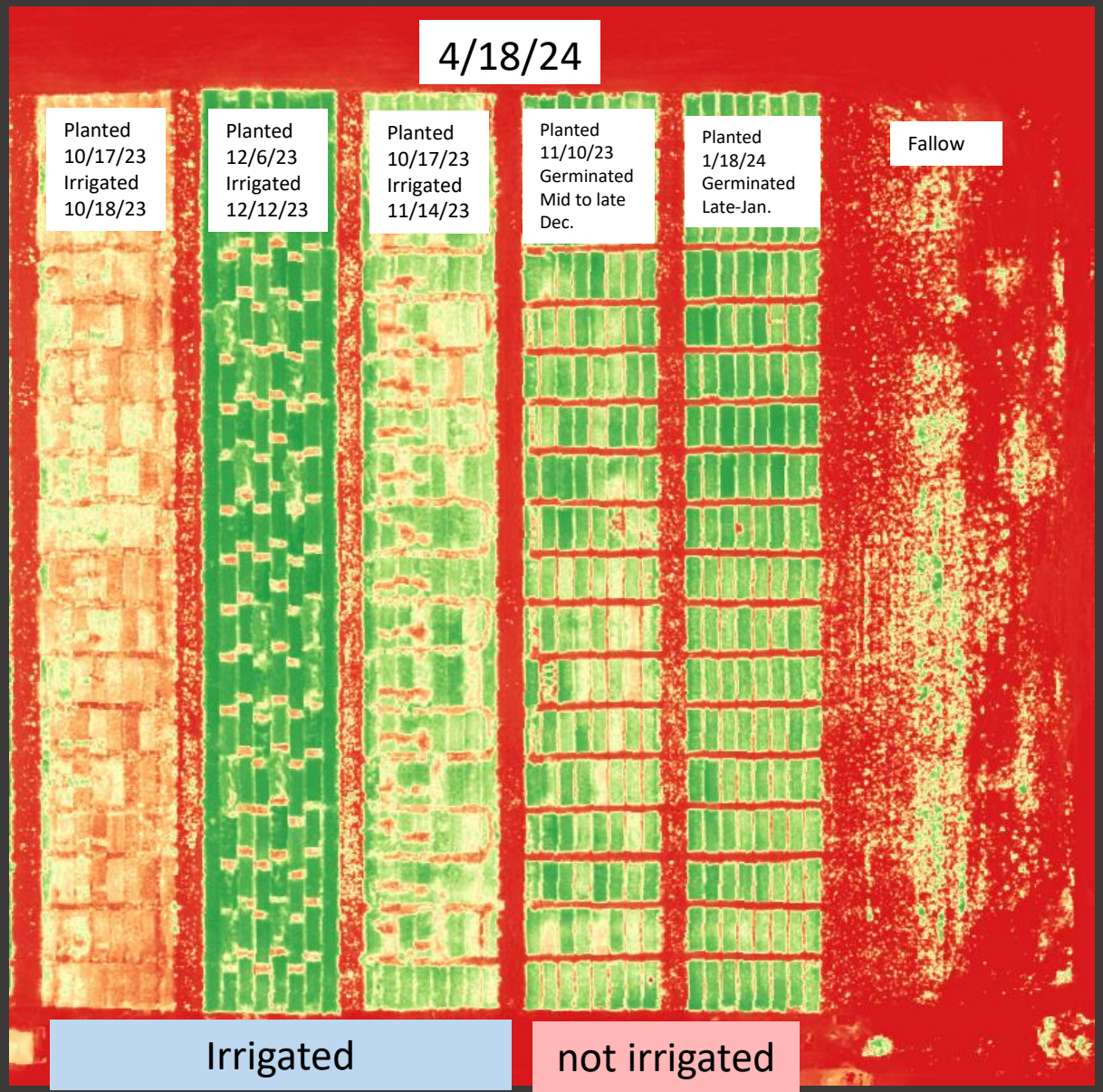
- If taking a deficit-irrigation approach to winter cereal forage production:
  - early-planting and soft dough harvests maximize crop and water productivity

- 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.

Study 2:

How much does crop type and variety impact forage and grain yields under deficit-irrigation strategies?

