

SCREENING DRY BEAN GENOTYPE FOR DROUGHT TOLERANCE IN WYOMING

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Annual Report: Wyoming Bean Commission

Wyoming Crop Improvement Association Annual Meeting, February 07, 2019



Objective

- ❑ The purpose of this project is to investigate and identify the cultivars and management practices to increase dry bean production in Wyoming. Research is aimed:
 - ❑ to identify dry bean genotypes tolerant to drought;
 - ❑ quantify the relationship between dry bean yield components and tolerance to drought and
 - ❑ investigate the dry bean eco physiological traits in response to drought.

Study Location



Methodology

- For both locations, traditional sprinkler irrigated field with GPS mounted lateral move overhead sprinkler irrigation system was used.
- A split-plot arrangement with 32 genotypes at Powell and 28 genotypes in Lingle replicated three times was setup.
- Well-watered treatment in this research represented the conditions in which the crop was irrigated when soil water depletion was approximately 35-40% of the total available water, to avoid any potential water stress impact on crop yield.
- All plots were watered according to plant water requirement to prevent stress until 16-20 July (bloom stage) when the drought sections received only 65% of the well watered treatment.
- In 2018, a total of 10.5 and 7 inches of irrigation were applied to well-watered and drought treatments at Powell.
- The field was prepared with conventional tillage and land was fertilized as per soil test recommendation.

Dry bean Cultivars

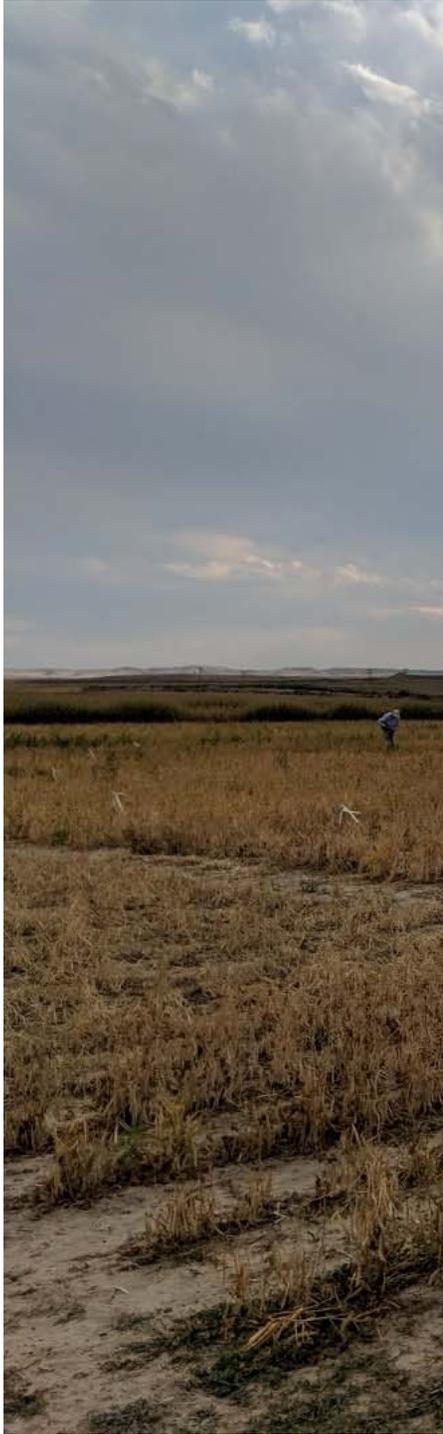
Black	Red Kidney	flor de junio	Great Northern	Jacobs cow	Navy	Pinto and Pinto Slow Darkening	
5	7	1	2	1	3	32	
Eclipse	Dynasty	Desert Song	Coyne	UCD-0908	Avalanche	Centennial	CO14790-3
T-39	Talon		Powderhorn		ISB96-3156	CO-46348	Medicine Hat
Zenith	CELRK				T-9905	Croissant	CO14330-10
Zorro	Rosie					ISB1259-60	CO33176-1
Eclipse	Com Red Mex					La Paz	CO25069-2
	Rio Rojo					Lariat	CO91216-15
	UI-259					Long's Peak	Scout
	Cayenne					Monterrey	Montrose
						ND-307	UIP-35NezPerce
						Othello	UIP-40TwinFalls
						Poncho	CO33176-15
						PT9-5-6	LaPaz
						Stampede	23S27
						UIP-35	Blackfoot
						COSD-7	CO14790-3
						COSD-35	CO33176-15

