On-Farm Test Results

Lincoln-Adams Area 1998

Aaron D. Esser

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Introduction

On-farm testing, as defined in this publication, is not researched managed small plots on farms, nor is it a single strip or split-field comparison. It is a replicated, statistically valid research with field trials established and managed by the growers with field scale equipment. On-farm testing enables farmers to evaluate different production options using an accurate low risk tool. Using these on-farm-testing methods, growers can achieve experimental precision comparable to those of intensive university research trials. Reliable results will enable farming practices to progress to greater productivity efficiencies and resource protection. This publication summarizes the on-farm test conducted in 1998 by growers in Adams and Lincoln County, Washington.

The need for scientific experimental designs in grower field trials is not readily apparent to most growers. They are usually very adept at observing how a new practice or management option performs and making decisions based on their farming experience. If this were not true most of the time, they probably wouldn't be in business today.

The need for "scientific" field trials often depends on the questions that the grower needs answered. For example, a growers does not need a scientific comparisons to answer questions like: " Will this new crop grow and reach maturity under my production condition?" But they do need a scientific approach if there question is: "What variety of this new crop works best under my production conditions?"

Utilizing basic experimental methods is critical to achieve accurate results with on-farm testing. Because of the natural variation that exists within every field, an important step is to replicate treatment comparisons. Statistical analysis of the results of replicated test can then be used to separate the effects of natural field variability from the treatment effects. Associated with most of the data tables presented in these on-farm test reports there is an "$LSD_{(0.05)}$" which stands for "least significant difference at the 5% probability level." The LSD is used to determine if the treatments averages is greater than the LSD shown, there is a 95% probability that the difference is due to the treatments and not the natural field variability. To help illustrate this variability, yield data collected from each replication of the test are included in most of the reports. Final decisions regarding management options evaluated in an on-farm test should also be based on the grower's experience, economics, interactions with other management practices and more than one year of test.

Growers in Adams and Lincoln Counties have expressed interest in no-till systems for many different reasons. However, they have also expressed concerns about the "no-till" learning curve that is often characterized as steep and rocky at times. Four of the trials summarized in this report examine no-till vs. conventional annual cropping with different objectives to better understand the learning curve associated with no-till. Other trials summarized examine long-term cropping systems research and variable fertilizer rates with spring wheat, safflower, and yellow mustard.

On-Farm Testing

The on-farm tests presented in this publication are designed to "scientifically" compare the performance (stand establishment, tillers, weed populations, diseases, soil moisture, yield, and cropping systems) of 2 to 4 different crop management practices, or "treatments." An on-farm test can be as simple as a comparison of fertilizer rates or more complex, with comparisons of different crop rotations and production systems.

On-farm testing methods involve:

1. Proper design and layout of the experiment.
2. Accurate measurement of yield and other factors of interest from the individual treatment plots.
3. Analysis and interpretation of results using accepted statistical procedures.

Proper Design and Layout of the Experiment

After deciding what the treatments are going to be, pick locations in the field (or area of interest) where you can place the treatments in long, side-by-side strips. Avoid field borders and corner areas where overlaps of fertilizer, seeding, herbicides or extra tillage passed might occur. Flip a coin to decide which treatment goes in which strip. Repeat this for each replication.

Designing a test that will produce accurate, conclusive information often has growers asking many questions such as:

Why is replication needed?

Replication is used to overcome the fact that any two plots under the same management will not have exactly the same yield, stand count, weed population, etc. In other words, replication allows us to determine if differences between plots are due to treatments or due to "normal" field variation. In statistical jargon this normal variation is called "experimental error." Replication is based on the theory that if one practice is superior to another, it will become evident if you give it several chances.

How many replications are needed?

Research in the PNW has shown that four replications usually give the best chance of success for the amount of effort. Five or six replications can give a slight gain in statistical power in separating treatment differences, but may not be worth the extra effort. Three replications are less precise in determining treatment differences than four replications, but may be adequate for some management practice comparisons. The danger of starting with three replications is that if data from a plot is lost, you no longer have an effective trial. With the availability of portable weighting equipment, 8 to 12 strips (4 replications of 2-3 treatments) can usually be harvested in less than three hours.

