NO-TILL AND CONVENTIONAL TILLAGE FALLOW WINTER WHEAT PRODUCTION COMPARISON

IN THE DRYLAND CROPPING REGION OF EASTERN WASHINGTON

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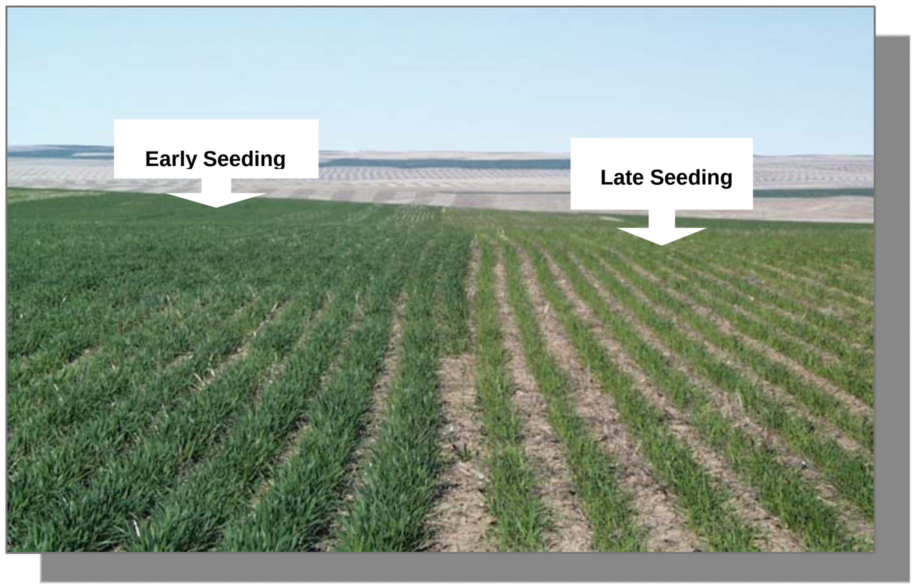
ABSTRACT

Winter wheat (WW) (*Triticum aestivum* L.) production on tillage based summer fallow systems has been a standard practice for producers in the dryland cropping region of eastern Washington for generations. This practice has been profitable but it comes at a cost that includes soil loss through wind and water erosion. Producers have examined alternative methods including no-till farming systems for maintaining or increasing profitability and reducing soil erosion. A series of on-farm tests were completed over a 5 year period examining WW established under three treatments; 'conventional' tillage fallow system, 'No-till early', or seeded at the same time as the conventional treatment, and 'no-till late' or planting was delayed 1 month. Conventional methods include a chisel sweep and multiple cultiweeding for fertilization and weed control and seeding with a deep furrow hoe drills. No-till includes multiple chemical applications for weed control and seeding and fertilization with a no-till hoe drill with Anderson® paired row openers. Similar to previous research, conventional increased seed zone moisture (0-8") but no differences were detected between treatments in total moisture to a depth of 3 feet. Soil compaction was monitored to a depth of 18 inches in one-inch increments. Less soil compaction was detected in no-till at a depth of 10-16 inches. No difference in grain yield was detected between conventional and no-till early averaging 71-bu/acre. No-till late produced 20% less yield. Economic return above variable costs was similar to yield with no differences between conventional and no-till early and lower when seeding was delayed.

Background and Objective

WSU Lincoln-Adams Extension on-farm testing helps improve farm profitability in a manner that reduces erosion and improves air and water quality. Winter wheat (WW) (*Triticum aestivum* L.) production on tillage based summer fallow systems has been a standard practice in the dryland cropping region (8-14 inches precipitation annually) of eastern Washington for generations. This has been profitable; but it comes with a cost, including soil loss through wind and water erosion.



Producers have examined alternative methods including no-till systems for increasing profitability and reducing soil erosion. The objective of this project is to better understand, both agronomically and economically, no-till fallow WW system in comparison to a conventional minimum tillage fallow WW system. A second objective is to determine what happens in no-till fallow if seeding date or emergence is delayed because of low moisture conditions.