51 total cultivars were tested



Lingle

- ❑ Hail storms occurred mid June, mid-July, and early September with the September storm causing the shattering of pods, especially for entries that had just matured.
- ❑ Yields from non-hail-damaged plots were collected by hand harvest of two, 8-foot sections from the center rows of each plot and threshing in late September. However, yields were significantly low.

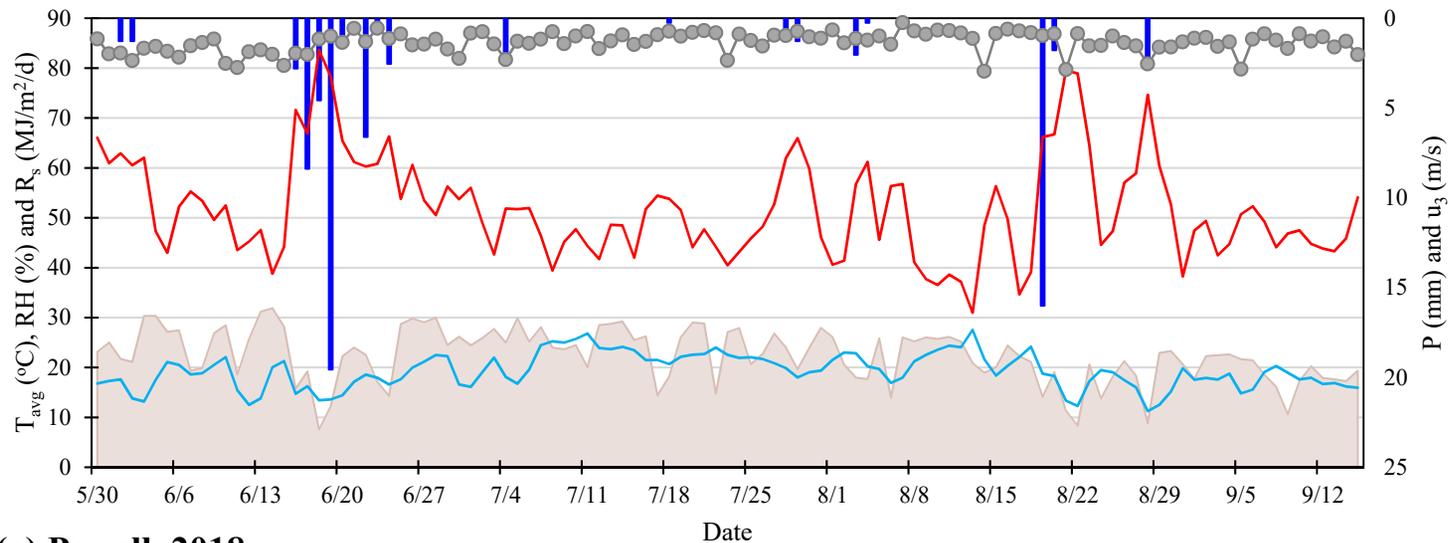


