

Winter Rye as a Preceding Cover Crop for Pinto Bean Production in North Dakota



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INTRODUCTION

North Dakota ranks first in the U.S. for pinto bean production, averaging annually about 300,000 acres. Production is primarily with conventional-till soils, which are susceptible to erosion. Winter (cereal) rye grown as a cover crop has numerous benefits when properly managed. A four-year field study was conducted at the NDSU Carrington Research Extension Center to establish winter rye as a living ground cover in the fall and spring prior to pinto bean production to identify advantages and challenges with this production system.

HYPOTHESIS

Winter rye as a preceding cover crop can provide adequate pinto bean seed yield if rye is timely terminated, reduce potential soil erosion and aid in weed management.

MATERIALS AND METHODS

- ND Dylan winter rye was planted in 7-inch rows into small grain or soybean residue at 60-65 lb per acre during Sep. 17 to Oct. 8, 2017-20. Rye plant populations during early spring ranged from 354,000 to 432,000 plants per acre (2020-21).
- Lariat or ND Palomino pinto bean was planted in 21- or 30-inch rows into no residue (tilled plots), rye residue or living rye ("green planted") during May 31 to June 4, 2018-21 at rates targeted to establish 70,000 plants per acre.
- Treatments (trts) based on rye termination timing and pinto bean planting dates are shown in Table 1.

Treatment	
Rye termination timing	Rye growth stage
1. Conventional production system check: fall and/or spring tillage followed by preplant (PP) or pre-emergence (PRE) glyphosate (glyt; Roundup Powermax at 28.4 fl oz per acre plus adjuvant) and PRE Spartan Charge (5 fl oz per acre) or Spartan Elite (20 fl oz per acre)	----
2. PP glyt 29-36 days before bean planting (DBBP)	1-leaf to tiller
3. PP glyt 29-36 DBBP plus PRE herbicide	
4. PP glyt 16-20 DBBP	Tiller
5. PP or PRE glyt 5 DBBP to 1 day after bean planting (DABP)	Joint to boot
6. PRE glyt 7-11 DABP	Flag leaf to flower

Table 1. Description of study treatments.

RESULTS

Averaged over four years (2018-21), pinto bean seed yield with winter rye terminated 16-36 DBBP (trts 2-4) ranged from 1,705-1,855 lb per acre and were statistically similar to the conventional check (trt 1) (Table 1). Yield averaged 1,390 lb per acre with delaying rye termination until near bean planting (trt 5), reducing yield 22% compared to the average yield of trts 2-4. Averaged over three years, delaying rye termination 7-11 DABP (trt 6) reduced yield 35% compared to yield with trts 2-4.

During each year of pinto bean production, topsoil moisture in the trials was reduced by delaying rye termination until near bean planting and rainfall to replenish soil moisture was less than normal (range of 2.4-5.9 inches during May-June compared to long-term average of 6.6 inches).

Treatment	Seed yield		Ground cover
	3-year average	4-year average	
	lb per acre		%
Rye termination			
1. Conventional check	1945	1750	18
2. PP glyt 29-36 DBBP	2025	1795	32
3. PP glyt 29-36 DBBP/ PRE Spartan Charge or Elite	2060	1855	29
4. PP glyt 16-20 DBBP	1965	1705	34
5. Near planting glyt 5 DBBP to 1 DABP	1475	1390	50
6. PRE glyt 7-11 DABP	1315	----	59
LSD 0.05	355	260	24

Table 2. Pinto bean seed yield and ground cover with timing of rye termination, 2018-21.

RESULTS (CONTINUED)

Average ground cover, measured by the line-transect method one to two DABP, generally was greater with delay of rye termination near or after planting compared to the conventional check and PP termination of rye (Table 2 and Figure 1). The increasing ground cover with delaying termination of rye provides increased and extended protection during the season from soil erosion.

Grass and broadleaf weeds present in this study generally had similar control, when visually evaluated three to four weeks following planting, with the use of PRE herbicides and when rye termination was delayed until or after bean planting. Weed control generally was reduced with early rye termination (without PRE herbicide) as the lack of live rye and residue allowed weed presence earlier in the growing season. For example, averaged across three years, green and yellow foxtail control averaged 87-89% with trts 1, 3 and 5 compared to 71-72% control with trts 2 and 4.

