Optimizing Row Spacing and Seeding Rate for Improved Pinto Bean and Kidney Bean Agronomic Performance Under White Mold Disease Pressure

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Planting pinto and kidney beans to narrow rows is known to maximize pinto bean yields in the absence of white mold, but worries about white mold have limited the adoption of narrow rows.

In 2019 and 2020, the plant pathology program at the Carrington Research Extension Center, in conjunction with the agronomists at the Oakes Irrigation Research Site, evaluated the impact of seeding rate and row spacing on agronomic performance of pinto beans under white mold disease pressure. Testing was done with 'Palomino' and 'Vibrant' slow-darkening pinto beans and 'Rosie' light-red kidney beans, 'Dynasty' dark-red kidney beans, and 'Pink Panther' light-red kidney beans. To assess the impact of row spacing and seeding rate under different levels of disease pressure, testing was done with no foliar fungicide, with a single fungicide application at early bloom (Topsin at 40 fl oz/ac), with two sequential fungicide applications (Topsin at 40 fl oz/ac followed by Endura at 8 oz/ac), or with pinto beans seeded into a rye cover crop terminated either 10-14 days before planting or 0-3 days after planting. Plots were 10 feet wide by 25 feet long, with the middle 5 feet by 20 feet harvested for yield. All studies were conducted with six replicates. Overhead irrigation was applied as needed to create conditions favorable for white mold. White mold was assessed shortly before or at maturity. Within each plot, a third to half of the plants were individually assessed for white mold severity.

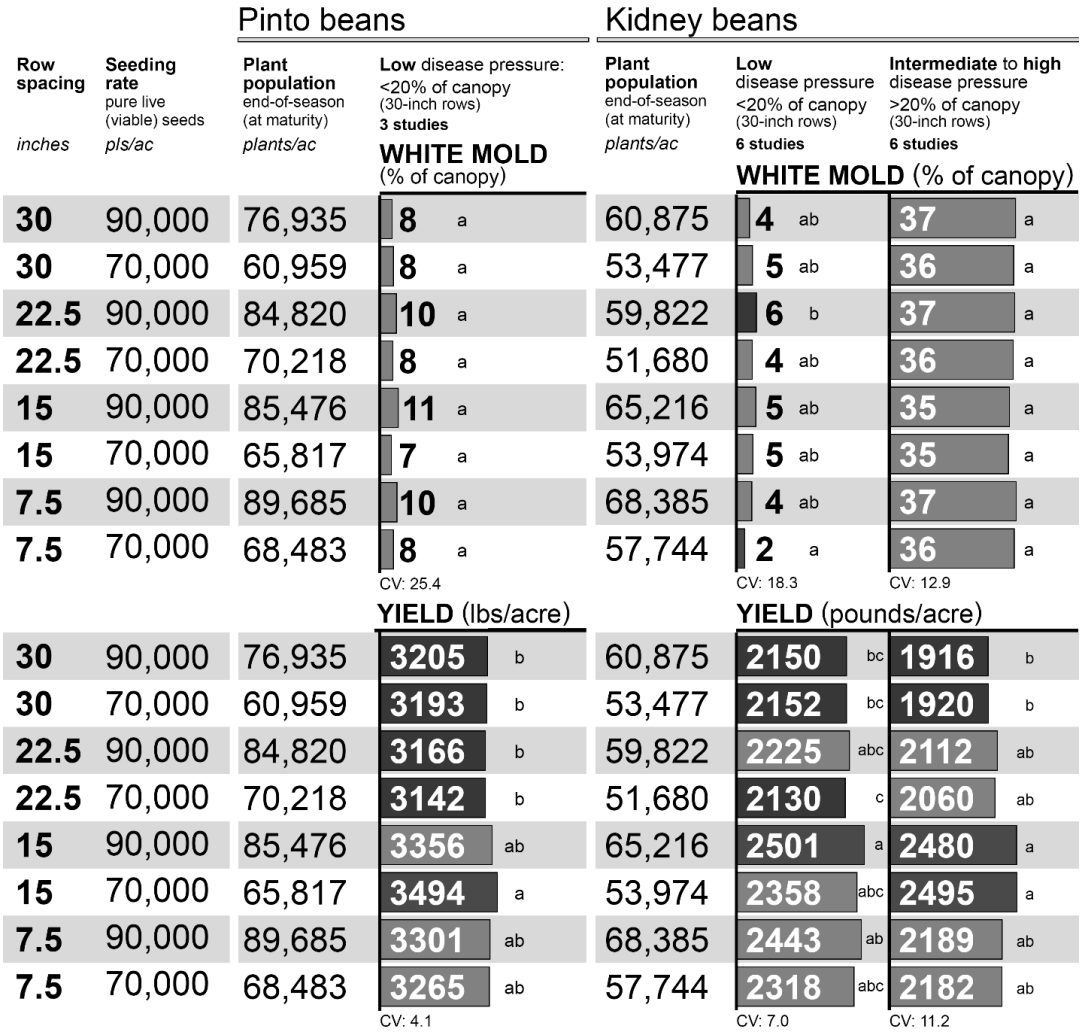
The row spacing that optimized pinto bean agronomic performance was contingent on white mold disease pressure (Figure 1). When white mold pressure was low to moderate (less than 20% in 30-inch rows), pinto bean yield was maximized in narrow (7.5- or 15-inch) rows. The yield gain associated with earlier canopy closure and the resulting increase in photosynthesis was greater than the reduction in yield associated with the modest increase in white mold pressure associated with narrower rows. When white mold yield was high (more than 20% in 30-inch rows), pinto bean yield was similar across row spacings, and pinto bean agronomic performance was optimized in wide (30-inch) rows. Disease was lower in the 30-inch rows, and the reduction in white mold observed in wide rows reduces seed quality problems (primarily moldy seed and sclerotia contamination).