2018 Planting: May 31, 2018

PREC research associate Andi Pierson Helping Vivek Sharma in Planting



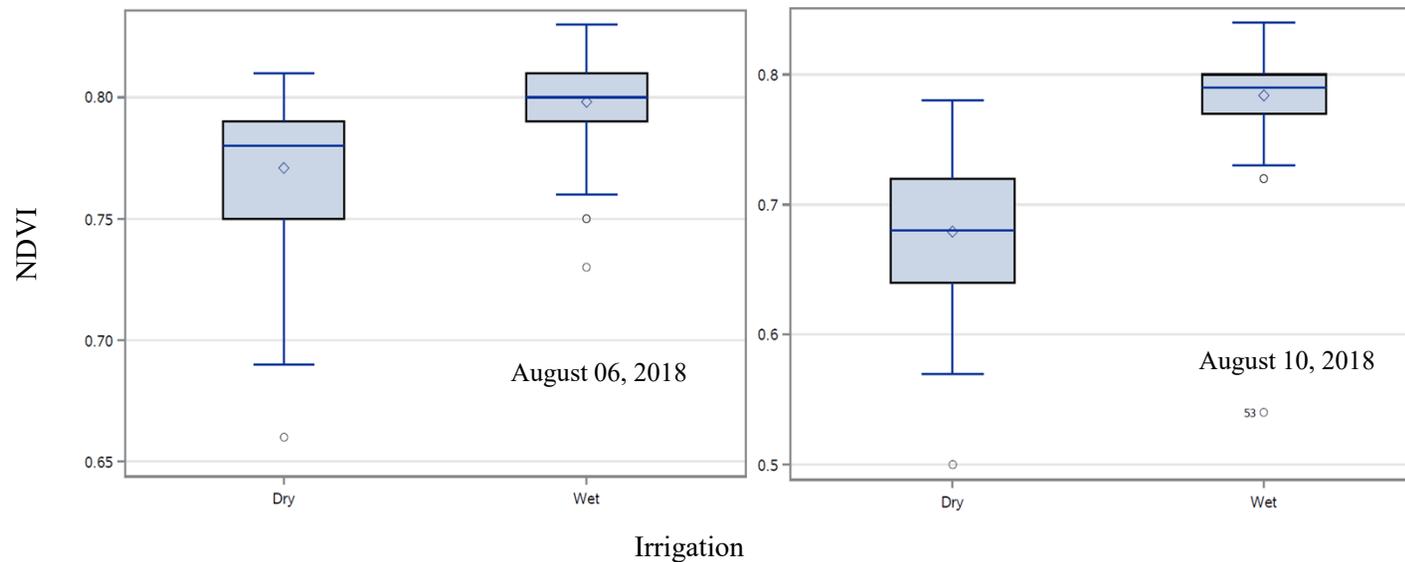
Climate Conditions: 2018



(a) Powell, 2018

- Year 2018 was a relatively wet year compared to the previous two years (2016 and 2017) with seasonal precipitation (May 30 to September 15) of 76.5 mm (3.01 inch) compared to 42 mm (1.7 inch) and 37 mm (1.5 mm) in 2016 and 2017, respectively.