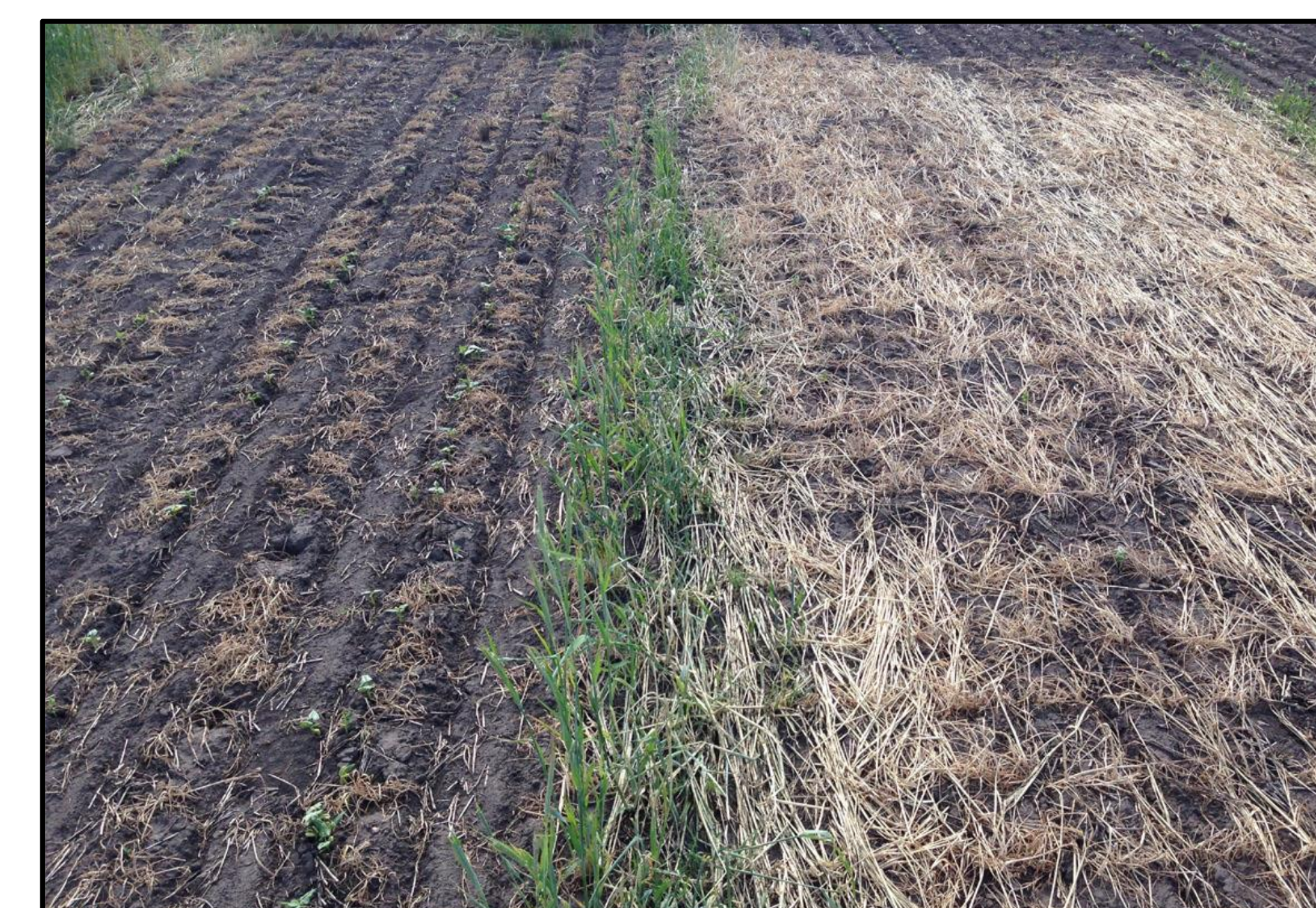


Figure 1. Trt 2 (left) and trt 6 (right) plots at early pinto bean plant emergence (mid-June 2019).

SUMMARY

- Pinto bean seed yield with preplant terminated winter rye was similar to yield with the conventional check.
- Delay in terminating rye until near or after bean planting allowed the rye to deplete topsoil moisture that was needed to timely establish bean plants, and negatively impacted bean seed yield.
- Delay in rye termination provided increased protection from soil erosion and weed control similar as PRE herbicides.