Material and Methods

An on-farm test was designed to examine WW established under 3 treatments; ‘conventional’ tillage fallow system, ‘no-till early’, or seeded at the same time as the conventional treatment, and ‘no-till late’, or planting was delayed one month. Conventional methods include a chisel sweep and multiple cultiweeding for fertilization and weed control and seeding with a deep furrow hoe drills. No-till include multiple chemical applications as needed for weed control and seeding and fertilization with a no-till hoe drill with Anderson® paired row openers. Table 1 outlines the treatments timeline and operations.

The on-farm test is located 6 miles northwest of Wilbur, Washington in a 12-14 inch annual precipitation zone (Figure 1). Two sites (fallow treatments and crop each year) were established on a bagdad silt loam soil with at least 2 years of direct seed spring cropping history (Table 2). The trial at both sites is a RCBD with 5-replications. Plots are approximately one acre in size, and seeded, maintained, and harvested by the producer.

Gravimetric soil water samples were collected each year prior to seeding in mid-September in 4 inch increments (seed zone) in the top foot and 1-foot increments to a depth of 3 feet for total moisture. Soil compaction data was collected (4 samples/plot) in the spring of the year in the 2006 and 2007 WW crops with a Spectrum™ Field Scout SC900 Soil Compaction Meter in 1 inch increments to a depth of 18 inches. Grain yield, test weight and protein were also collected.

Table 1. Timeline and operations for each of the 3 treatments.

	Operations	
Timeline	**Conventional**	**No-Till**
Early May	Roundup® applied	Roundup® applied
Mid May	5-bar harrow	5-bar harrow
Mid June	Sweep chisel	Roundup® applied if needed
Mid July	Cultiweed	Roundup® applied if needed
Early Sept	Cultiweed-Fertilization	Roundup® applied if needed
Mid Sept	Deep furrow seeded	Seeded and fertilized 'early'
Mid Oct		Seeded and fertilized 'late'

Roundup® was applied at 16 oz/ac. All three treatments were seeded with 'Eltan'WW at 60 lbs./ac in 2004-06 and 'Bruehl' WW at 60 lbs./ac in 2007. The trial was fertilized each year with 52 lbs. N/ac in the form of aqua at the time of fertilization, and had dry fertilizer with the seed applied at a rate of 8-10-0-7 lbs./ac.