			Pinto beans			Kidney beans			
Row spacing *inches*	Seeding rate pure live (viable) seeds *pls/ac*	Plant population end-of-season (at maturity) *plants/ac*	Low disease pressure <20% of canopy (30-inch rows) **12 studies**	Intermediate disease pressure 20-40% of canopy (30-inch rows) **8 studies**	High disease pressure >40% of canopy (30-inch rows) **7 studies**	Plant population end-of-season (at maturity) *plants/ac*	Low disease pressure <20% of canopy (30-inch rows) **6 studies**	Intermediate disease pressure 20-40% of canopy (30-inch rows) **5 studies**	High disease pressure >40% of canopy (30-inch rows) **7 studies**
			WHITE MOLD SEVERITY (% of canopy)				**WHITE MOLD SEVERITY** (% of canopy)		
30	70,000	50,894	**9** a	**29** a	**53** a	52,559	**5** ab	**34** a	**46** a
22.5	70,000	52,427	**11** ab	**36** ab	**60** a	50,606	**4** ab	**32** a	**47** a
15	70,000	52,818	**11** ab	**38** b	**59** a	53,488	**5** b	**33** a	**49** a
7.5	70,000	53,144	**13** b	**35** ab	**55** a	55,979	**2** a	**35** a	**46** a
			CV: 27.7	CV: 17.7	CV: 10.2		CV: 19.2	CV: 14.9	CV: 11.0
			YIELD (pounds/acre)				**YIELD** (pounds/acre)		
30	70,000	50,894	**3015** b	**2596** a	**1919** a	52,559	**3015** ab	**1799** b	**1446** a
22.5	70,000	52,427	**3022** b	**2424** a	**1836** a	50,606	**3022** b	**1878** b	**1514** a
15	70,000	52,818	**3398** a	**2522** a	**1876** a	53,488	**3398** a	**2309** a	**1632** a
7.5	70,000	53,144	**3305** a	**2482** a	**1738** a	55,979	**3305** ab	**2054** ab	**1466** a
			CV: 7.4	CV: 8.1	CV: 8.0		CV: 6.4	CV: 10.6	CV: 13.1

