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Water management in alfalfa crops

Jézéquel S. & Arcia Ruiz I.

Parallel session 1

FROM 03 › TO 06 nov. 2025

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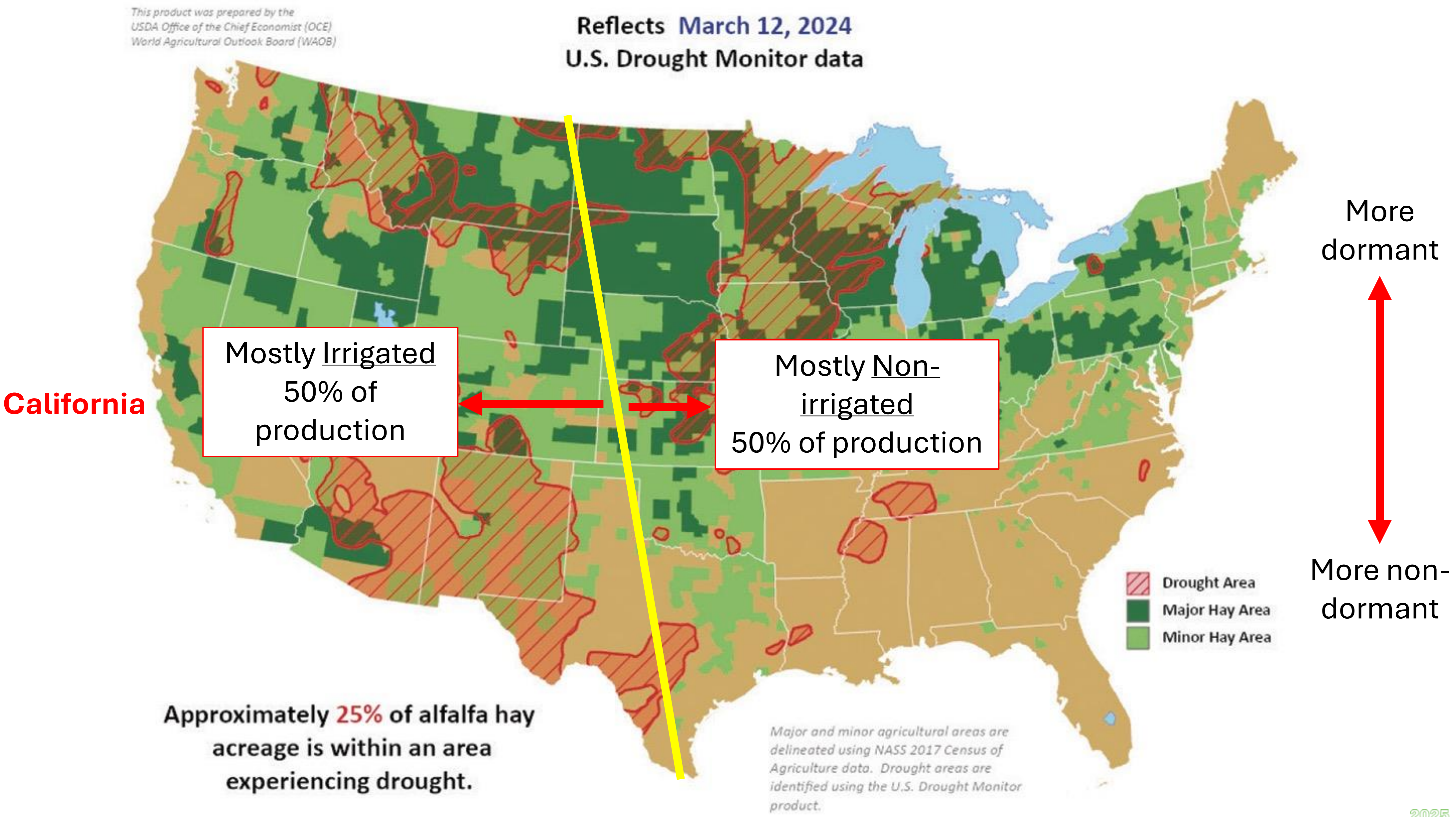
Developing and Testing Alfalfa Cultivars Under Limited Water Conditions cont…