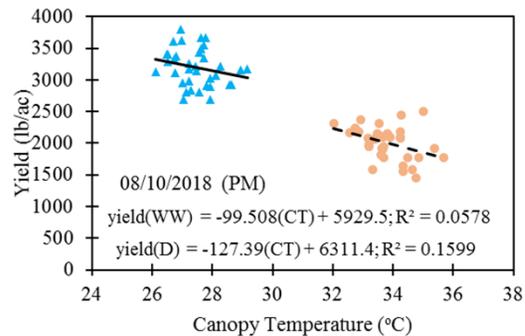
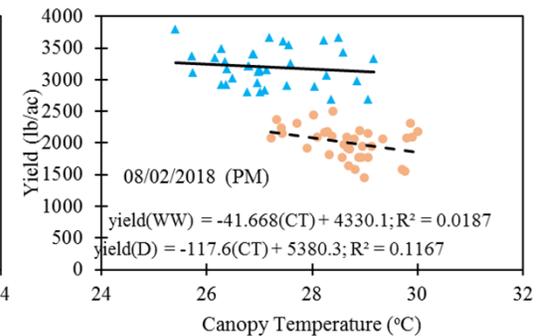
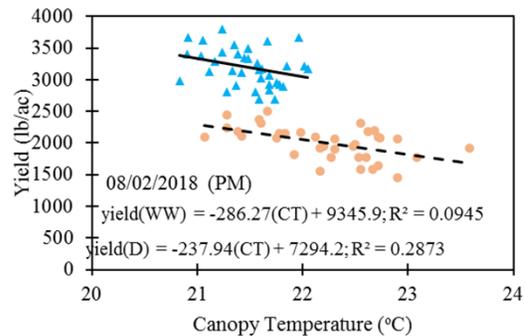
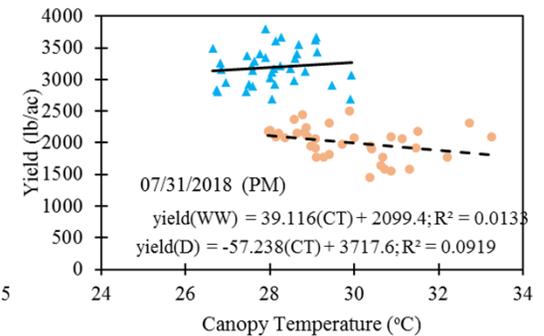
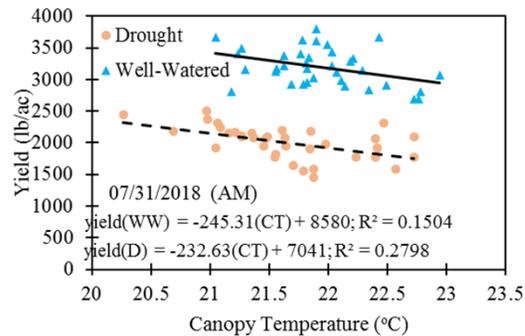
NDVI



- NDVI on two dates in early August 2018 was significantly higher in full irrigation than deficit (0.80 vs. 0.78 and 0.77 vs. 0.68).