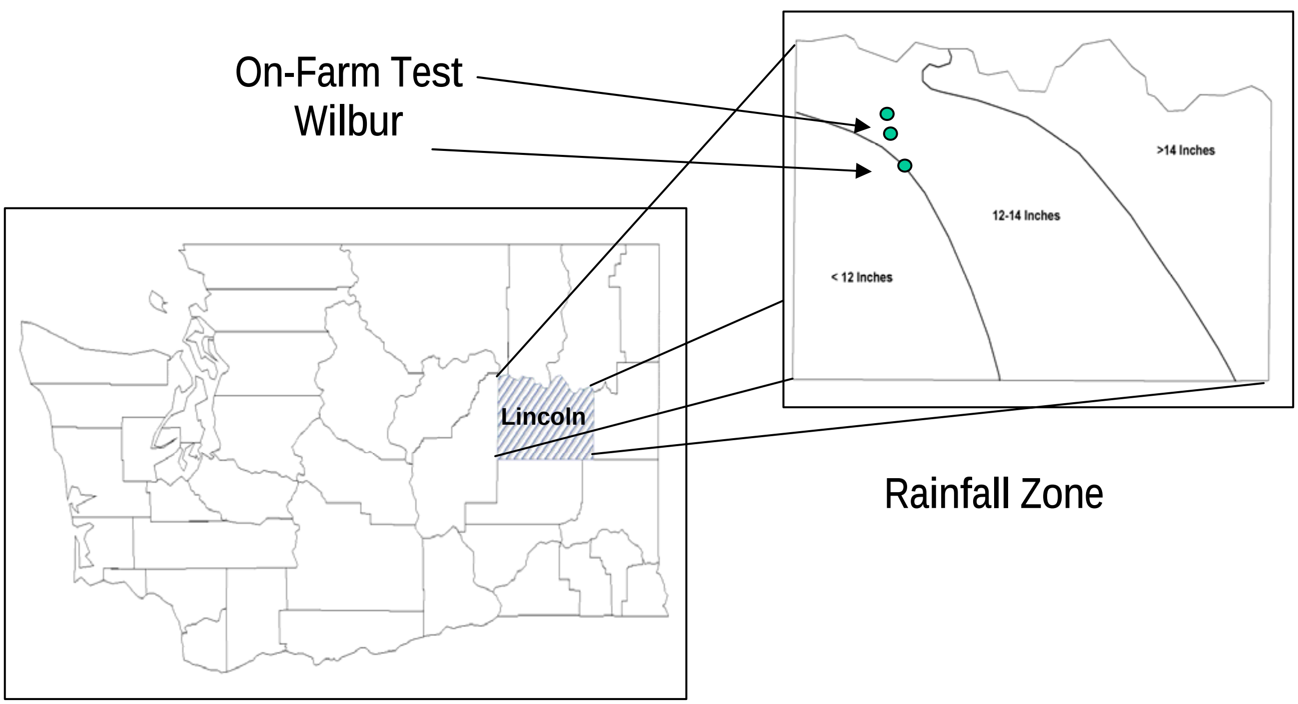


Figure 1. Location and precipitation zone of the on-farm test sites located 6 miles northwest of Wilbur, Washington.

Table 2. Cropping sequence over the 5 years.

Year	Site A	Site B
2003	Fallow Treatments	-
2004	Winter Wheat	Fallow Treatments
2005	Fallow Treatments	Winter Wheat
2006	Winter Wheat	Fallow Treatments
2007	-	Winter Wheat

Agronomic Production Results

Over the four years total average soil water was uniform and no differences were detected between treatments (Figure 2). Seed zone soil water (0-12 inches) has not been limiting in each of the four years, but has been greater in the conventional tillage system with an average of 1.63 in/ft compared to only 1.49 in/ft in the no-till fallow treatment.

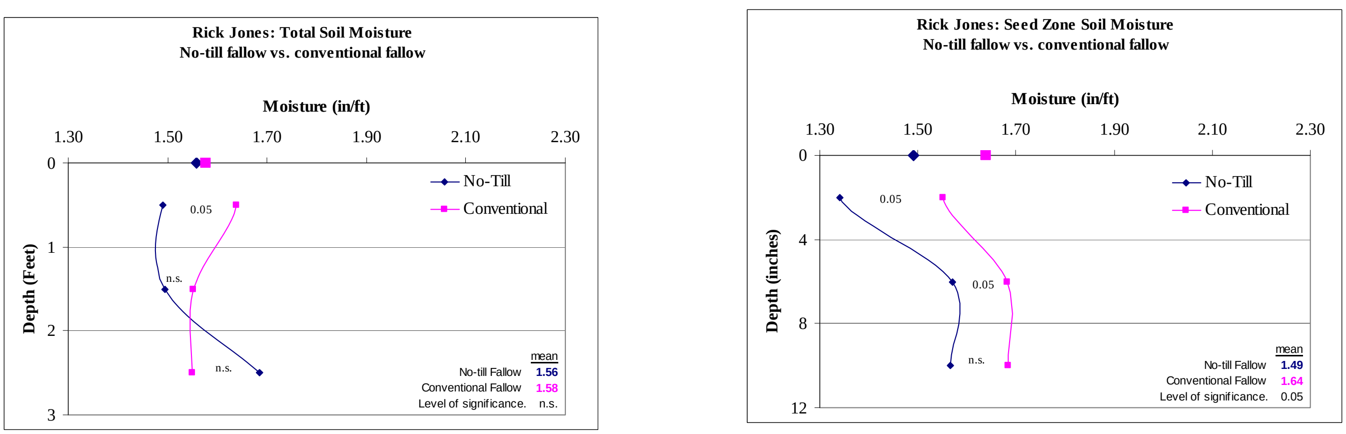


Figure 2. Average total moisture and seed zone soil moisture of Conventional and No-till fallow systems.