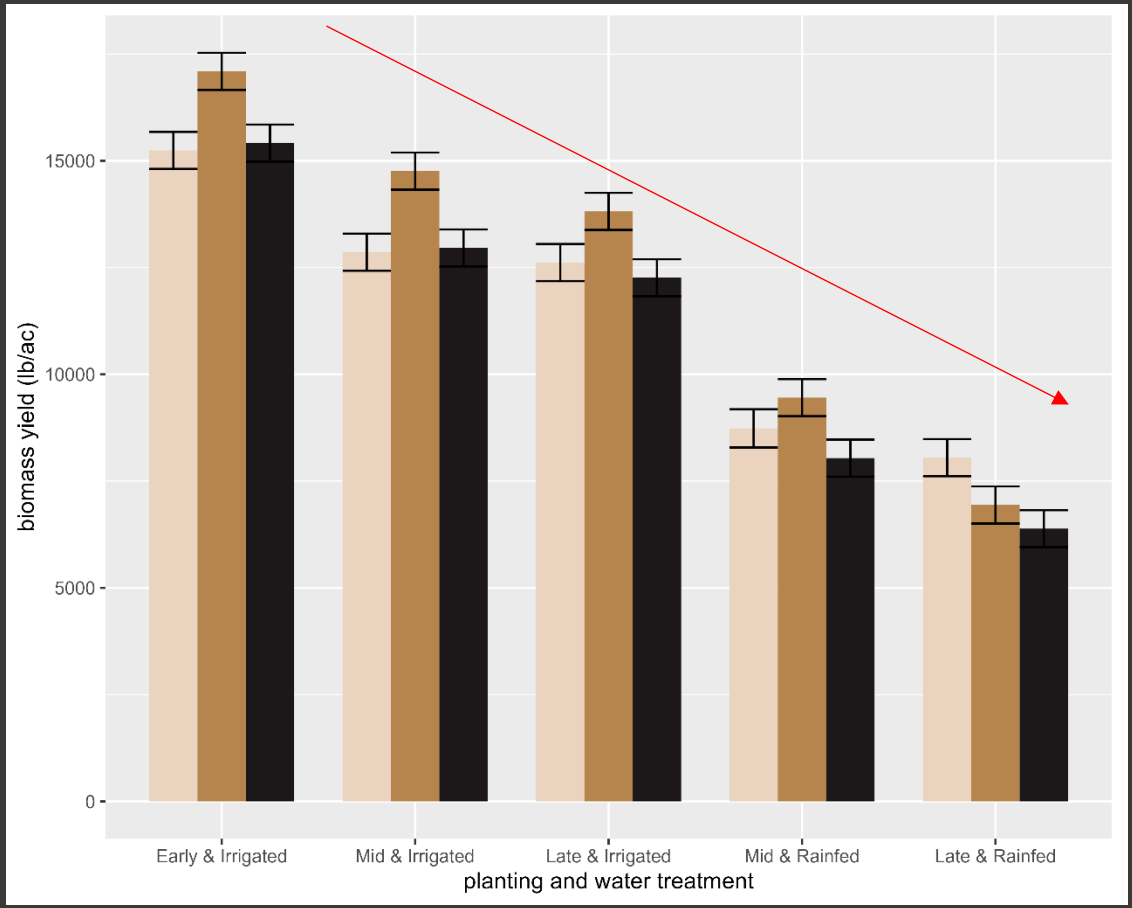
Methods: identifying genotypes/phenotypes that maximize water productivity under deficit irrigation



Planting date has inconsistent effect on biomass vs grain yields

Irrigated (~4 in)

not irrigated



Biomass: the earlier the better

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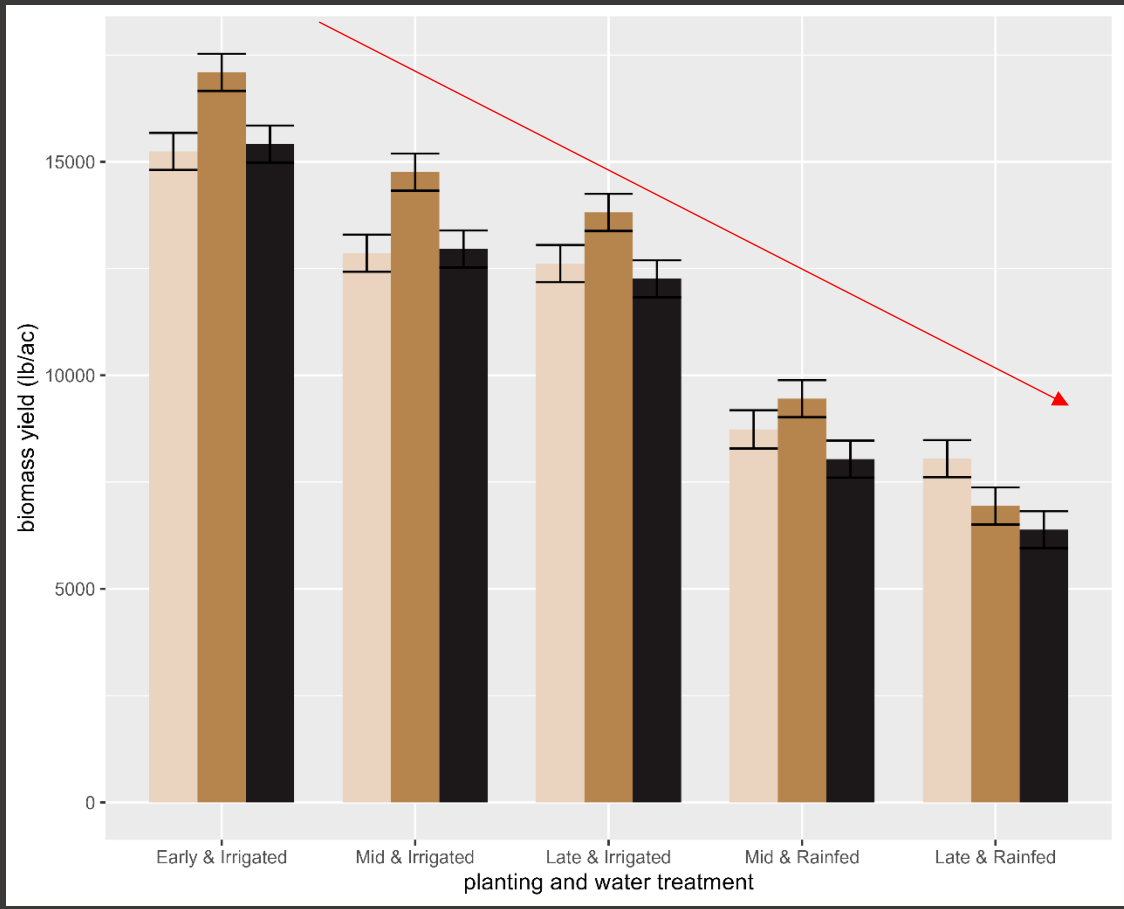