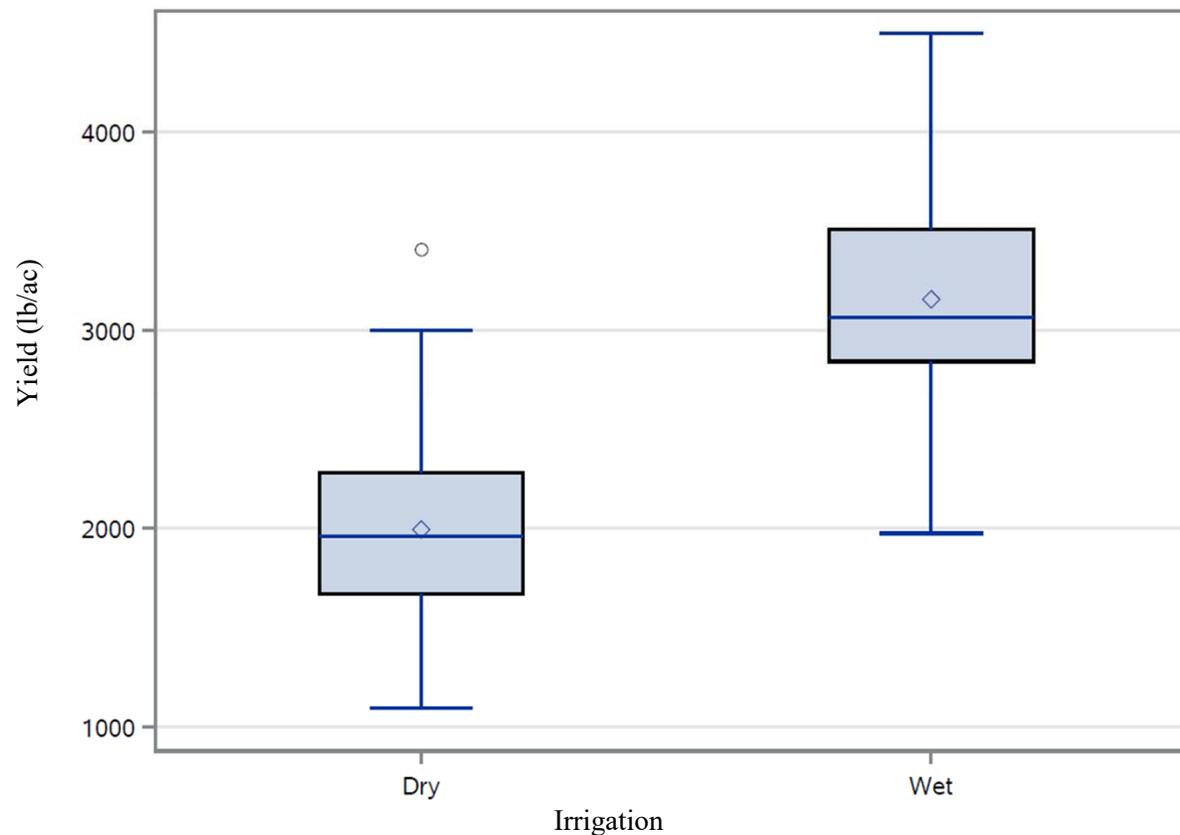
Canopy Temperature

- Canopy temperature in late July was not significantly different between the irrigation treatments during a morning measurement but was 2°C cooler under full irrigation that afternoon (28°C vs. 30°C).
- On 10 August, canopies under full irrigation were 7°C cooler than deficit irrigation (27°C vs 34°C).
- Under all cases, yield were negatively correlated with canopy temperature, except July 31, where irrigated yields were unrelated to canopy temperature.



Yield Data

- Averaged across the 32 genotypes, full irrigation increased grain yield by 58% compared to deficit irrigation (3158 vs. 1994 lbs per acre)



Yield Data

	Treatments	Average	Max	Min
2017	Well-Watered	3158 lb/ac	3644 lb/ac	2342 lb/ac
			Wyo50	CO14330-10
	Dry	1994 lb/ac	2578 lb/ac	1440 lb/ac
			ND-Palmino	Blackfoot

- Genotypes with notable yields (> 2250 pounds per acre) under deficit irrigation included CO46348, CO91216-15, Desert Song, ND-Palomino, Othello, Poncho, and Powderhorn.
- Genotypes with superior yields (> 3500 pound per acre) under full irrigation included 23ST27, La Paz, PT9-5-6, UI-537, and Wyo-50.