Why should treatments be randomized?

Selection of treatment locations in a field comparison must be "unbiased" or fair. This may appear obvious, but there are many ways to consciously or unconsciously give an advantage to one of the practices being compared. The scientific way to choose which practice or treatment goes in which plot is to flip a coin, or to "randomize." Once you have chosen plot areas, which as far as you can tell should perform the same, the logical way to convince yourself and others that you did not consciously or unconsciously favor one of the treatments is to assign them at random. Remember all treatments in a replication should have an equal chance to perform well in your best judgement!

What statistical design works best?

The statistical design often the most appropriate for on-farm testing with field-scale equipment is called "Randomized Complete Block" design (figure 1). The "complete block" means that each of the two or more treatments are included in side-by-side comparisons in each of the trial "replications or blocks." A randomized complete block means that the order of each treatment in each replication is chosen randomly to ensure no bias in assigning treatments to plots. Because field variability generally increased with distance across the field, data variability is decreased through establishing the replications of side-by-side comparisons in areas where field variability is lower. Variability in results due to natural variability between blocks can then be separated in the statistical analysis of the results.

Replication I		**Replication II**		**Replication III**		**Replication IV**	
N	**C**	**C**	**N**	**C**	**N**	**C**	**N**

Figure 1. Potential randomized complete block design on-farm test with two treatments (C=control; N=new practice) and four replications. Each block, or replication can be placed side-by-side or at different locations.

Finally, how long should on-farm test plots be?

The longer the plots are, the better the data is likely to be, but that depends on landscapes, soil variability, and past farming practices in the field. Although, there have been many successful tests with four replications of 300 feet strips, research in the Pacific Northwest (PNW) has shown strip lengths of 750 feet or longer strips usually produce more precise results.

Accurate Measurement of Interest from the Individual Treatment Plots

Accurate data collection is very important for good results and should start with keeping notes on what you observe throughout the trial year. Observation is a valuable learning tool and will often help explain the "scientific" results. When data measurements are taken, such as plant populations or yield, record them separately for each strip. At harvest, cut a full header width out of the center of each plot, and weight the grain from each plot separately. Measure the length of each cut, especially if plot length varies, for more accurate calculations of yield. Portable truck scales or weigh wagons are available for making yield comparisons within a 5 to 10 pound accuracy.

Analysis and Interpretation of Results Using Accepted Statistical Procedures

When measurements are made, such as stand counts or yield, record them separately for each replication of each treatment. The data can then be analyzed statistically using a hand calculator and step-by-step formulas. Assistance in analyzing the test data is also available through your county extension agent. Even without statistics a lot can be learned from observation of different treatments to see if one is consistently better than the other in each of the replications.

Before you start your first replicated on-farm test, ask for assistance in design and conduction on-farm test from your county extension agent or others experienced with on-farm testing. Effectively designed and conducted, on-farm tests can provide growers with an accurate, low-risk tool for evaluating new production options and making successful management decisions.

This information was obtained from the Idaho, Oregon and Washington STEEP II on-farm testing project. For additional information on designing an on-farm test talk to your local extension agent or Washington State Cooperative Extension publication EB1706 "On-Farm Testing, a Grower's Guide".

Nitrogen Fertilizer for No-Till Spring Wheat in Lincoln County

Don Phillips
with Aaron Esser, WSU Cooperative Extension

Objective:

The objective of this research was to examine nitrogen rates for effect on seed yield and profitability of no-till spring wheat.

Study Location:

Location: about 2 miles east of Harrington, WA
Annual Precipitation: 12-13 inches
Soil Type: silt loam
Previous Crop: winter wheat

Soil Test Results:

Soil pH = 6.4

		Available Nitrogen (lb N/acre)
N mineralization	=	42†
NO_3 (3')	=	39
NH_4 (1')	=	09
Total Available N	=	90

† Estimated N released from 2.1% organic matter.

