

EFFECT OF PLANT DENSITY AND ROW ARRANGEMENTS ON DRY BEAN PRODUCTIVITY IN WYOMING

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Wyoming
BEAN COMMISSION



Objective

- ❑ To determine the optimum combination of dry bean planting density and row spacing.
- ❑ Development of yield-plant density relationship under different irrigation rates in Wyoming.
- ❑ Investigate the dry bean eco-physiological traits in response to different dry bean plant density and row spacing.

Study Location



Methodology

- ❑ Split-plot design with three dry bean cultivars at five population densities and two row spacing under three irrigation rates (main plots) i.e. full irrigation treatment (FIT), 80% FIT and 60% FIT was set-up at PREC in 2018.
- ❑ The target dry bean seeding rates of 50,000; 75,000; 90,000; 105,000; and 120,000 plants per acre on 22-inch and 7.5-inch row spacing at Powell and 7.5 inch and 15 inch at Lingle, WY.
- ❑ Three pinto dry bean upright to indeterminate to upright cultivars i.e. Poncho, Sundance, and La Paz were used in this study.
- ❑ For both locations, plots were prepared with conventional tillage and were be fertilized according to soil test recommendations.

CaseIH grain drill was used to plant dry bean on 7.5 inch row spacing.



Kincaid Voltra planter was used to plant dry bean on 22 inch row spacing.