Figure 1. Impact of row spacing on white mold severity and yield in pinto and kidney beans (light-red and dark-red). Data are from studies conducted in Carrington and Oakes, ND in 2019 and 2020 with no foliar fungicide, one or two fungicide applications, fallow ground, direct-seeded into winter rye terminated 10-14 days prior to planting, or direct-seeded into rye terminated 0-3 days after planting. *Within-column means followed by different letters are significantly different (P < 0.05; Tukey procedure).*

Planting pinto beans at 70,000 viable seeds per acre optimized agronomic performance under white mold pressure (Figures 2 and 3). Increasing seeding rate to either 90,000 or 120,000 viable seeds per acre had little impact on yield but was consistently associated with higher white mold disease pressure.

Row spacing	**Seeding rate** pure live (viable) seeds	**Plant population** end-of-season (at maturity)	**Low** disease pressure <20% of canopy (30-inch rows)	**Intermediate** disease pressure 20-40% of canopy (30-inch rows)	**High** disease pressure 40-60% of canopy (30-inch rows)
inches	*pls/ac*	*plants/ac*	**4 studies**	**4 studies**	**1 study**
			WHITE MOLD (% of canopy)		
30	120,000	96,439	**11** a	**36** ab	**57** ab
30	70,000	48,536	**8** a	**22** a	**58** ab
22.5	120,000	85,054	**12** a	**44** b	**60** ab
22.5	70,000	42,646	**8** a	**28** ab	**51** ab
15	120,000	90,750	**10** a	**42** b	**75** b
15	70,000	48,972	**8** a	**35** ab	**56** ab
7.5	120,000	115,454	**10** a	**36** ab	**72** b
7.5	70,000	49,513	**9** a	**37** ab	**46** a
			CV: 26.7	CV: 20.4	CV: 15.0
			YIELD (pounds/acre)		
30	120,000	96,439	**3182** de	**2846** ab	**2403** a
30	70,000	48,536	**3083** e	**2937** a	**2267** a
22.5	120,000	85,054	**3614** bcd	**2439** b	**2318** a
22.5	70,000	42,646	**3326** cde	**2653** ab	**2345** a
15	120,000	90,750	**3867** ab	**2849** ab	**2041** a
15	70,000	48,972	**3737** abc	**2772** ab	**2430** a
7.5	120,000	115,454	**4148** a	**2826** ab	**1888** a
7.5	70,000	49,513	**3937** ab	**2643** ab	**2173** a
			CV: 6.1	CV: 6.4	CV: 13.6



In kidney beans, seeding rate and row spacing had little or no impact on white mold severity, and yields were maximized in 15-inch rows irrespective of white mold pressure (Figure 3). Increasing seeding rate from 70,000 to 90,000 viable seeds per acre was associated with modest yield gains in 15-, 22.5-, and 30-inch rows when white mold pressure was low to moderate, but differences were not statistically significant. Increasing seeding rate had no impact on yield when white mold pressure was high (Fig. 3).

The research suggests that pinto bean seeding rate should be kept to 70,000 viable seeds/ac in fields where white mold is a concern. The optimal row spacing in pinto beans changes as disease pressure increases, with narrow (7.5 and 15-inch) rows optimal when white mold pressure is low to moderate and wide (30-inch) rows optimal when white mold pressure is high. The research also suggests that kidney bean agronomic performance is optimized in 15-inch

rows irrespective of white mold pressure, and that increasing seeding rate from 70,000 to 90,000 viable seeds/ac confers no gain in yield when white mold pressure is high.

This research was conducted by M. Wunsch, Thomas Miorini, Jesse Hafner, Suanne Kallis and Xavier Klocke (NDSU Carrington Research Extension Center) and Kelly Cooper, Heidi Eslinger, and Seth Nelson (NDSU Oakes Irrigation Research Site).