Treatments and Operations:

Roundup® was applied at 12 oz/acre about 10 days prior to planting. "Edwall" soft white spring wheat was seeded on April 7, 1998 with a McGregor no-till drill with 12-inch row spacing. Spring wheat was seeded at a rate of 60-lb/acre, and a depth of approximately 2-inches. Anhydrous ammonia fertilizer was placed 5-inches below the seed. The study was a randomized complete block design with 4 replications. Fertility treatments are as follows:

Treatments	N Applied (lb/acre)	Soil Test N (3') (lb/acre)	Available N (lb N/acre)†
T-1	50	90	140
T-2	60	90	150
T-3	70	90	160

† Winter wheat residue was not incorporated into the soil; therefore, no additional fertilizer was applied to help break it down.

Results and Conclusions:

No agronomic differences were detected between applying 50, 60, and 70 lb N/acre. Overall there was no significant difference in plant populations and tillers per plant (Table 1). No significant difference in seed yield was detected as average seed yield was 27.2 bu/acre (Table 2).

Economically, applying 50 lb N/acre had a return above fertilizer cost of $52.67, applying 60 lb N/acre had a return above fertilizer cost of $50.87, and applying 70 lb N/acre had a return above fertilizer cost of only $49.07 (Table 3).

Agronomic Data:

Table 1. Plant population and tiller count of spring wheat seeded with a McGregor no-till drill in an on-farm test at Don Phillips' in 1998.

Treatments	Population (plants/ft^2)	Tiller Count (tiller/plant)
T-1	8.7 a[†]	3.9 a
T-2	8.1 a	3.8 a
T-3	8.3 a	4.7 a
LSD $_{(0.05)}$	3.8	2.1
CV	26.1%	29.4%

[†] Treatment means within columns followed by the same letter are not significantly different at the 95% probability level (*P*<0.05).

Table 2. Yield (bu/acre) of spring wheat seeded with a McGregor no-till drill produced under 140, 150, and 160 lb of total available nitrogen in an on-farm test at Don Phillips' in 1998.

Treatments	Rep I	Rep II	Rep III	Rep IV	Average
T-1	24.6	28.2	30.7	26.9	27.6 a[†]
T-2	23.3	28.0	34.0	25.3	27.6 a
T-3	24.2	26.7	31.3	22.9	26.3 a
LSD $_{(0.05)}$					2.5
CV					5.2%

[†] Treatment means within columns followed by the same letter are not significantly different at the 95% probability level (*P*<0.05).

Economic Data:

Table 3. Returns above nitrogen fertilizer cost of applying 50, 60, and 70 lb N/acre with a McGregor no-till drill in an on-farm test at Don Phillips' in 1998.

Treatments	Gross Returns @ $2.27/bu†	Net Cost of N Fertilizer @ 18 cents/lb of N	Returns above N Fertilizer Cost
T-1	$61.67	$9.00	$52.67
T-2	$61.67	$10.80	$50.87
T-3	$61.67	$12.60	$49.07

† FOB on August 17, 1998 at Odessa Union.

Nitrogen Fertilizer for No-Till Safflower in Lincoln County

Roger and Jerry Sheffels
with Aaron Esser, WSU Cooperative Extension

Objectives:

The objective of this research was to examine nitrogen rates for effect on seed yield of no-till yellow mustard.

Study Locations:

Location: about 5 miles north, northwest of Wilbur, WA
Annual Precipitation: 14 inches
Soil Type: Bagdad silt loam
Previous Crop: winter wheat

Soil Test Results:

Soil pH = 6.5

		Available Nitrogen (lb N/acre)
N mineralization	=	34[†]
NO_3 (4')	=	56
NH_4 (1')	=	03
Total Available N	=	93

[†] Estimated N released from 1.7% organic matter.

Treatments and Operations:

Roundup® was applied at 16 oz/acre approximately 3 weeks prior to planting. Safflower was seeded on May 1, 1998 with a Yielder no-till drill with 12-inch row spacing. Safflower was seeded at a rate of 40-lb/acre, and a depth of approximately 1.5-inches. One hundred pounds of 16-20-0-14 was applied with the seed, and aqua, the primary source of nitrogen, was banded in paired rows about 3 inches below the seed. The study was a randomized complete block design with 4 replications. Fertility treatments are as follows:

Treatments	N Applied (lb/acre)	Soil Test N (3') (lb/acre)	Available N (lb N/acre)[†]
T-1	59	93	152
T-2	68	93	161
T-3	77	93	170

[†] Winter wheat residue was not incorporated into the soil; therefore, no additional fertilizer was applied to help break it down.