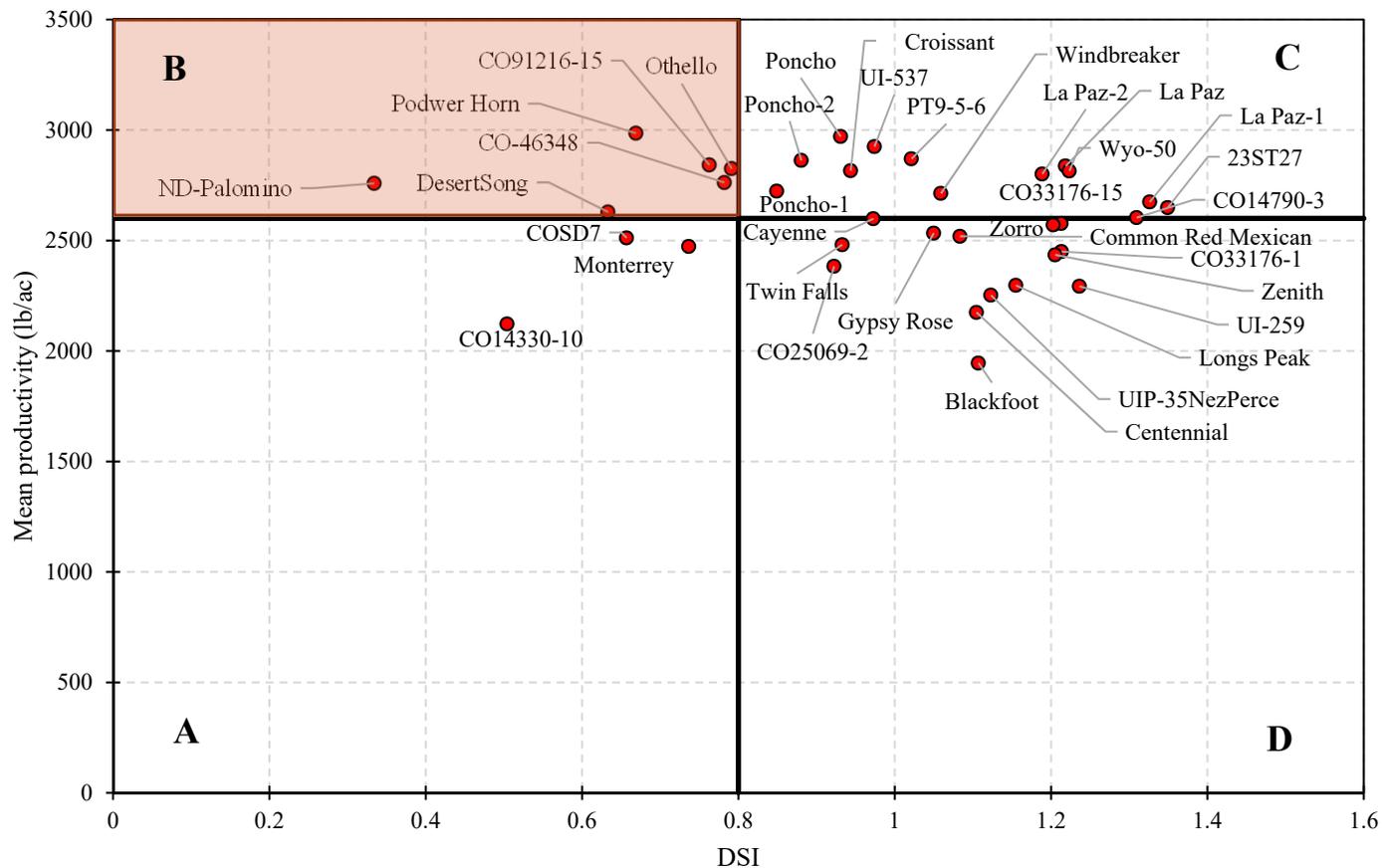
Drought Susceptible Index (DSI)

- To further identify the cultivars that performed well under deficit irrigation, we correlated the average yield of each cultivar (across irrigation rates) to drought susceptibility index (DSI) which is defined as:

$$DSI = \frac{1 - \frac{Y_D}{Y_{WW}}}{1 - \frac{X_D}{X_{WW}}}$$

- DSI represents the index to identify the cultivars that have less difference in yield between well-watered vs. deficit treatment.
- Higher DSI number represent the large difference in yield between well-watered vs. deficit treatment.
- It is important to note that it is not necessary that lower DSI numbers are among the highest yielding cultivars.