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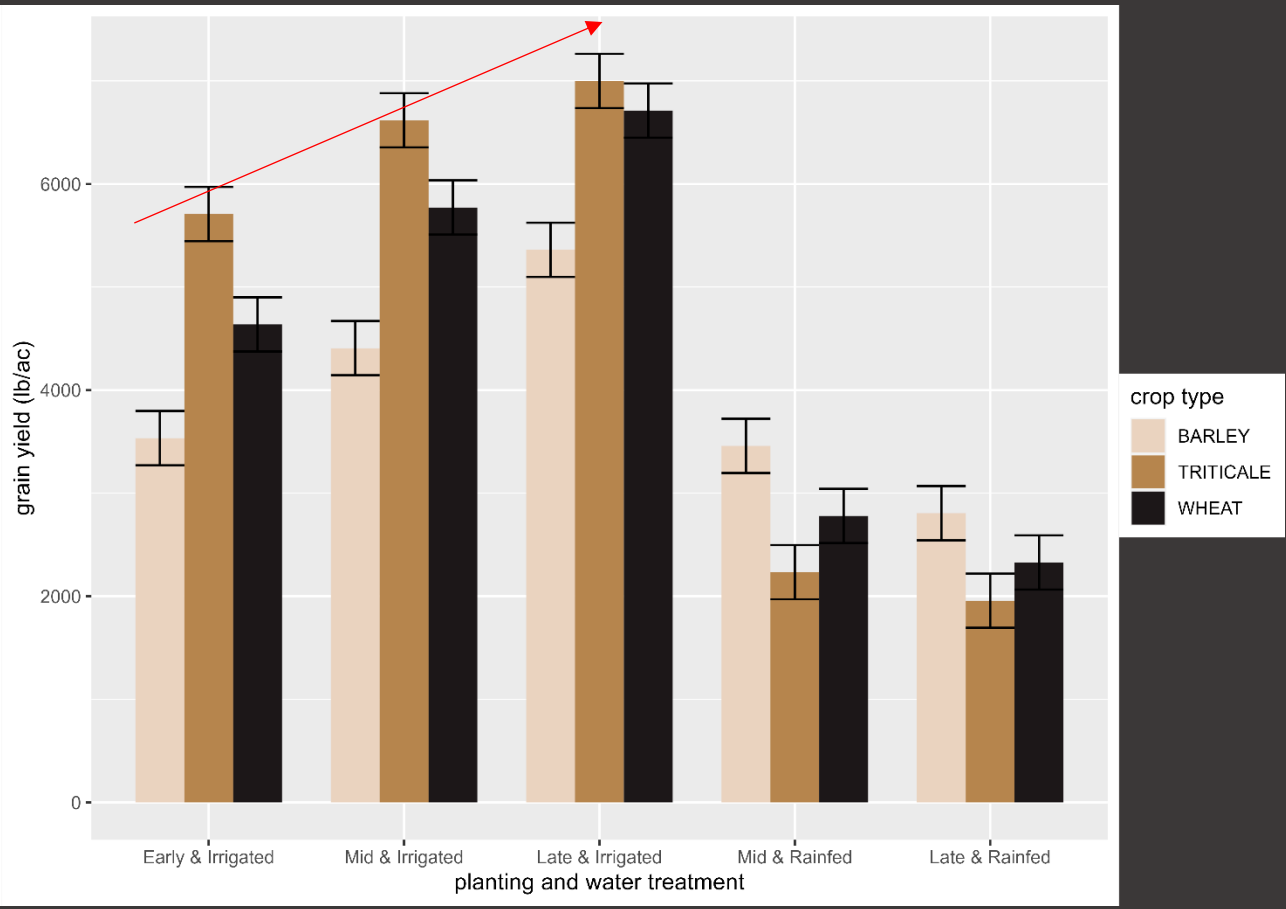