Results and Conclusions:

There was no significant difference in seed yield within any of the 3 nitrogen treatments as this location had a large amount of nitrogen already in the soil (Table 1). Safflower yields produced in replication III and replication IV were lower than safflower yields in replication I and replication II. Overall, safflower yields were suppressed by a few potential reasons. Hot dry conditions at planting and after planting reduced stand establishment, growth, and development of safflower. A heavy infestation of both grass and broadleaf weeds also further reduced seed yield.

The application of 68-lb N/acre was the most economical with returns above nitrogen fertilizer cost of $40.86/acre (Table 2). Applying 59 and 77-lb N/acre of nitrogen fertilizer had returns above nitrogen fertilizer cost of only $39.24 and $37.62/acre, respectively.

Agronomic Data:

Table 1. Yield (lb/acre) of no-till safflower produced under 152, 161, and 170 lb of total available nitrogen in an on-farm test at Roger and Jerry Sheffels' in 1998.

Treatments	Rep I	Rep II	Rep III	Rep IV	Average
T-1	581	508	218	290	399 a†
T-2	726	581	290	315	478 a
T-3	508	532	218	387	411 a
LSD $_{(0.05)}$					104
CV					14.0%

† Treatment means within columns followed by the same letter are not significantly different at the 95% probability lever (*P*<0.05).

Economic Data:

Table 2. Returns above nitrogen fertilizer cost of applying 59, 68, and 77-lb N/acre on no-till safflower with an average yield of 429 lb/acre in an on-farm test at Roger and Jerry Sheffels' in 1998.

Treatments	Gross Returns @ 12 cents/lb	Net Cost of N Fertilizer @ 18 cents/lb of N	Returns above N Fertilizer Cost
T-1	$51.48	$10.62	$40.86
T-2	$51.48	$12.24	$39.24
T-3	$51.48	$13.86	$37.62

Nitrogen Fertilizer for No-Till Yellow Mustard in Lincoln County

Roger and Jerry Sheffels
with Aaron Esser, WSU Cooperative Extension

Objectives:

The objective of this research was to examine nitrogen rates for effect on seed yield and profitability of no-till yellow mustard.

Study Location:

Location: About 5 miles north, northwest of Wilbur, WA
Annual Precipitation: 14 inches
Soil Type: Bagdad silt loam
Previous Crop: winter wheat

Soil Test Results:

Soil pH = 6.6

		Available Nitrogen (lb N/acre)
N mineralization	=	48†
NO_3 (4')	=	52
NH_4 (1')	=	06
Total Available N	=	106

† Estimated N released from 1.6% organic matter.

Treatments and Operations:

Roundup® was applied at 16 oz/acre approximately 1 week prior to planting. Yellow mustard was seeded on May 8, 1998 with a Yielder no-till drill with 12-inch row spacing. Yellow mustard was seeded at a rate of 8 lb/acre, and a depth of approximately 1-inch. One hundred pounds of 16-20-0-14 was applied with the seed, and aqua, the primary source of nitrogen, was banded in paired rows about 3 inches below the seed. The study was a randomized complete block design with 4 replications. Fertility treatments are as follows:

Treatments	N Applied (lb/acre)	Soil Test N (4') (lb/acre)	Available N (lb N/acre)†
T-1	46	106	152
T-2	58	106	164
T-3	70	106	176

† Winter wheat residue was not incorporated into the soil; therefore, no additional fertilizer was applied to help break it down.

Results and Conclusions:

There was no significant difference in seed yield within any of the 3 nitrogen treatments as this location had a large amount of nitrogen already in the soil (Table 1). Overall, yellow mustard yields were suppressed by a few potential reasons. Hot dry conditions at planting and after planting reduced stand establishment, growth, and development of yellow mustard. This location may have also had residual herbicides that reduced the stand establishment, growth, and development of yellow mustard. A heavy infestation of both grass and broadleaf weeds (partially a result of poor establishment, growth, and development) also further reduced seed yield.