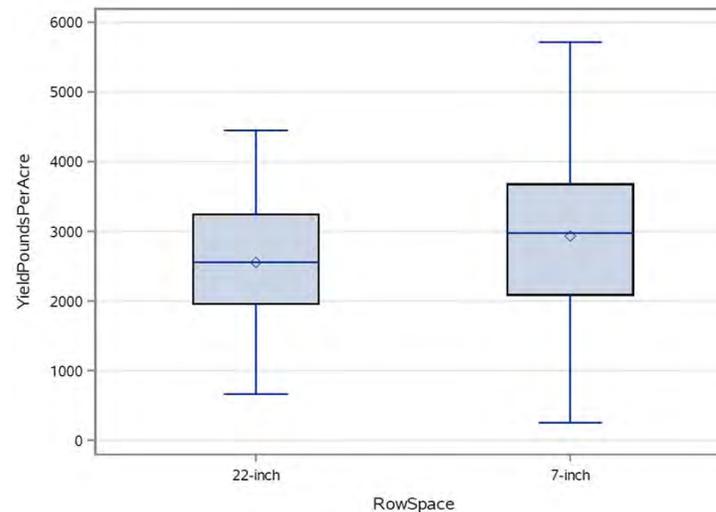
2018.06.05

Late September Hail Damage at Lingle, WY



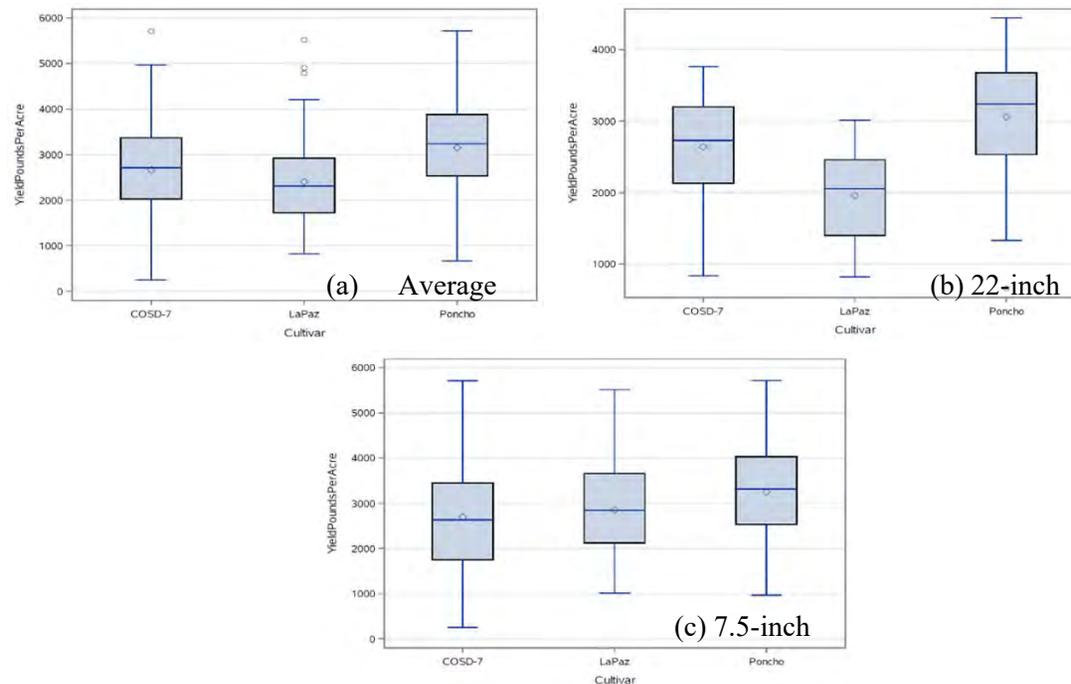
Yield Variation – Row Spacing

- Significant row spacing vs. cultivar interaction was observed on dry bean yield. Averaged across three cultivars and all seeding rates, 7.5-inch planted dry bean had 15% higher grain yield compared to 22-inch planted dry bean (2930 vs. 2552).



- Higher yield in 7.5-inch row spacing might be due to the differences in number of pods and seed size between two row spacings. PI is currently working in analyzing the yield component data to further understand the difference in yield between two row spacings.

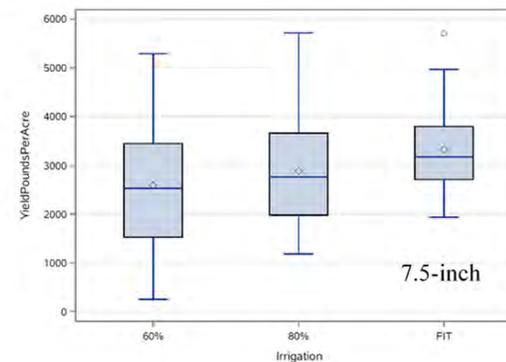
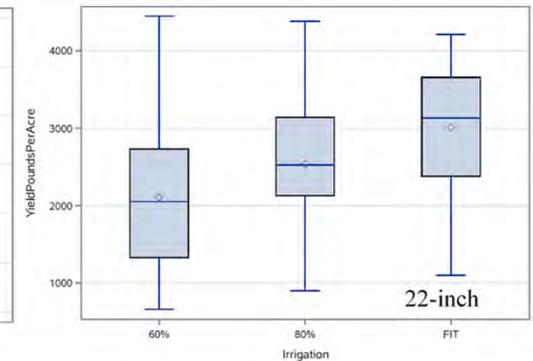
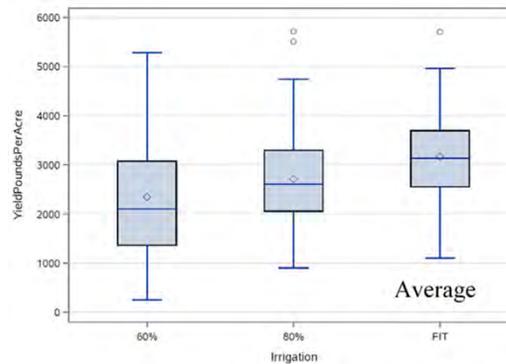
Yield Variation - Cultivar



- ❑ Significant difference in yield was also observed among cultivars (average across all irrigations, row spacing, and seeding rates).
- ❑ Average yield of 3154, 2665, and 2405 was observed for Poncho, COSD7 (Sundance), and La Paz, respectively.
- ❑ For both row spacings, Poncho performed best under 22-inch and 7.5-inch row spacing with average yield of 3060 and 3247 lbs./ac, respectively.