Grain: later is better when irrigated at planting

Variety selection (and development) matters

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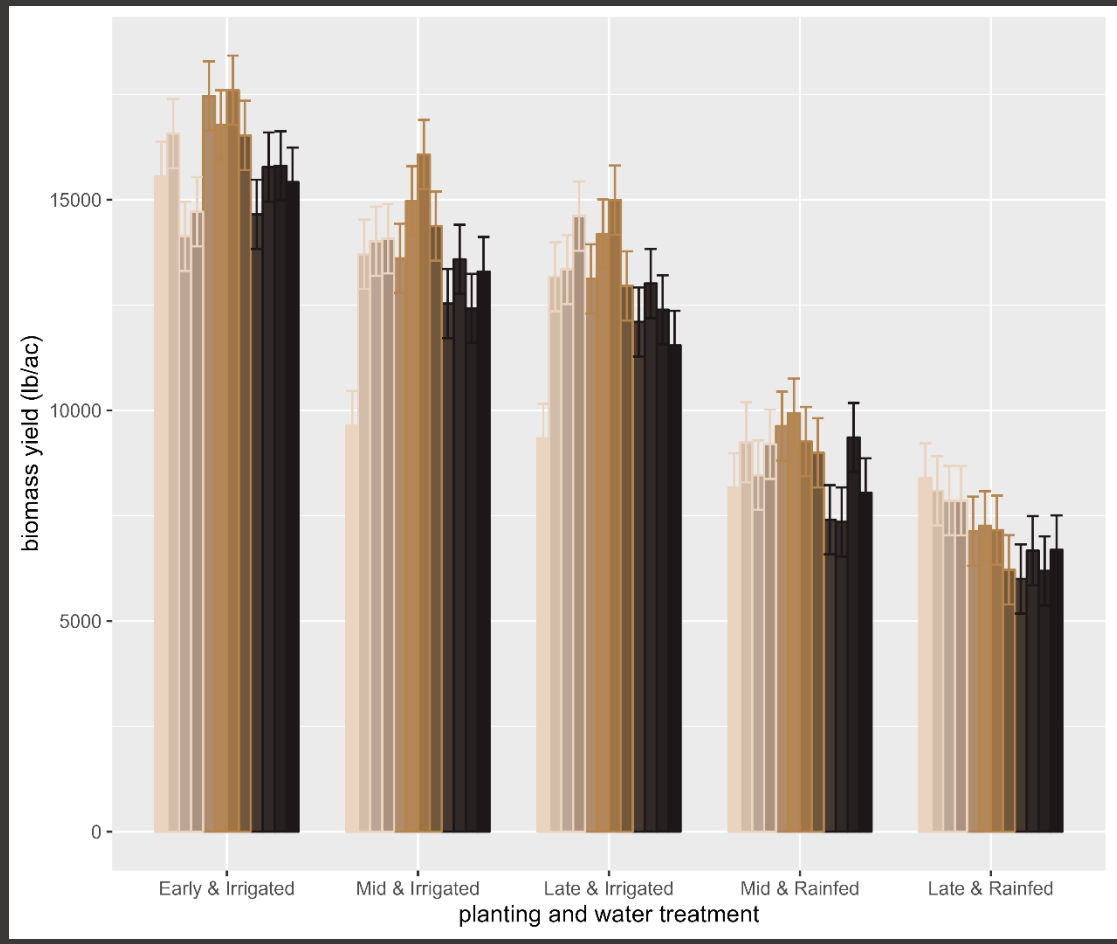