The application of 58 lb N/acre was the most economical with returns above nitrogen fertilizer cost of $28.31/acre (Table 2). Applying 46 and 70 lb N/acre of nitrogen fertilizer had returns above nitrogen fertilizer cost of only $25.47 and $23.40/acre, respectively.

Agronomic Data:

Table 1. Yield (lb/acre) of no-till yellow mustard produced under 152, 164, and 176 lb of total available nitrogen in an on-farm test at Roger and Jerry Sheffels' in 1998.

Treatments	Rep I	Rep II	Rep III	Rep IV	Average
T-1	282	327	218	254	270 a†
T-2	282	327	327	303	310 a
T-3	282	290	290	290	288 a
LSD $_{(0.05)}$					51
CV					10.2%

† Treatment means within columns followed by the same letter are not significantly different at the 95% probability level (*P*<0.05).

Economic Data:

Table 2. Returns above nitrogen fertilizer cost of applying 46, 58, and 70-lb N/acre on no-till yellow mustard with an average yield of 289 lb/acre in an on-farm test at Roger and Jerry Sheffels' in 1998.

Treatments	Gross Returns @ 12.5 cents/lb	Net Cost of N Fertilizer @ 18 cents/lb of N	Returns above N Fertilizer Cost
T-1	$36.13	$8.28	$27.85
T-2	$36.13	$10.44	$25.69
T-3	$36.13	$12.60	$23.53

Nitrogen Fertilizer for No-Till Yellow Mustard in Adams County

Rob and John Dewald
with Aaron Esser, WSU Cooperative Extension

Objective:

The objective of this research was to examine nitrogen rates for effect on seed yield and profitability of no-till yellow mustard.

Study Location:

Location: About 6 miles southwest of Ritzville, WA
Annual Precipitation: 11-12 inches
Soil Type: Ritzville silt loam
Previous Crops: 51 bu spring wheat (1997), spring barley (1996), winter wheat (1995)

Soil Test Results:

Soil pH = 6.9

		Available Nitrogen (lb N/acre)
N mineralization	=	15†
NO_3 (4')	=	31
NH_4 (1')	=	17
Total Available N	=	63

† Estimated N released from 1.09% organic matter.

Treatments and Operations:

Roundup® was applied at 16 oz/acre 2 days prior to planting. This was the only herbicide applied. Yellow mustard was seeded on April 10, 1998 with a McGregor no-till drill with 12-inch row spacing. Yellow mustard was seeded at a rate of 12 lb/acre, and a depth of approximately 1-inches. Anhydrous ammonia fertilizer was placed 5-inches below the seed. Liquid sulfur and phosphorous was applied at a rate of 10 lb/acre each. The study was a randomized complete block design with 4 replications. Fertility treatments are as follows:

Treatments	N Applied (lb/acre)	Soil Test N (3') (lb/acre)	Available N (lb N/acre)†
T-1	50	63	113
T-2	70	63	133
T-3	90	63	153

† Winter wheat residue was not incorporated into the soil; therefore, no additional fertilizer was applied to help break it down.

Results and Conclusions:

Good weed control was observed in the trial and in the surrounding yellow mustard field. The trial was uniform in both stand establishment and soil moisture over all three-fertility treatments (Table 1). There was no significant difference in seed yield between having 133 and 153 lb/acre of available N (Table 2). One hundred thirteen lb/acre of available N was significantly less yielding.

The application of 70-lb N/acre was the most economical with returns above nitrogen fertilizer cost of $102.03/acre (Table 3). Applying 90 and 50 lb N/acre of nitrogen fertilizer had returns above nitrogen fertilizer cost of $100.18 and $94.63/acre, respectively.

Agronomic Data:

Table 1. Stand establishment and soil moisture 1 month after planting of no-till yellow mustard with 113, 133, and 153 lb/acre of total available nitrogen in an on-farm test at Rob and John Dewald's in 1998.