Growers throughout the region have expressed concerns with potentially increasing soil compaction with no-till systems. Soil compaction was not different in the top 9 inches between conventional and no-till systems, and no-till had significantly less compaction between 10-16 inches (Figure 3).

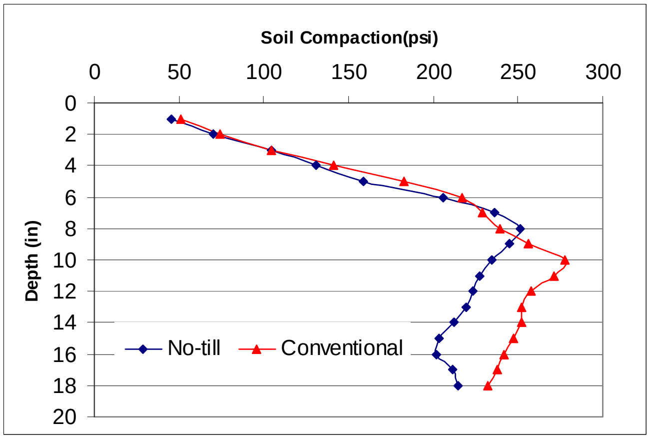


Figure 3. Soil compaction in conventional and no-till fallow WW systems. Differences from 10 to 16 inches are significant (*P< 0.05).*

Grain yield between conventional and no-till early WW over the 4-years was not significantly different at 71 and 69 bu/ac (Table 3). No-till late yielded 55 bu/ac and was significantly less than other two treatments. No-till late WW also had significantly higher test weigh and grain protein (Figure 4).

Table 3. Grain yield of winter wheat produced under conventional fallow, no-till fallow seeded early and no-till fallow seeded late.

Treatments	**2003-04 Site A**	**2004-05 Site B**	**2005-06 Site A**	**2006-07 Site B**	**Mean**
	-----------------	-----------------	bu/ac	-----------------	-----------------
Conventional	81	76	82	48	71 a
No-Till (Early)	82	77	70	48	69 a
No-Till (Late)	67	60	67	27	55 b
LSD(0.05)					3

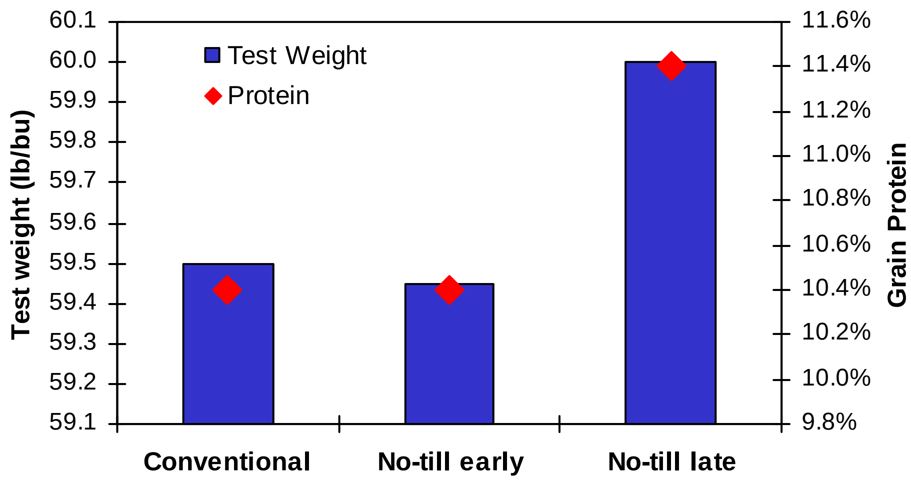


Figure 4. Average grain test weight and protein of winter wheat produced under conventional fallow, no-till fallow seeded early and no-till fallow.