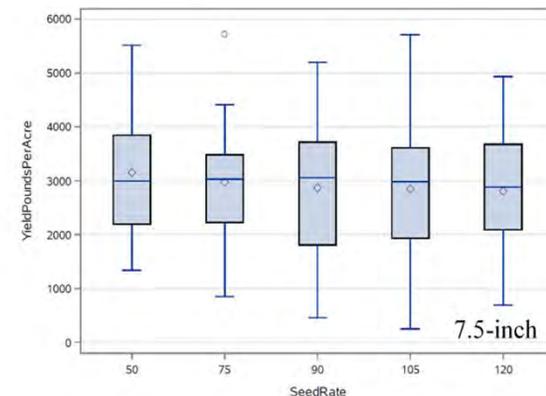
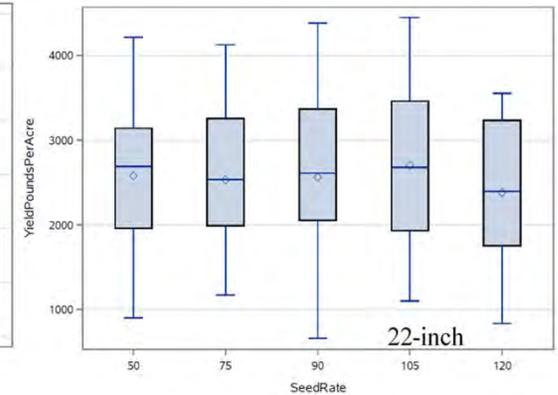
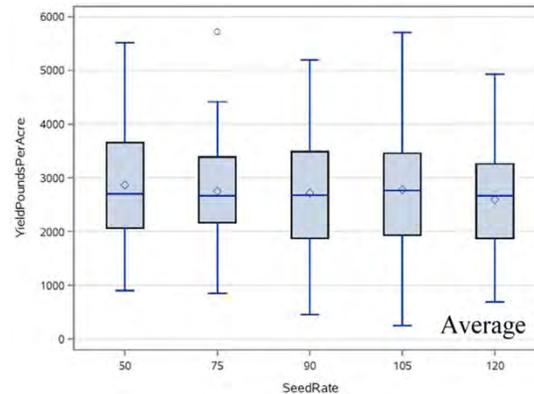
Yield Variation -Irrigation

- As expected, for both row spacing, yield increased linearly with increasing irrigation rate with higher yields were for FIT under both 22-inch and 7.5-inch row spacing.
- On average, FIT yield was 14% and 26% higher than 80%FIT and 60%FIT yields.
- Greater difference in yield was observed for 22-inch row spacing compared to 7.5-inch row spacing among different irrigation treatments. For 22-inch row spacing, yield was reduced by 16% and 30% under 80%FIT and 60%FIT, respectively.



Yield Variation - Density

- Surprisingly, no difference in yield was observed for different seeding rates for both 22 inch and 7.5-inch planted dry bean.
- For both row spacings, there was a slight non-significant trend for lower yield with the higher seeding rates.



22-inch Row Spacing

Poncho

7.5-inch Row Spacing

22-inch Row Spacing

COSD7

7.5-inch Row Spacing



Poncho-50K



Poncho-50K



COSD-7-50K



COSD-7-50K



Poncho-75K



Poncho-75K



COSD-7-75K



COSD-7-50K



Poncho-90K



Poncho-90K



COSD-7-90K



COSD-7-50K



Poncho-105K



Poncho-105K



COSD-7-105K



COSD-7-50K



Poncho-120K



Poncho-120K



COSD-7-120K



COSD-7-50K

LaPaz

22-inch Row Spacing



LaPaz-50K



LaPaz-75K



LaPaz-90K



LaPaz-105K



LaPaz-120K

7.5-inch Row Spacing



LaPaz-50K



LaPaz-75K



LaPaz-90K



LaPaz-105K



LaPaz-120K

Yield Variation - Density

- ❑ Lower yields for higher seeding rate might be due to:
 - ❑ Higher leaf area index (LAI) which might results in less light penetration in the mid-canopy and increase the number of saprophytic leaves in the lower canopy which could reduce overall photosynthesis.
 - ❑ disease issues and
 - ❑ excessive soil water depletion