Treatments	Establishment (plants/ft^2)	Inches Moisture			
		1'	2'	3'	4'
T-1	7.3 a[†]	1.51 a	1.47 a	1.45 a	1.39 a
T-2	6.6 a	1.55 a	1.45 a	1.47 a	1.39 a
T-3	6.1 a	1.57 a	1.44 a	1.45 a	1.43 a
LSD $_{(0.05)}$	2.2	0.13	0.08	0.08	0.08
CV	18.7%	4.9%	3.0%	3.4%	3.2%

[†] Treatment means within columns followed by the same letter are not significantly different at the 95% probability level (P<0.05).

Table 2. Yield (lb/acre) of no-till yellow mustard produced under 113, 133, and 153 lb/acre of total available nitrogen in an on-farm test at Rob and John Dewald's in 1998.

Treatments	Rep I	Rep II	Rep III	Rep IV	Average
T-1	820	807	807	880	829 b[†]
T-2	895	895	895	983	917 a
T-3	917	946	953	909	931 a
LSD $_{(0.05)}$					58
CV					3.8%

[†] Treatment means within columns followed by the same letter are not significantly different at the 95% probability level (P<0.05).

Economic Data:

Table 3. Returns above nitrogen fertilizer cost of applying 50, 70, and 90 lb N/acre on no-till yellow mustard in an on-farm test at Rob and John Dewald's in 1998.

Treatments	Gross Returns @ $12.5/bu[†]	Net Cost of N Fertilizer @ 18 cents/lb of N	Returns above N Fertilizer Cost
T-1	$103.63	$9.00	$94.63
T-2	$114.63	$12.60	$102.03
T-3	$116.38	$16.20	$100.18

Previous Yellow Mustard Fertility Research:

A 3-year yellow mustard fertility study in a 17 and 24-inch annual rainfall area developed an equation to calculate total available nitrogen (applied plus soil test N in only the top 2 feet) based on a potential yield. For a potential yield of 1,200 lb/acre or less divide potential yield by 12.5, and for a potential yield greater than 1,200 lb/acre, divide the potential yield by 13 to determine the total N required in the top 2 feet.

At Rob and John Dewald's, potential yields for all treatments were calculated by multiplying the total N in only the top 2 feed (50 lb/acre soil test N plus N applied) by 13. Figure 1 shows the potential yield at Rob and John Dewald's compared to the actual yield for total N available in the top 2 feet. Averaged over all three treatments, actual yield was 40% less than predicted yield.