Charles Janssen, E. Charles Brummer, Daniel H. Putnam, Ali Montazar, Isaya Kisekka

FROM 03 › TO 06 nov. 2025

Alfalfa Production in the United States



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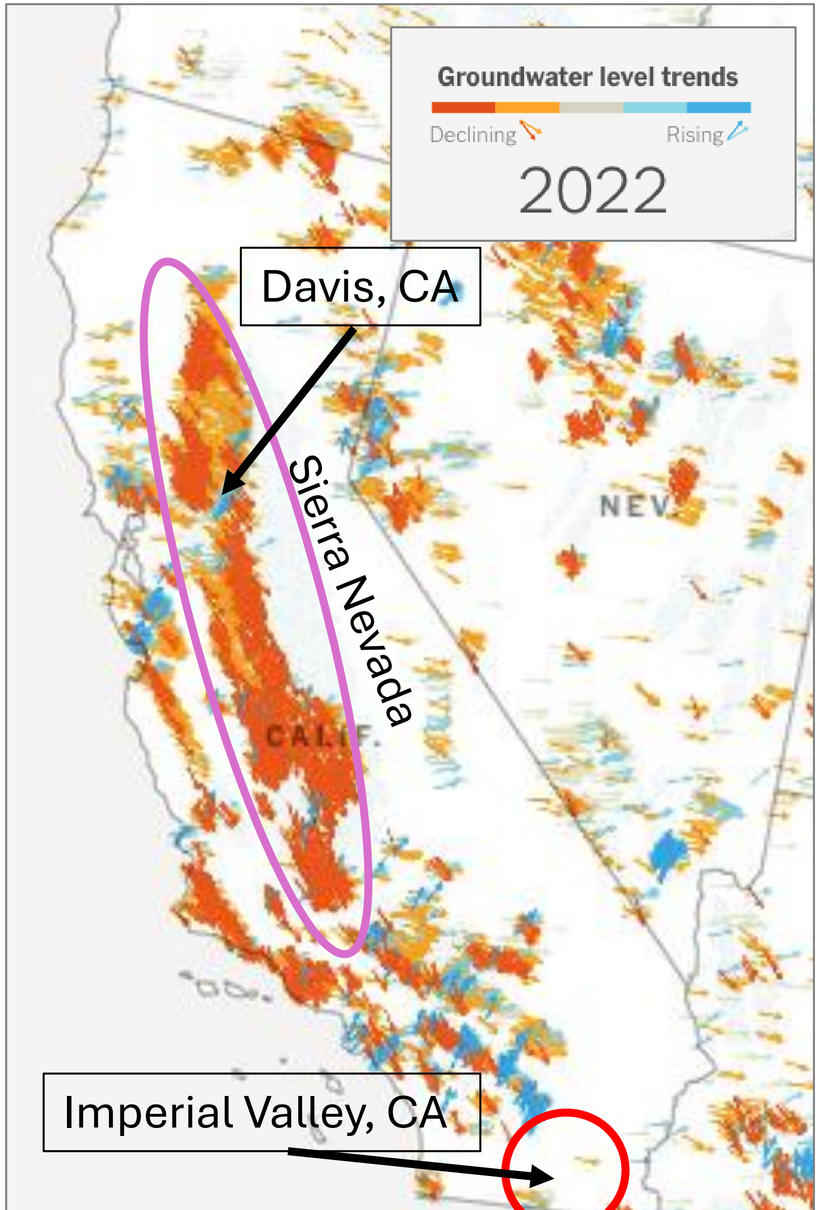
California Water Issues