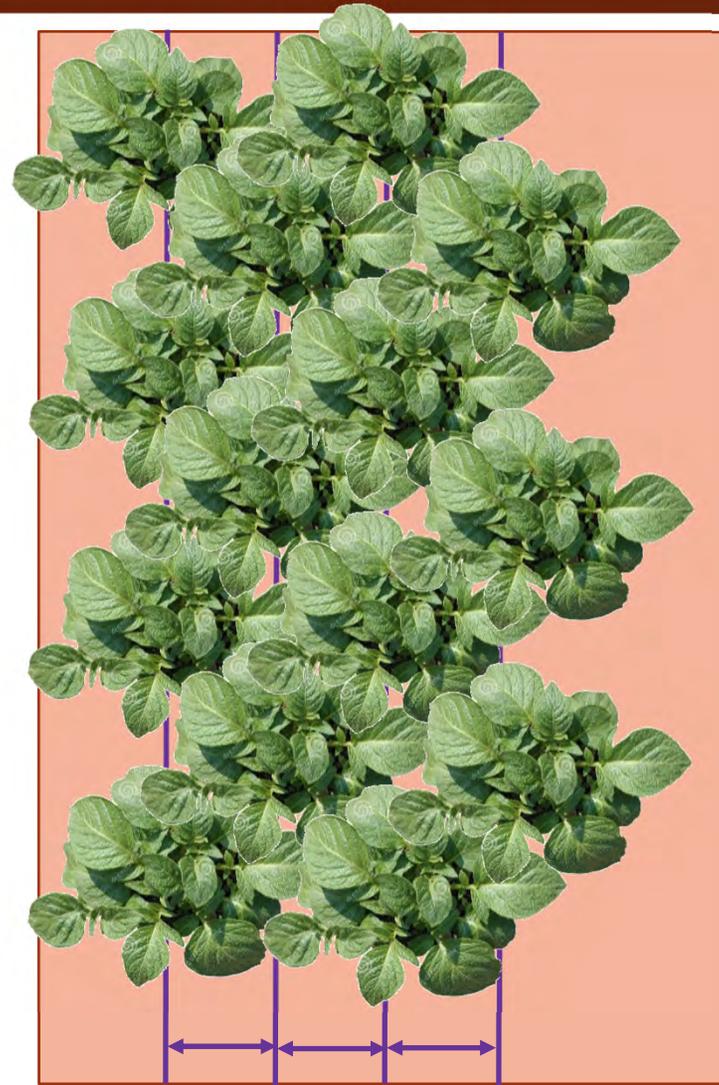
- ❑ Higher yield in 7.5-inch row spacing at all densities compared to 22-inch row spacing is probably due to
 - ❑ Planting pattern difference in 7.5-inch row spacing which results in equi-distant plant configuration and more even distribution of light in the plant canopy compared to an asymmetrical distribution of plants in 22-inch row spacing.