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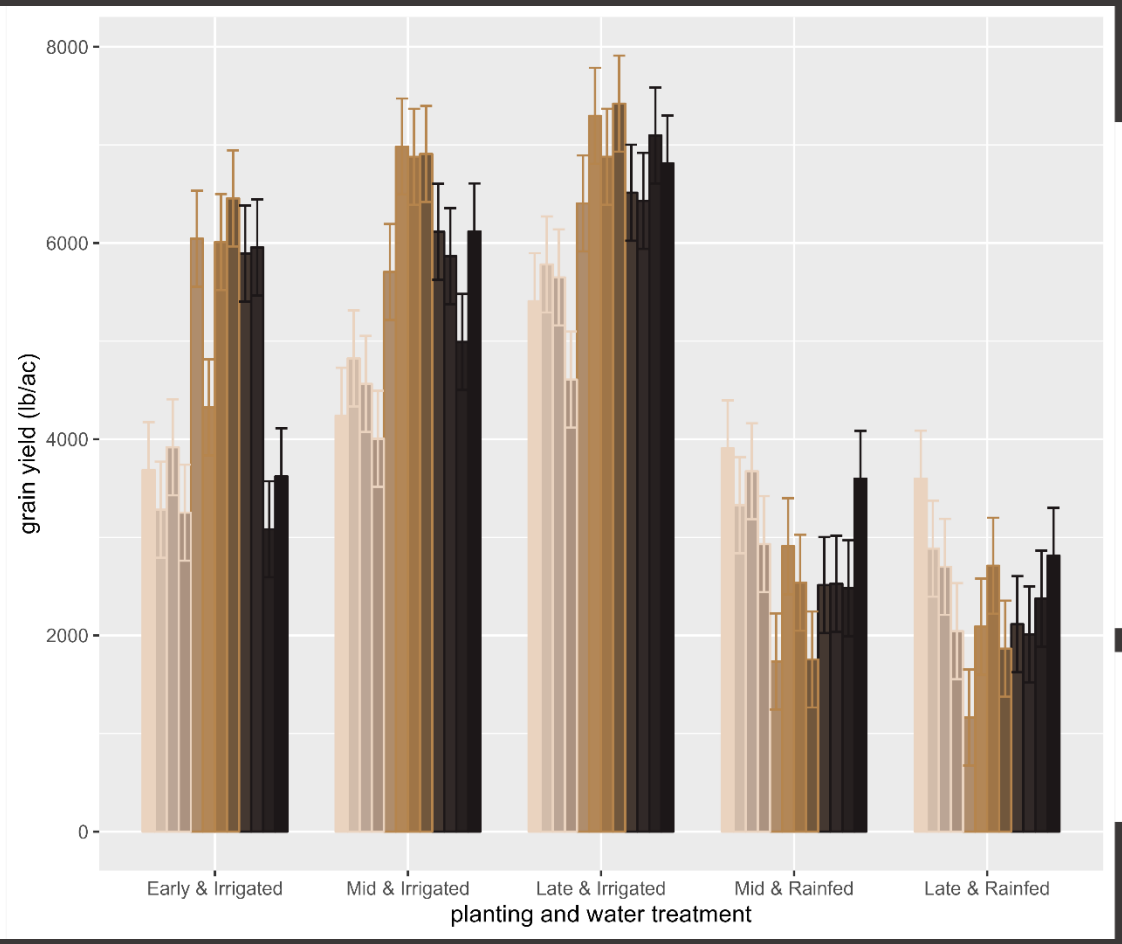

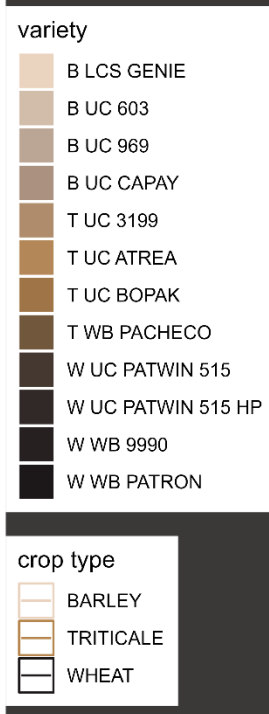

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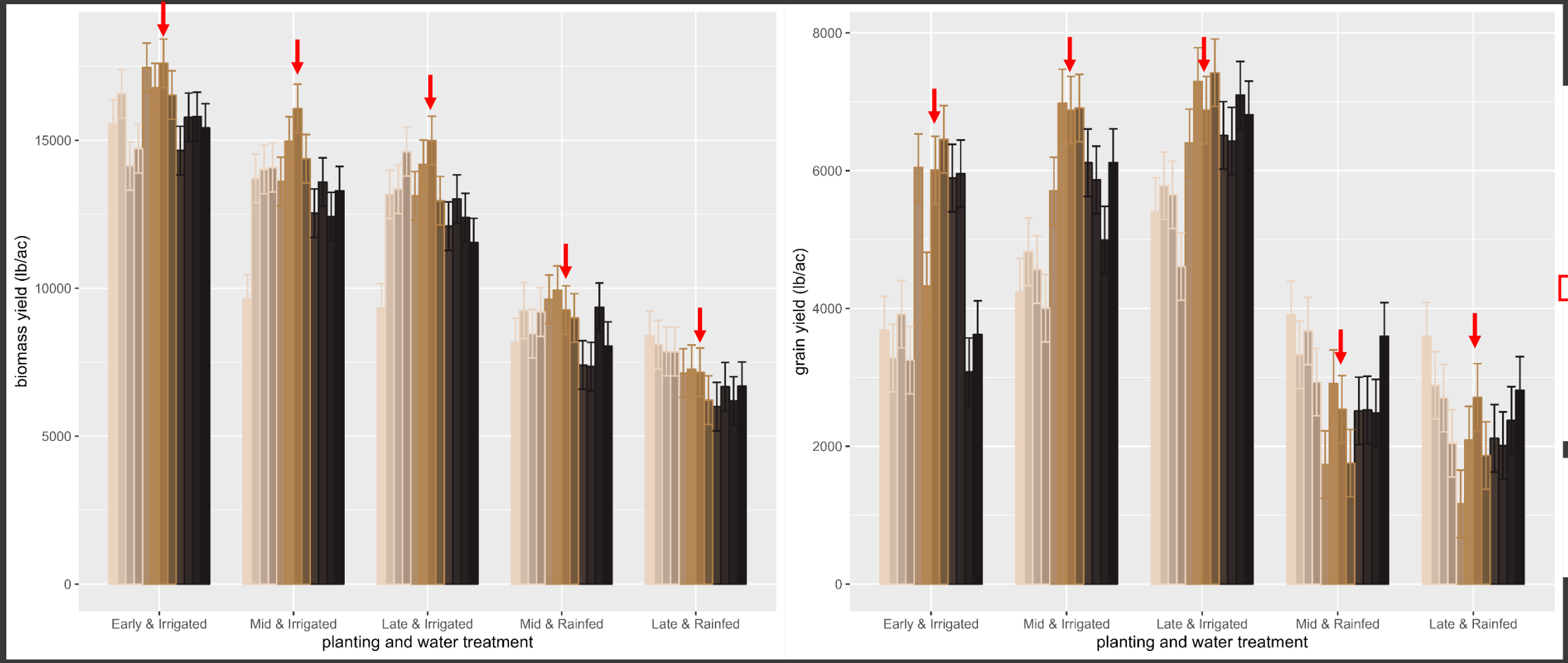