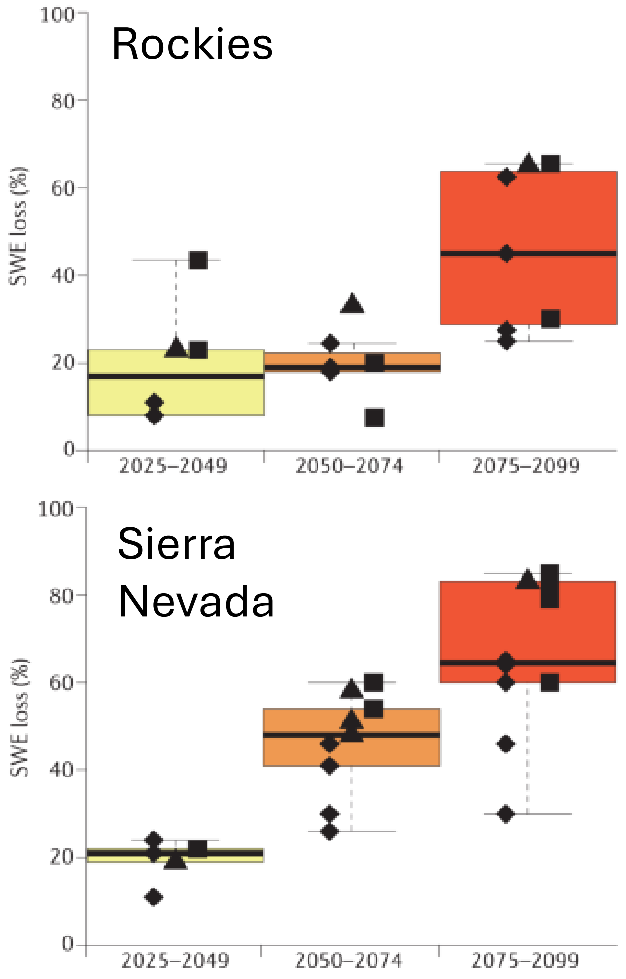
California's irrigation water comes from **aquifers** or **surface water**. Most of this water comes from **snowmelt** from Rockies and the Sierra.

An estimated **40% snow water equivalent loss** in Rockies and over **60% loss** in Sierra by the end of the century.



New York Times, 25 Sept 2023, America Is Using Up Its Groundwater Like There's No Tomorrow

Snow water equivalent loss projected through the 21st century



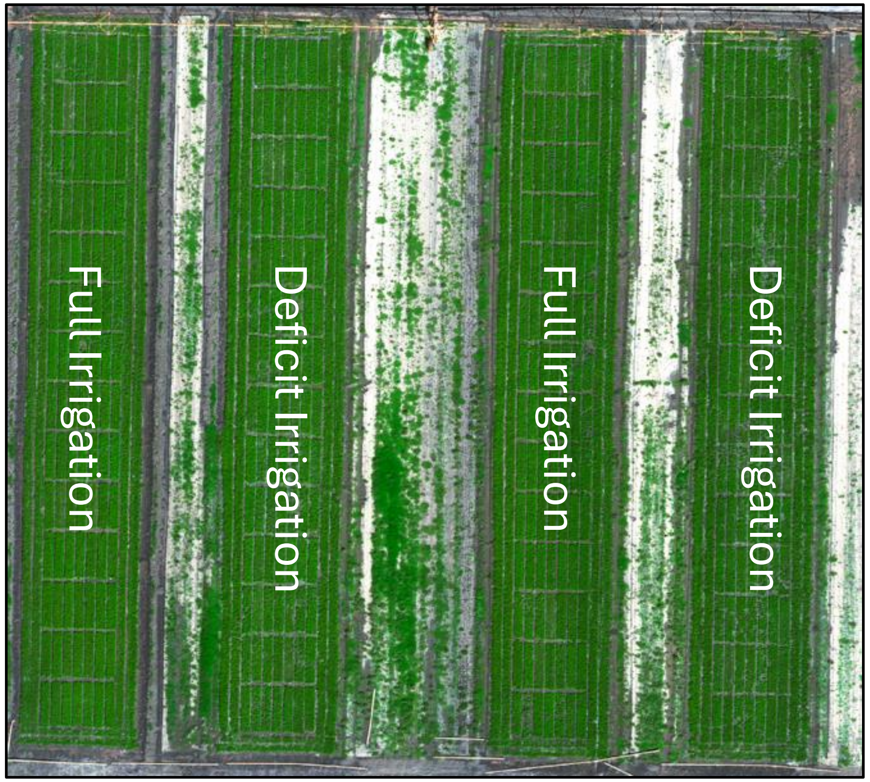
Siirila-Woodburn, E.R., Rhoades, A.M., Hatchett, B.J. *et al.* A low-to-no snow future and its impacts on water resources in the western United States. *Nat Rev Earth Environ* **2**, 800–819 (2021). https://doi.org/10.1038/s43017-021-00219-y