Yield Variation



22-inch

22-inch



7.5-inch

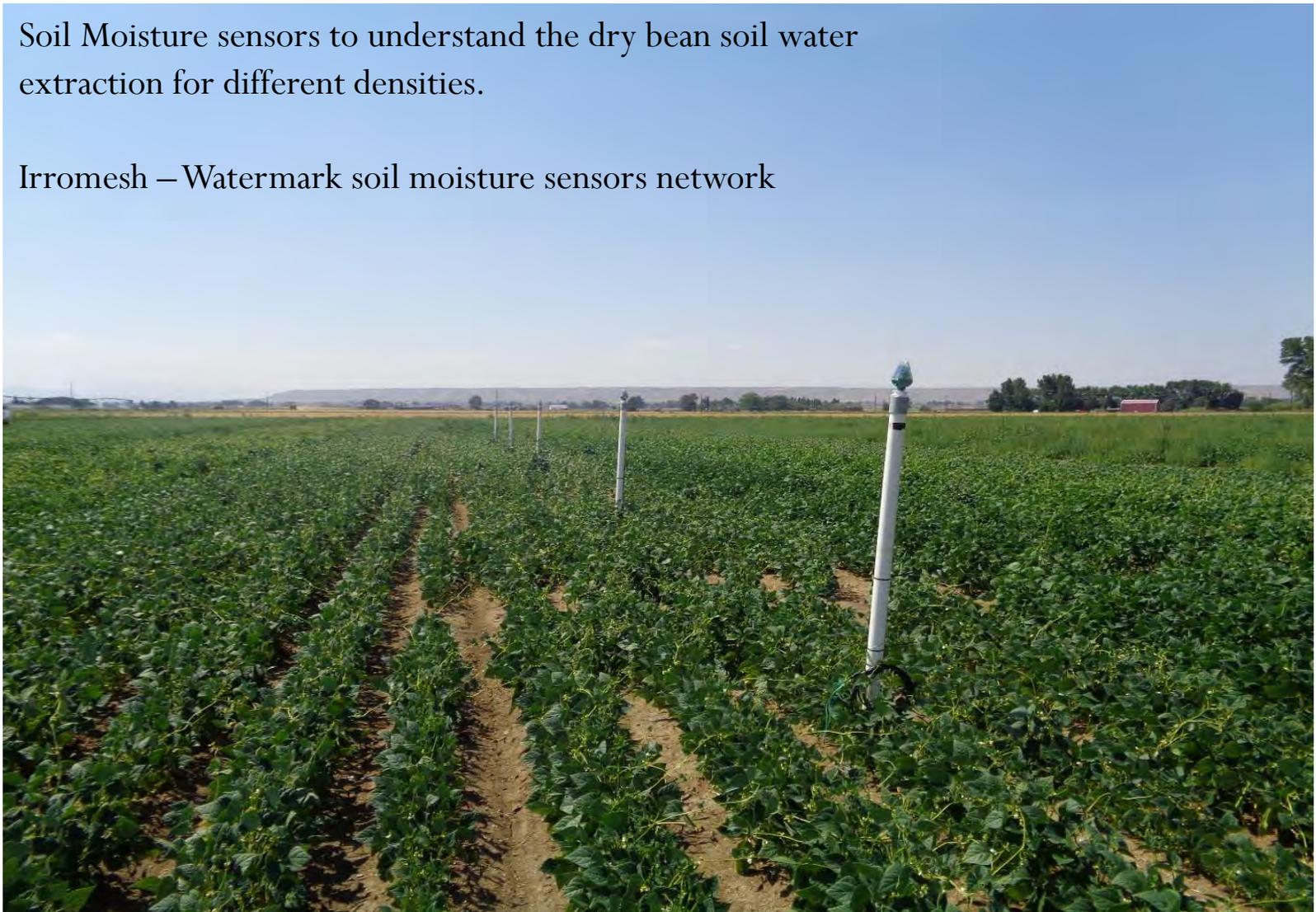
7.5-inch

7.5-inch

Yield Variation - Density

Soil Moisture sensors to understand the dry bean soil water extraction for different densities.

Irromesh – Watermark soil moisture sensors network



Yield Variation - Density



Light incident, reflected and intercepted measurement.

Apogee- PAR bar.

2019 Research Proposal

- ❑ We would like to continue this study for two more year at Powell, WY for better understanding of how plant density, row spacing and irrigation effect dry bean yield and economic.
- ❑ One graduate student currently working on this project for his M.S. program.

2019-2020 Budget

TOTAL Funds Requested	Year 1	Year 2 (2019)	Year 3 (2020)	Third Party Revenue
	-	13052.00	14794.00	

Year 2019	
Supplies (<i>i.e. Seeds, pesticides, fertilizers, etc.</i>)	\$ 2500.00
Personnel	\$ 8052.00
Equipment	\$ 0.00
Other	\$ 2500.00
Year 2020	
Supplies (<i>i.e. Seeds, pesticides, fertilizers, etc.</i>)	\$ 1500.00
Personnel	\$ 8294.00
Equipment	\$ 0.00
Other	\$ 5000.00

- Funds in the personnel category will be used to partially support one graduate student/summer intern.
- Funds in the supplies category will be used to buy plot stakes, flags, seed cost, fertilizer cost, plot fee, paper bags and other materials required in the project.
- Funds in the travel category will be used by PI's and graduate student to cover travel and lodging expenses for one regional or national conference to present the results of this study.
- The other expenses includes publication costs in addition to travel cost in 2020. Publication costs will be used to cover the publication expense i.e. peer reviewed journal publication.



Acknowledgement

- ❑ Wyoming Bean Commission.
- ❑ Wyoming Department of Agriculture
- ❑ Powell Research and Extension Center (PREC) and Sustainable Agricultural Research and Extension Center (SAREC).



Thanks

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