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Pinto Bean

Response to Row Spacing and Plant Population in North Dakota

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North Dakota State University has recommended an established stand of 70,000 plants per acre for pinto bean grown in wide rows, typically 30-inch rows. However, narrower row spacings and greater plant populations are trending in dry bean production. Field research in eastern North Dakota indicated pinto bean seed yield increase of 14% with 18-inch rows compared to 30-inch rows (Eckert et al., 2011). North Dakota data from a 2021 dry bean grower survey (Knodel et al., 2022) indicate 55% of pinto bean acres were planted in row widths ranging from 11 to 25 inches compared to 40% grown in wide rows. In addition, the survey indicates 53% of pinto bean acres were planted at rates of 80,000 to 99,000 seeds per acre, with the likely goal of establishing greater than 70,000 plants per acre.

This publication summarizes North Dakota State University field research trials conducted during 2011-13 and 2018-21 to evaluate potential yield increase of pinto bean with narrower rows and higher plant populations compared to the traditionally-recommended plant density in wide rows.

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Materials and Methods

Data to examine pinto bean response to the **combination** of row spacings and plant populations were generated from a study conducted at the NDSU Carrington Research Extension Center (REC) during 2018-21 and the NDSU Langdon REC during 2020-21. Data used for examining seed yield response to the **individual** factors of row spacings and plant populations were generated from trials conducted at NDSU RECs at Carrington during 2011-13 and 2018-21, Minot during 2018-19 and Langdon during 2020-21.

Experimental design was a randomized complete block with three or four replications. Best management practices were used for pinto bean production. The dryland research was conducted on loam soils using conventional tillage at Carrington and Langdon, and minimum tillage at Minot. The pinto cultivar Lariat was grown at Carrington during 2011-13, and ND Palomino at all locations during 2018-21. Plant populations were generally measured within one month after planting. White mold was occasionally present at Carrington at low levels not impacting yield. Other trial management details can be obtained by contacting the RECs.

Results

Row Spacings and Plant Populations

Pinto bean seed yield, averaged across four site-years (Carrington, 2018-20 and Langdon, 2021), was statistically different among means of the two-factor combinations (Table 1). Among plant populations, which averaged 49,900, 64,700 and 83,600 plants per acre, yield increased 16% to 19% with intermediate (18- or 21-inch) rows compared to wide (28- or 30-inch) rows. Greatest yield was achieved with intermediate rows and the densities of 64,700 and 83,600 plants per acre. Yield was similar among plant populations with wide rows.

Table 1. Pinto bean seed yield among row spacings and plant populations, Carrington and Langdon, 2018-21 (4 site-years)[1]

	Plant population (per acre)		
Row spacing	49,900	64,700	83,600
Inches	*Seed yield (pounds per acre)*		
18 or 21	1,790 bc	**1,860** ab	**1,990** a
28 or 30	1,500 d	1,610 cd	1,690 bcd
LSD (0.05)	- - - - - - - - - - - 200 - - - - - - - - - - -		

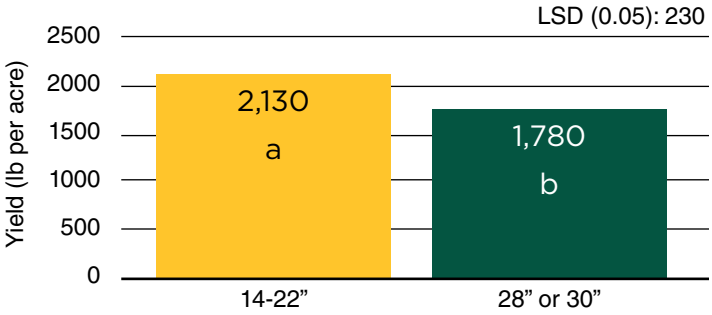
[1] Means with no similar letters are significantly different.

Averaged across three site-years (Carrington, 2018-20), days from pinto bean planting to plant emergence (10-11) and days from planting to plant physiological maturity (91-92) were similar among the combinations of the two row spacings (21- and 28-inch) and three plant populations (47,700, 64,200 and 84,000 plants per acre). Also, plant lodging, visually evaluated at plant maturity, was similar among the combinations of the two factors. However, averaged across plant populations, intermediate rows had 19% less lodging compared to wide rows. Plant canopy, visually estimated during July as % of ground covered, generally was greater at 80-86% among plant populations with the intermediate rows compared to wide rows at 66-75%. Also, averaged across plant populations, intermediate rows provided 18% greater canopy cover compared to wide rows. The greater canopy cover with the intermediate rows likely contributed to the increased seed yield compared to wide rows.

Row Spacings

Examining row spacing as a single production factor for pinto bean, seed yield average across 11 trials (Carrington, 2011-13 and 2018-21; Minot, 2018-19; and Langdon, 2020-21) indicates an advantage of 20% (350 lb per acre) with intermediate (15- to 22-inch) rows compared to wide rows (Figure 1).