Testing new cultivars under two irrigation managements

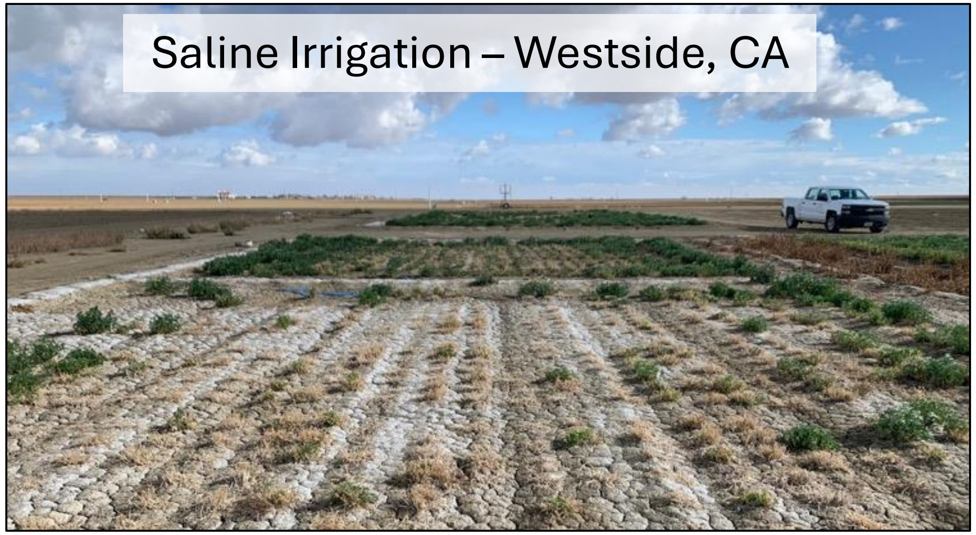
- Experimental cultivars selected under extreme conditions
- Trials seeded in Autumn 2023 in Davis, CA and Imperial Valley, CA with ~40 cultivars and experimentals
- Two irrigation treatments: Full Irrigation and Summer Cut-Off (Deficit) Irrigation

Davis, CA

Two reps per basin



Selection Environments



Summer water cut-off for four months
Imperial Valley, CA

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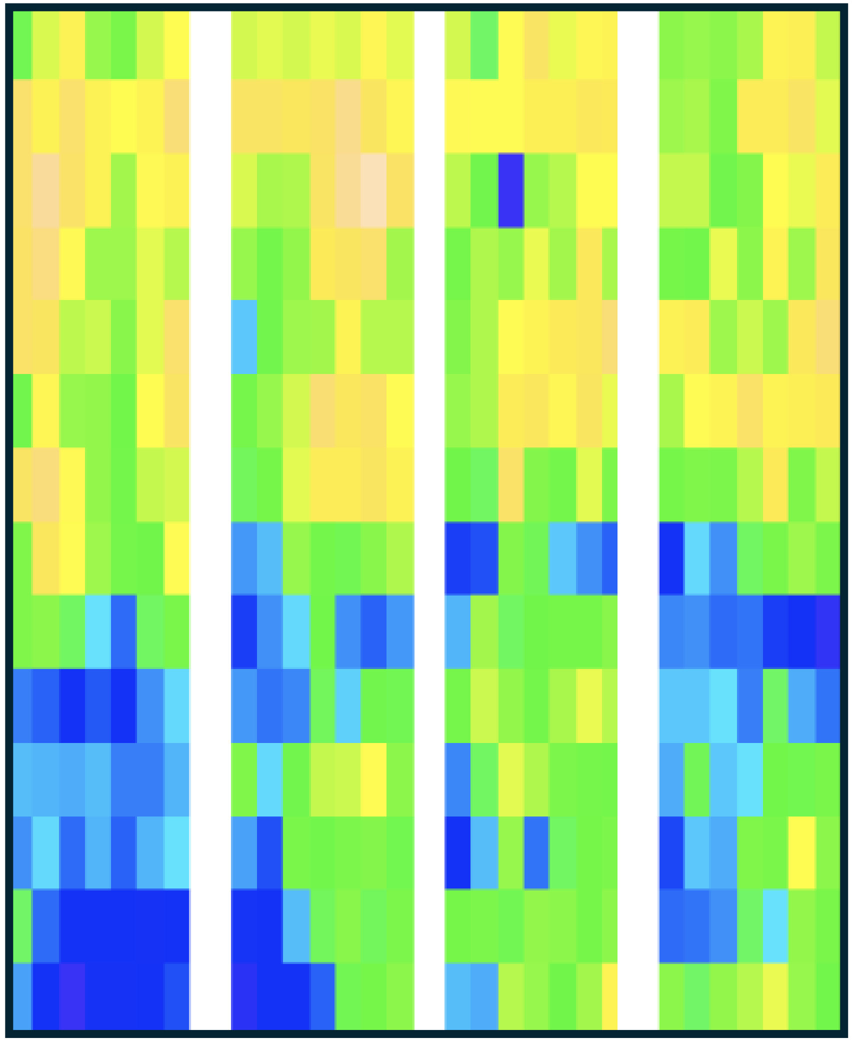
Data Analysis