Across all environments combined, UC Bopak (triticale) is highest yielding in biomass and grain yield

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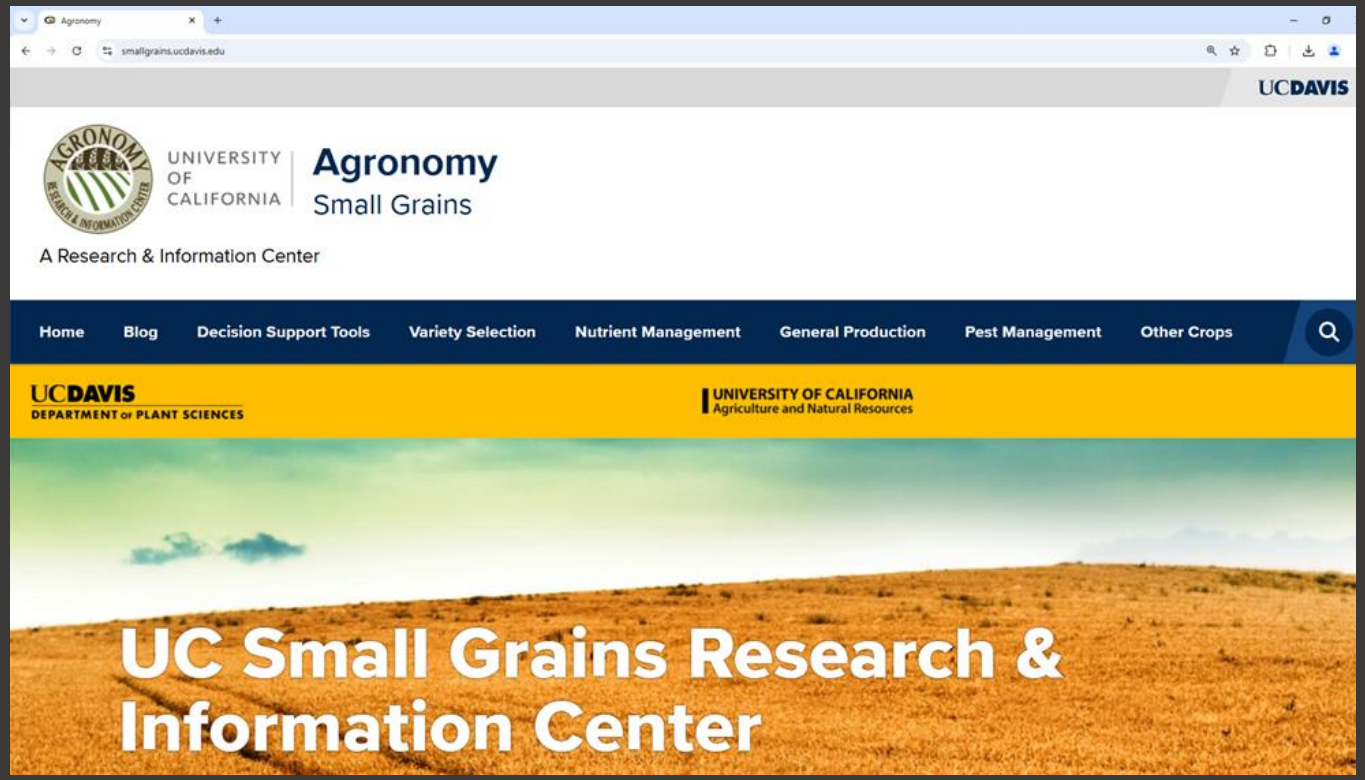
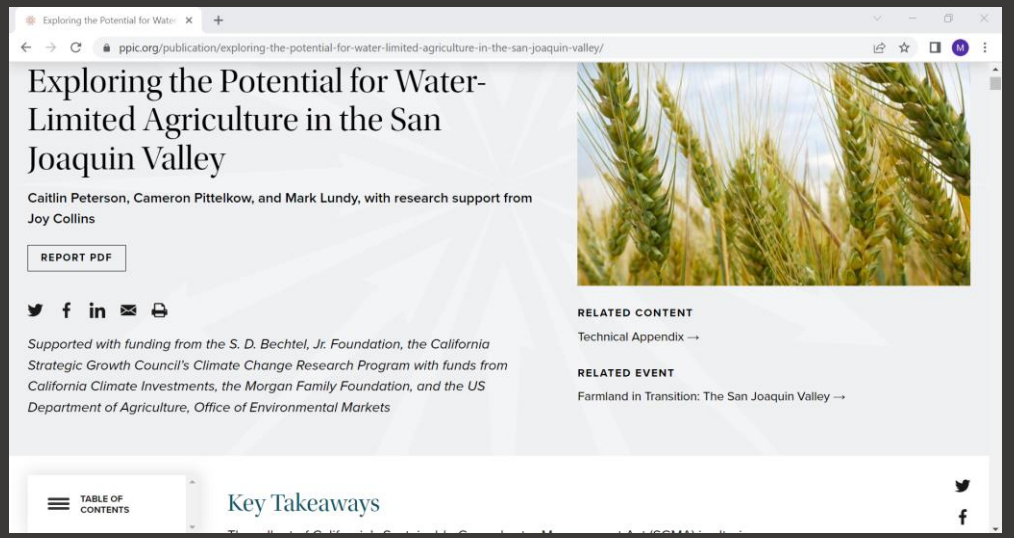
Additional Resources



