

Pinto bean response following winter rye cover crop, Carrington, 2018.
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The trial was conducted in 2018, at the NDSU Carrington Research Extension Center with support from Northarvest Dry Bean Growers Association to examine the performance of pinto bean with winter rye grown as a preplant (PP) cover crop (seeded in the fall of the previous growing season). Experimental design was a randomized complete block with four replications. The dryland trial was established on a conventionally tilled Heimdal-Emrick loam soil with 3.7% organic matter, 6.6 pH, 20 ppm P, 299 ppm K, and 1.0 ppm Zn. ‘ND Dylan’ rye was direct seeded into oat stubble in 7-inch rows at about 60 lb/A on October 4, 2017. ‘Lariat’ pinto bean was planted into tilled soil or rye residue at 83,300 seeds/acre in 21-inch rows on May 31, 2018. North Dakota Agricultural Weather Network (NDAWN) monthly rain (inches): April = 0.06; May = 1.28; June = 4.63; July = 2.65; and August = 0.24.

Rye termination treatments were designated by method and timing:

1. Tillage (2x roto-till) on October 17 (13 days after seeding rye) followed by preemergence (PRE) Roundup PowerMax (32 fl oz/A) plus NIS+AMS (Class Act NG; 2.5% v/v) and Spartan Charge (5 fl oz/A) on May 31 (conventional check).
2. PP tillage (2x roto-till) on April 26 (rye 1- to 2-leaf).
3. PP Roundup PowerMax plus NIS+AMS on April 26.
4. PP Roundup PowerMax plus NIS+AMS on April 26 followed by PRE Roundup PowerMax plus NIS+AMS and Spartan Charge (5 fl oz/A) on May 31.
5. PP Roundup PowerMax plus NIS+AMS on May 14 (rye 4-leaf plus tillers).
6. PP Roundup PowerMax plus NIS+AMS on May 30 (rye boot stage with some heads emerging).

Raptor (4 fl oz/A) plus MSO (Destiny; 24 fl oz/A) and AMS (12 lb/100 gal) was applied across trial on June 15 for post-emergence (POST) control of green and yellow foxtail, and rye escapes. Also, Raptor plus SelectMax (12 fl oz/A) and MSO HC (16 fl oz/A) were POST applied to treatments 2-3 and 5 on June 28 for control of foxtail escapes. Herbicide treatments were applied with a hand-boom sprayer delivering 10 gpa through 8001 flat-fan nozzles at 35 psi.

Bean plants were hand-pulled for field drying on August 29 and seed harvested with a plot combine on August 31.

Rye termination method and timing had minimal influence on dates of bean plant emergence, flowering, and maturity (Table 1). Plant stand was similar among treatments. Plant stand across treatments (50,590 plants/acre) was 61% of planting rate. Mid-July canopy closure was greatest with the conventional check (trt 1), while late July/early August evaluations generally indicated similar canopy closure among treatments. Also, pod height was similar among treatments.

Trt no.	Plant ^a							Pod ht cm	Seed		
	Emergence DOY	Stand (20- Jun) plt/A	Flower (R1) DOY	Canopy closure (%)			Maturity (R9) DOY		Yield lb/A	Test weight lb/bu	Count no./lb
				12-Jul	31-Jul	1-Aug ^b					
1	163	51,936	198	61	86	80	235	2	1171	55.6	1241
2	163	48,853	199	33	72	72	237	2	1080	55.6	1205
3	164	48,853	199	35	75	76	237	2	1104	55.8	1268
4	163	52,648	198	49	83	87	236	1	1237	55.7	1262
5	164	48,616	199	36	72	71	237	1	919	54.7	1223
6	163	52,648	198	49	81	81	235	2	1127	55.4	1279
Mean	163	50,592	199	44	78	78	236	1	1106	55.5	1246
CV (%)	0.4	11.0	0.4	15.9	6.3	11.0	0.3	95.0	24.9	1.3	7.8
LSD (0.10)	1	NS	1	9	6	NS	1	NS	NS	NS	NS

^aDOY (day of year): 163=June 12; 199=July 18; 236=Aug 24. Plant stage at stand count = VC.

^bCanopeo reading.

Soil moisture was adequate for bean plant establishment and vegetative stage growth. However, during bean reproductive (seed production) stages, rainfall was limited to 0.72 inches (NDAWN) from July 5 to August 31. Thus, trial seed yield was greatly reduced. Yield, test weight and seed size were similar among treatments (Table 1). Yield with treatment 4 tended to be greater than others, likely due to increased soil moisture and weed control with PRE herbicide after planting; treatment 5 tended to have lowest yield.

Soil moisture was measured at 4-inch depth with a hand-held tester during mid-May to mid-July (Table 2). Soil moisture was consistently lower with rye termination at bean planting time with glyphosate (trt 6), when measured May 14 and 31, and June 15, compared to the standard check (trt 1). Also, soil moisture was reduced by half with early spring rye termination with tillage (trt 2) compared to treatment 1. Soil moisture was similar among all treatments when measured June 28 and July 12.

Table 2. Soil moisture with pinto bean following a rye cover crop , Carrington, 2018.

Trt no.	Soil moisture ^a				
	14-May	31-May	15-Jun	28-Jun	12-Jul
	%				
1	21.5	18.1	24.2	24.0	20.8
2	10.6	17.6	22.3	25.0	23.0
3	20.5	20.0	22.0	22.3	21.4
4	20.5	20.4	24.7	23.5	22.8
5	19.9	19.7	22.1	23.6	22.4
6	17.7	11.1	20.9	23.2	20.7
Mean	18.4	17.8	22.7	23.6	21.8
CV (%)	13	12.9	5.8	6.2	11.0
LSD (0.10)	3.0	2.8	1.6	NS	NS

^aMeasured with Extech Instruments MO750 soil moisture meter at 4-inch soil depth.

The trial contained grassy weeds: green and yellow foxtail, and rye escapes, plus late-season Kentucky bluegrass. Rye control at bean planting (May 31) was excellent (94-99%) with spring PP tillage or glyphosate (trts 2-5) (Table 3). Foxtail control was excellent at bean planting with presence of living rye (trt 6). Control of rye generally was excellent at June 15 and 28, and July 12 evaluations. Foxtail control was excellent (94-95%) on June 28 with PRE herbicides followed by POST Raptor or rye terminated at bean planting (trts 1, 4, and 6). Grass control generally was excellent with all treatments on July 12.

Table 3. Weed control in pinto bean following a rye cover crop , Carrington, 2018.

Trt no.	Weed control ^a							
	31-May		15-Jun		28-Jun		12-Jul	
	rye	grass	rye	grass	rye	grass	rye	grass
	%							
1	74	71	99	75	99	95	99	96
2	98	0	91	38	94	63	99	95
3	94	63	85	61	85	69	96	90
4	96	50	99	73	99	94	99	92
5	99	44	99	51	99	69	99	89
6	0	93	99	71	99	95	99	89
Mean	77	54	95	61	96	81	99	92
CV (%)	6.7	36.3	5.5	19.5	5.0	8.5	1.7	5.7
LSD (0.10)	6	24	6	15	6	9	NS	NS

^aGrass=green and yellow foxtail, plus Kentucky bluegrass on July 12.

In summary, lack of adequate rainfall and stored soil moisture during the bean reproductive period greatly reduced yield potential among all treatments. Delay of rye termination until bean planting (trt 6) reduced early season soil moisture for bean plants compared to the standard check. However, this treatment substituted for weed control obtained with the PRE herbicide while bean yield was similar to the standard check.