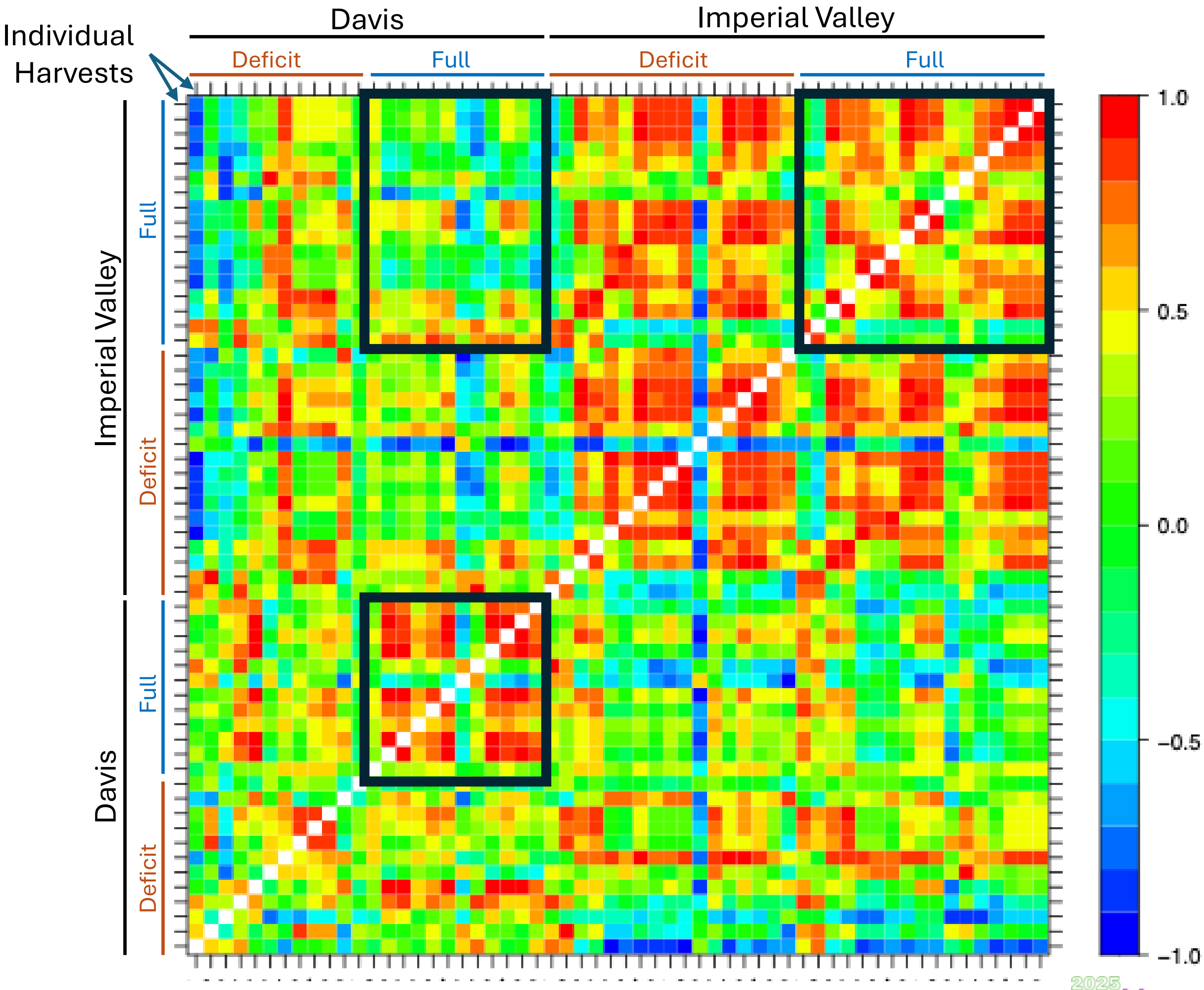
Davis, CA



- Significant field variation for yield observed esp. in Davis
- One stage model using AsREML-R
- Accounted for spatial variance, temporal variance [repeated measures], and heterogeneous variances and covariances
- Variety included as random effect
- Generated Best Linear Unbiased Predictions (BLUPs) for each variety

Genetic Correlation of Varieties

- Genetic correlations of varieties between all Loc:Tmt:Harvest pairs
- Variety performance among harvests in the same treatment-location combination are positively correlated (red).
- Variety performance between Davis and Imperial Valley is largely uncorrelated (green) or negatively correlated (blue).