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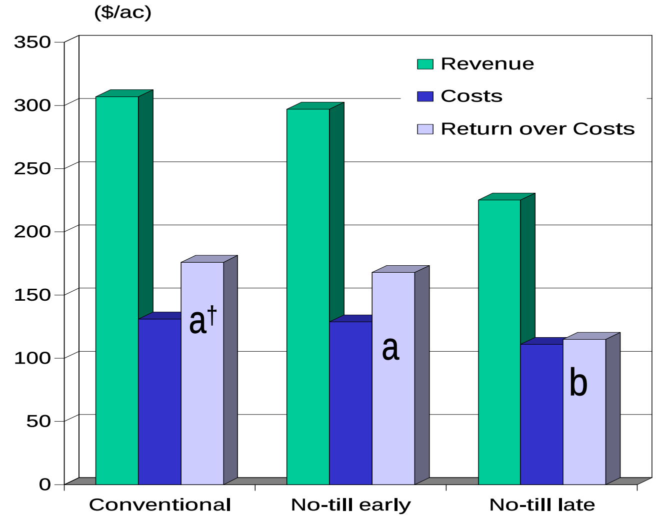
Economic Output Results

Gross economic return was calculated using the F.O.B. price at Ritzville, Warehouse on September 15 each year. Operation and production costs were established using 2003 Extension enterprise budget for Lincoln County, Washington and adjusted. Land costs were a ¾-¼ crop share where the landowner pays ¼ of the fertilizer and receives ¼ of the crop.



† Return over cost column followed by the same letter are not significantly different.
LSD $_{(0.05)}$ = 10 CV= 10.5%

Figure 5. Revenue, production costs, and return over variable costs of WW produced under 3 treatments.

No significant difference in WW was detected in gross economic return, production costs and return over costs between the conventional and no-till early treatments (Figure 5). Return over costs for conventional averaged $176/ac and no-till early treatment averaged $168/ac. Gross economic return, production costs and return over costs were all significantly less for the no-till late treatment. Production cost was lower because of less land cost associated with reduced production. Return over costs for the no-till late treatment averaged only $115/ac.

Conclusions

Overall larger agronomic and economic differences were detected between the two no-till treatments. Little differences were detected between conventional and no-till early treatments. As anticipated the conventional fallow system had more seed zone moisture but in each of the four years seed zone moisture was adequate despite less than average yearly precipitation 4 out of the 5 years during the study (Figure 6). If no-till fallow seed zone moisture was limited slowing emergence or delaying seeding date, a producer can anticipate 20% less yield and significantly less return over costs given similar market prices and input costs.

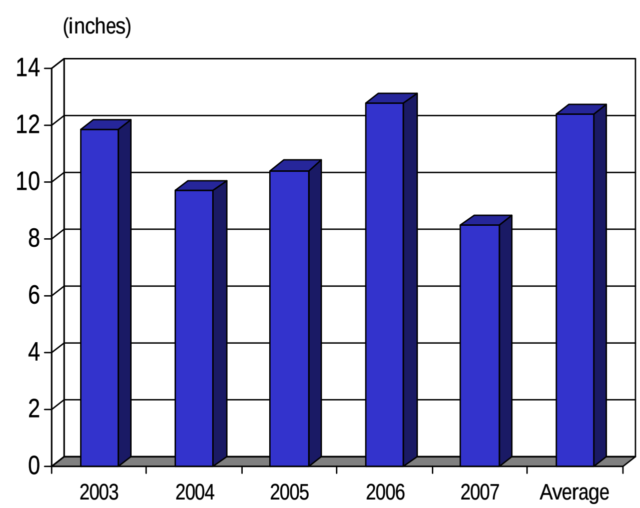


Figure 6. Crop season precipitation (Oct-Sept) during the duration of the study and the 78 yr historic average.

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