https://smallgrains.ucdavis.edu/



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

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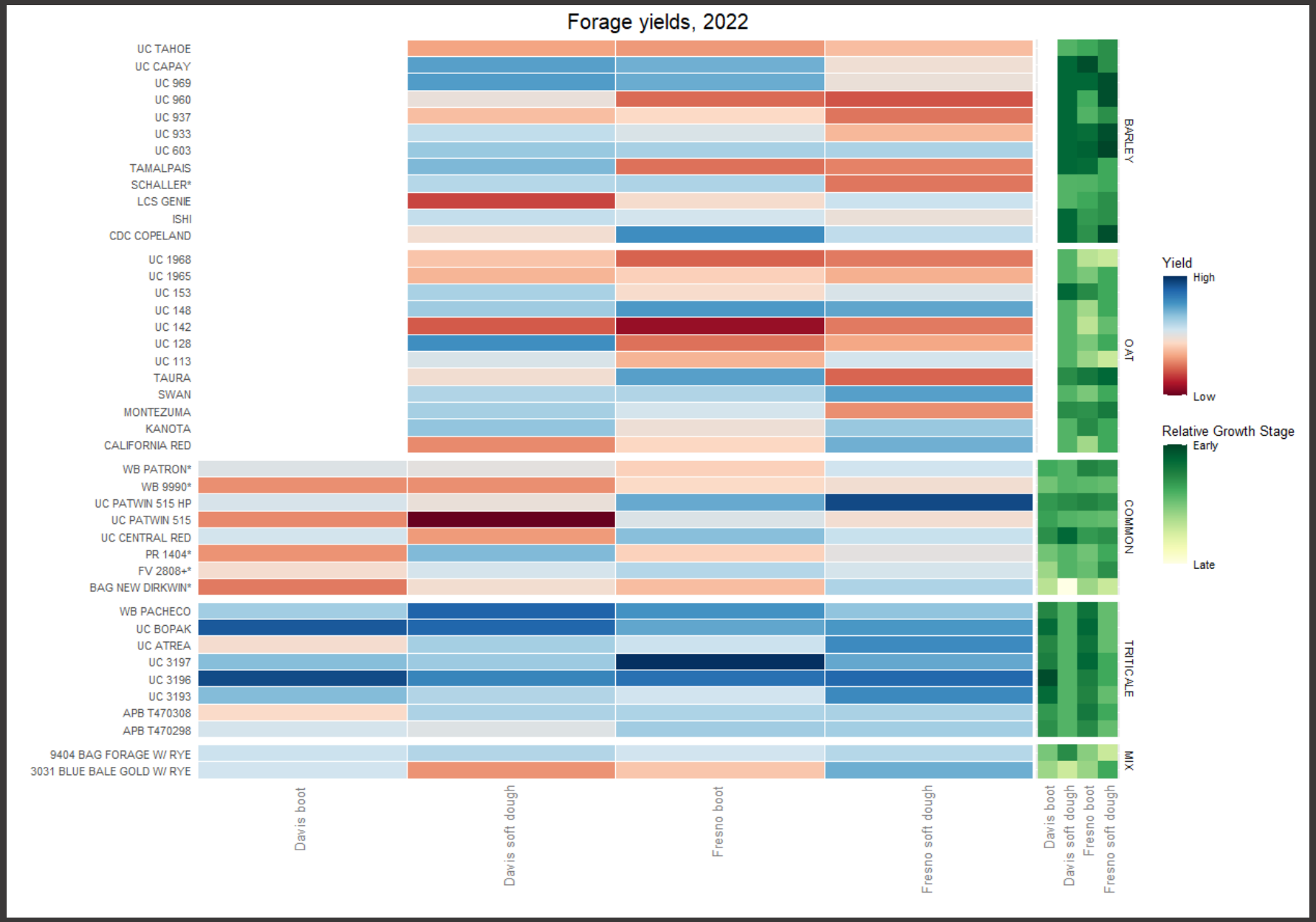