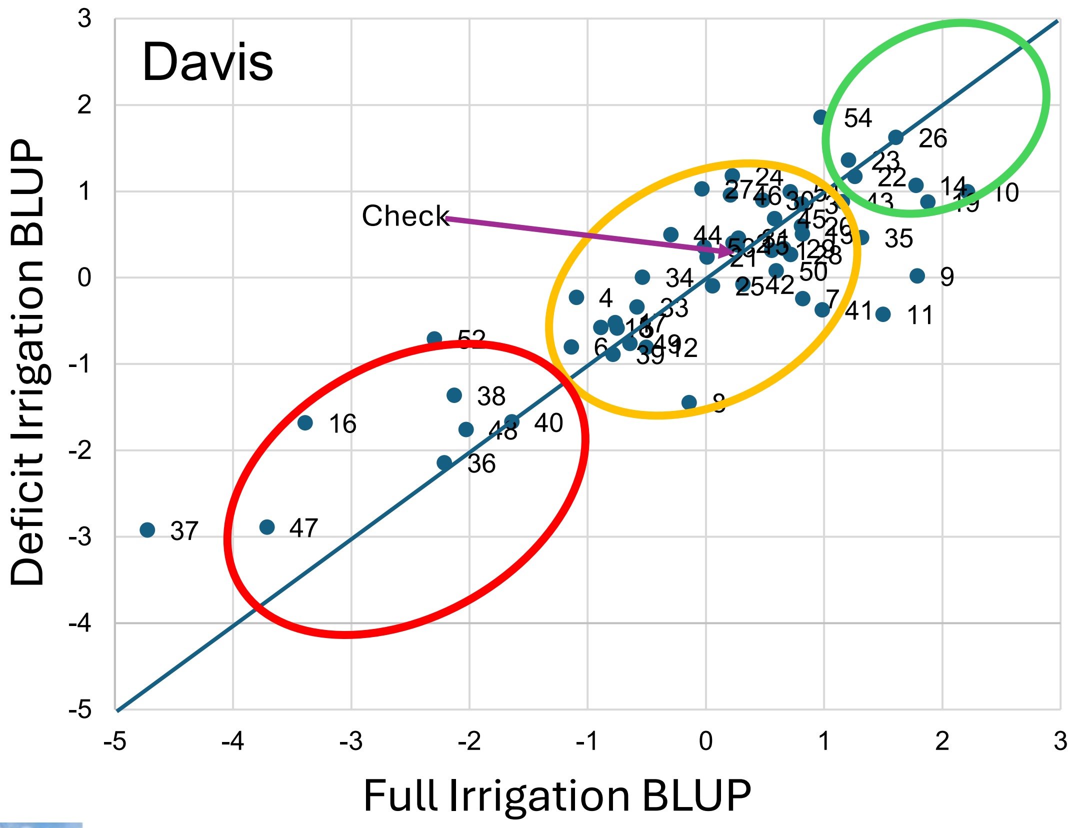


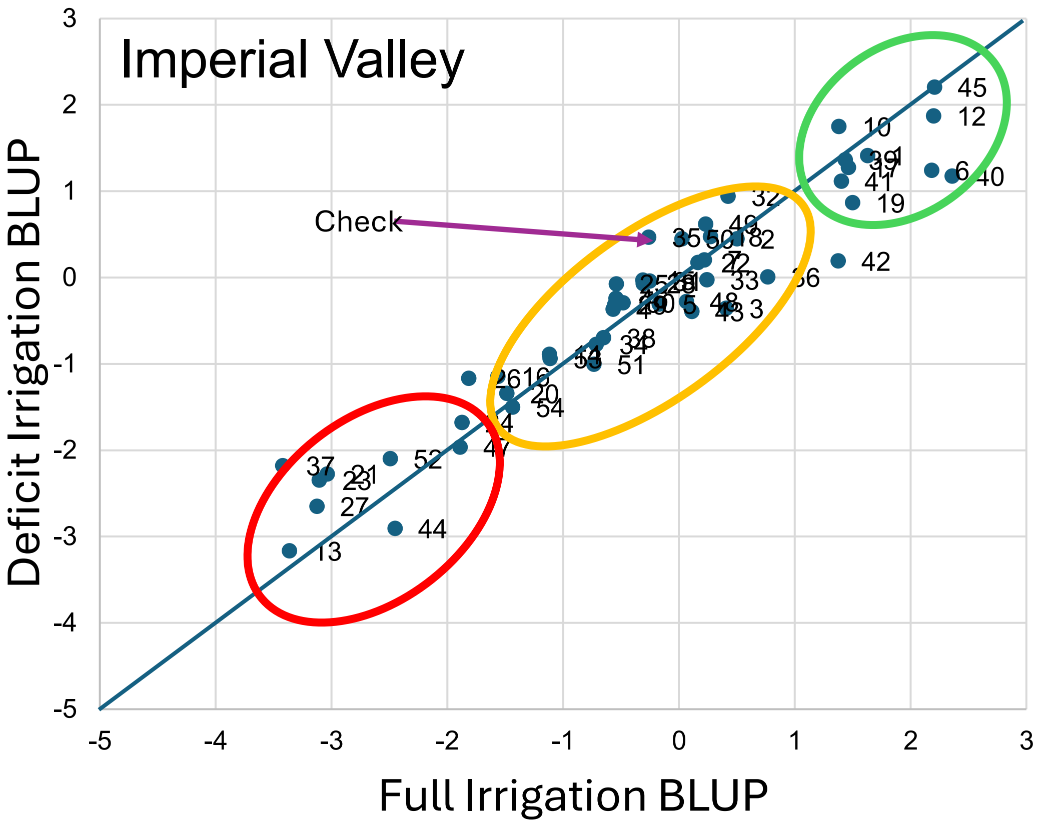
Variety Yield Under Full vs. Deficit Irrigation

Each variety compared to a check cultivar at each location is

Significantly overperforming - Not significantly different - Significantly undeforming