Figure 1. Pinto bean seed yield between row spacings, Carrington, 2011-13 and 2018-21; Minot, 2018-19; and Langdon, 2020-21 (11 site-years)[1]

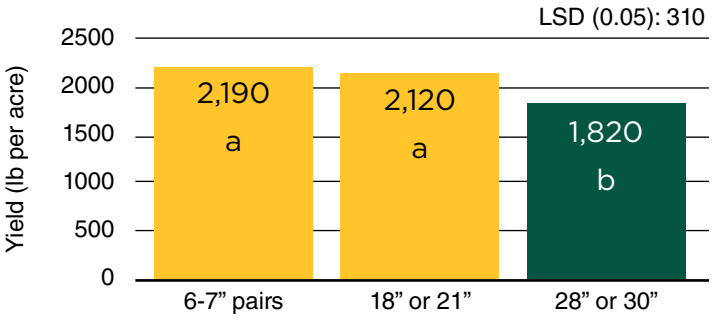


[1]Means with no similar letters are significantly different.

Research trials conducted at Carrington (2019-21) and Langdon (2020-21) also included pinto bean grown in paired rows (separated by 6 or 7 inches and centered on 30 or 28 inches, respectively) (see picture below). Seed yield with paired rows, averaged among five site-years, was similar to intermediate rows and 20% greater than wide rows (Figure 2).

Paired rows at different plant populations.

Figure 2. Pinto bean seed yield with paired rows, Carrington, 2019-21 and Langdon, 2020-21 (5 site-years)[1]

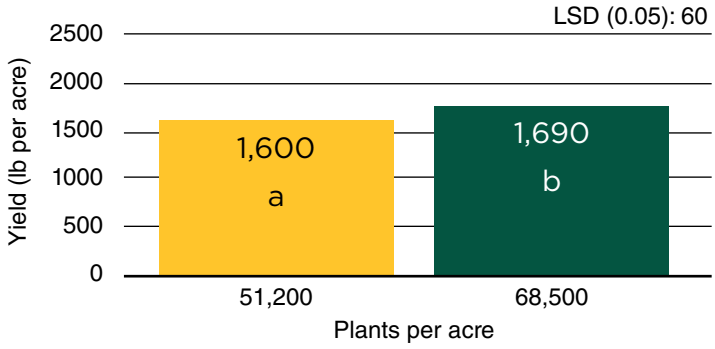


[1]Means with no similar letters are significantly different.

Plant Populations

Analyzing pinto bean plant population as a single production factor, the impact of reduced plant population was measured across eight site-years of trials (Carrington, 2018-21; Minot, 2018-19; and Langdon, 2020-21). The average population of 51,200 plants per acre produced 1,600 lb per acre compared to the population of 68,500 plants per acre that produced 1,690 lb per acre (Figure 3). The greater plant density, which is similar to the standard recommendation of 70,000 plants per acre, had a yield advantage of 6%.

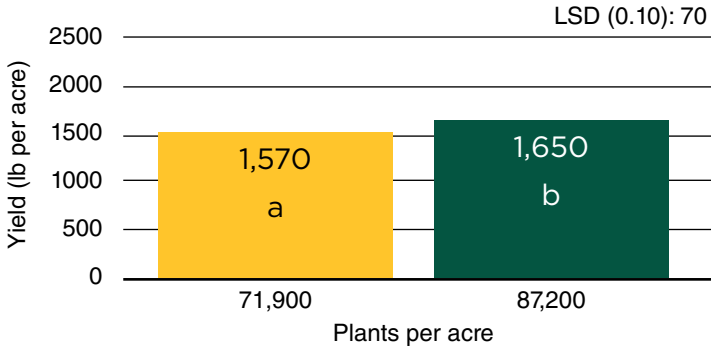
Figure 3. Pinto bean seed yield between reduced and standard plant populations, Carrington, 2018-21; Minot, 2018-21; and Langdon, 2020-21 (8 site-years)[1]



[1]Means with no similar letters are significantly different.

Another database, averaged across three site-years of trials (Carrington, 2013 and 2018; and Langdon, 2021), indicates a pinto bean yield increase with greater than the standard plant population. Average plant density of 87,200 plants per acre produced 1,650 lb per acre compared to 1,570 lb per acre with 71,900 plants per acre (Figure 4). The increased plant density had a yield advantage of 5%.

Figure 4. Pinto bean seed yield between standard and increased plant populations, Carrington, 2013 and 2018; and Langdon, 2021 (3 site-years)[1]



[1] Means with no similar letters are significantly different.

Summary

- Pinto bean seed yield was primarily impacted by row spacing in the two-factor combination study. Average yield increase was 17% with intermediate (18- or 21-inch) row spacing and plant populations of about 65,000 or 84,000 plants per acre versus wide (28- or 30-inch) rows.
- Plant emergence and maturity, and lodging were similar among the row spacing and plant population combinations in the study. Averaged among plant populations, canopy closure with intermediate rows was greater than wide rows.
- Row spacing evaluated as a single factor across 11 trials indicates a yield increase of 20% with 15- to 22-inch versus wide rows. Also, paired rows provided similar yield as 18- to 21-inch rows and 20% greater yield than wide rows.
- Plant population evaluated as a single factor indicates a yield increase of 5% with plant population at 87,000 plants per acre compared to a population similar to the standard density of 70,000 plants per acre.

References

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