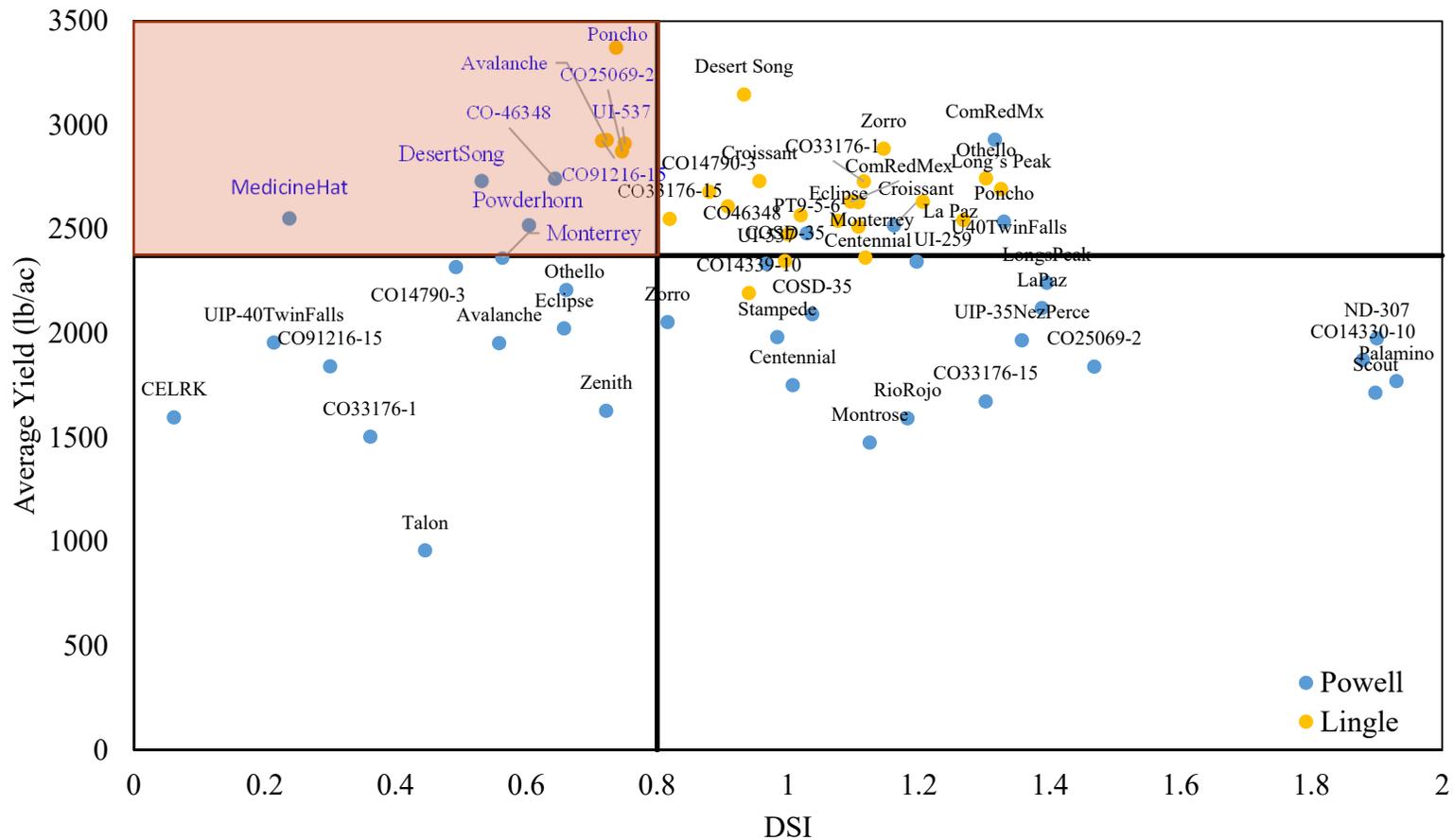
Drought Susceptible Index (DSI)-2018



- Our yield vs. DSI result indicated that genotypes such as Desert Song, ND-Palomino, CO-46348, CO91216-15, Powderhorn, and Othello are higher yielding cultivars and are more tolerant to drought stress under the semi-arid to arid climate of the Intermountain West (e.g., Bighorn Basin, Wyoming).



Drought Susceptible Index (DSI)-2017



2018 results are also very consistent with 2017 results, where dry bean cultivars such as Powderhorn, CO-46348, Desert Song, MedicineHat were among the most tolerant to drought stress (Sharma and Heitholt, 2018)





Acknowledgement

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