Yield under full irrigation reflects relative yield under deficits





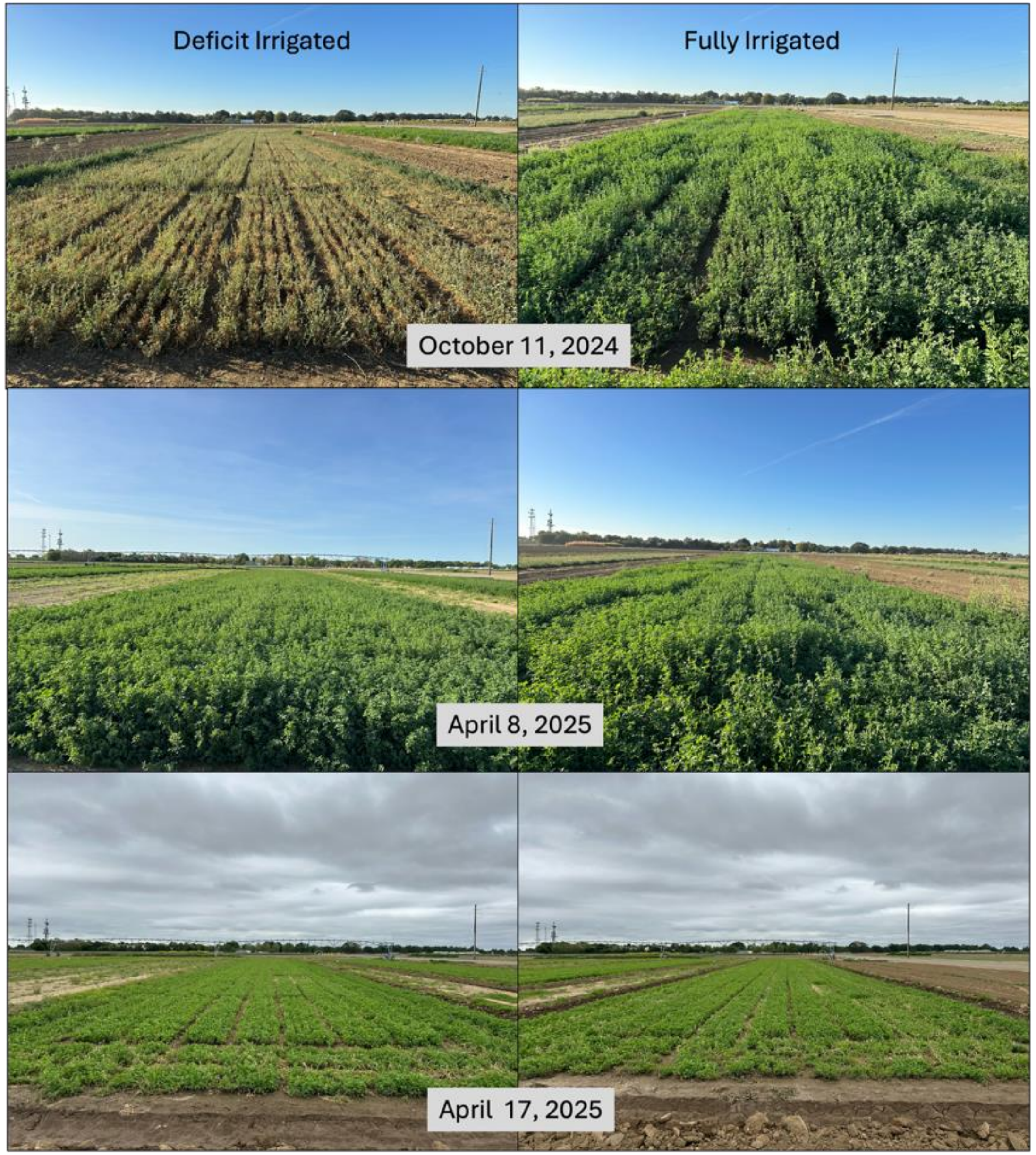
Yield, water savings, and persistence

Yield (Two Year Total)

	Full	Deficit	Yield Penalty
	Mg ha-1 dry matter		
Davis	45	31	14 (-30%)
El Centro	51	42	9 (-17%)

Irrigation Water Applied

	Full	Deficit	Savings
Davis	*cm of water applied*		*%*
2024	90	47	48
2025 (thru Sept)	126	90	29
Total	**217**	**137**	**37**
El Centro			
2024	191	115	39
2025 (thru Sept)	152	90	41
Total	**343**	**205**	**40**



Deficit Plot Recovery, Davis

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Conclusions

- High early season productivity minimizes losses due to deficit irrigation.
- High yielding varieties in the full irrigation treatment are also highest in the deficit treatment.
- <u>More water is saved seasonally than yield lost seasonally</u>.
- Major grower concern with deficits is stand loss, but no loss in first two years of production.
- **Summer cut-off irrigation success is highly dependent on soil type, texture, and crop and irrigation management.**


Thank You!
Questions?