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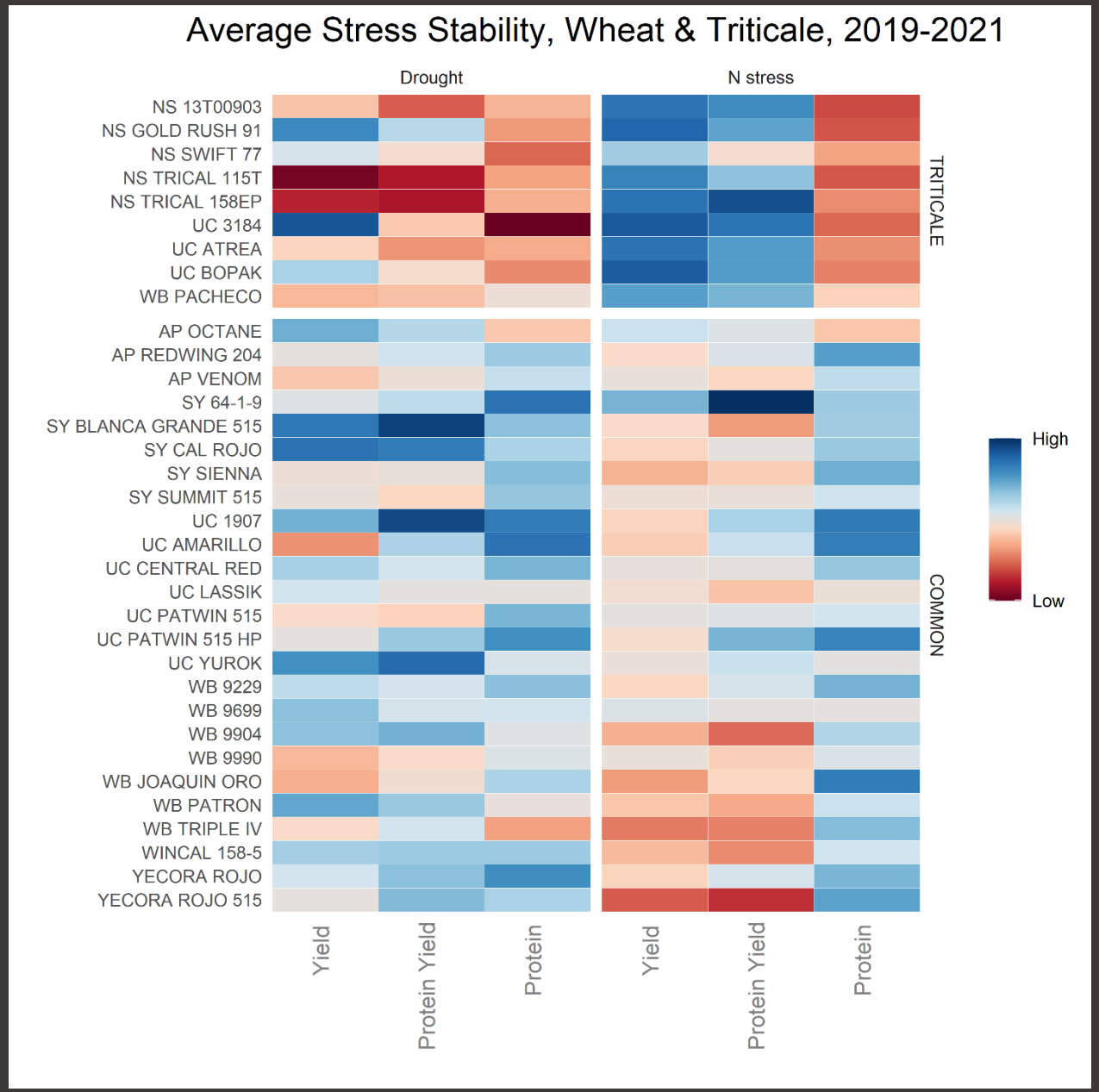

Thanks!

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Photo credit: Salvador Grover

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