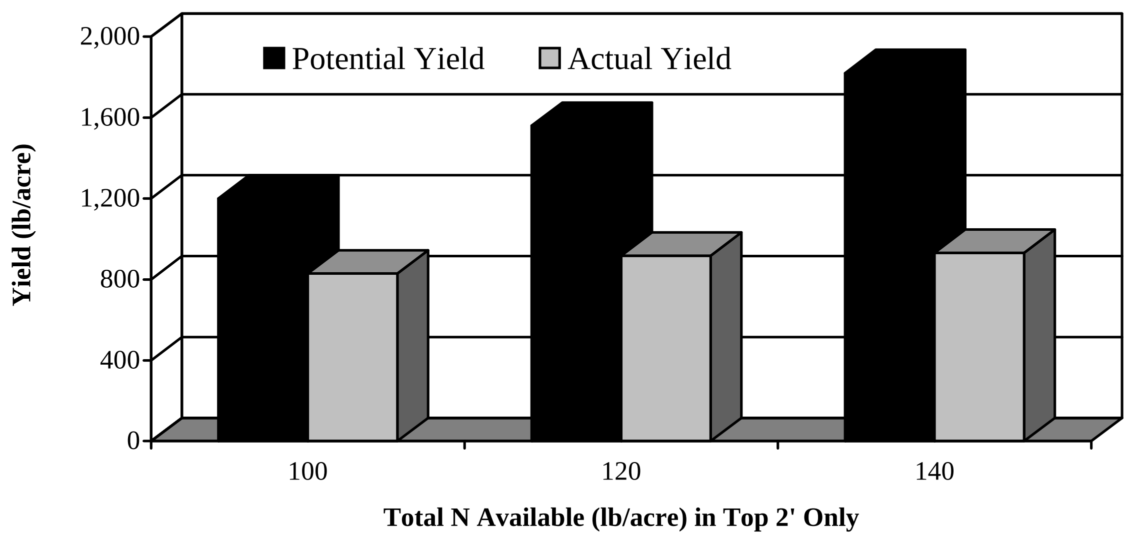

Figure 1. Potential seed yield utilizing an equation from previous research and actual seed yield of yellow mustard with 50 lb/acre residual N in the soil in the top 2 feet plus the application of 50, 70, and 90 lb/acre of nitrogen in an on-farm test at Rob and John Dewald's in 1998.

No-Till and Conventional Planted Spring Barley in Adams County

Jerry and Les Snyder
with Aaron Esser, WSU Cooperative Extension

Objective:

The objective of this research is to utilize on-farm testing to examine no-till planted spring barley in comparison with conventional planted spring barley and help reduce the steep no-till learning curve for Adams County growers.

Study Location:

Location: About 6 miles southeast of Ritzville, WA
Annual Precipitation: 11-12 inches
Soil Type: Ritzville silt loam
Previous Crop: 35 bu spring wheat

Treatments and Operations:

Roundup® was applied two weeks prior to seeding at 16 oz/acre on both the no-till and conventional treatments. Baroness spring barley was seeded on April 3, 1998 at 70 lb/acre. The no-till spring barley was seeded with a McGregor no-till drill with 12-inch row spacing, and the conventional spring barley was planted with John Deere 9350 disk drills with 7-inch row spacing. The conventional spring barley was disked, cultivated and fertilized in one pass, and then seeded. The no-till spring barley was fertilized and seeded in one pass. Both treatments were fertilized at a rate of 60 lb/acre of nitrogen, 15 lb/acre of phosphorus, and 5 lb/acre of sulfur. Salvo® was applied post-emergence at 8 oz/acre on both treatments to control broadleaf weeds. The trial was a randomized complete block design with 4 replications.

Agronomic Results:

Few differences were observed in the agronomic performance of no-till and conventional spring barley in Adams County, as there was no significant difference in plant populations and tillers between treatments (Table 1). No-till spring barley plots had 15 plants/ft^2 emerge and conventional spring barley had 17 plants/ft^2 emerge. No-till spring barley had 9 tillers per plant, opposed to 7 tillers for conventional spring barley. Seed yield for no-till spring barley averaged 1.17 tons/acre, significantly ($P<0.01$) less than conventional spring barley that had an average seed yield of 1.33 tons/acre (Table 2). One potential reason for significantly lower no-till barley yields were skips during planting as the plot size did not account for equipment overlap. The no-till plots had twice as many skips because it took 3 passes per plot and the conventional system took only 2 passes per plot. Soil moisture at planting and 34 days after planting (May-98) was not significantly different down to 3 feet, and 83 days after planting (Jun-98), no-till spring barley plots had significantly ($P<0.05$) more soil moisture in the second and third foot then conventional seeded spring barley (Figure 1).

Economic Results:

Gross returns were calculated using $71.00/ton, the FOB price on August 3, 1998 at Ritzville Warehouse. Gross returns for conventional spring barley were estimated at $94.43/acre, and gross returns for no-till spring barley were estimated at $83.07/acre (Table 3).

Roundup®, baroness barley seed, and Salvo® costs remained constant over both treatments (Table 4). Roundup® costs were estimated at $4.48/acre, baroness barley seed costs were estimated at $5.60/acre, and Salvo® costs were estimated at $1.84/acre. Fertilizer costs for both treatments also remained constant over both treatments at and estimated $21.00/acre.

Ownership and operating costs were estimated using MACHCOST, a machinery cost analysis program developed by the University of Idaho. No-till ownership costs were estimated at only $1.38/acre (Table 5), opposed to an estimated $5.33/acre for conventional ownership costs (Table 6). Operating costs were similar to ownership cost as no-till operating costs were estimated at only $4.12/acre (Table 7), and conventional operating costs were estimated at $6.34/acre (Table 8).

Total establishment costs are comprised of total input product, ownership, and operating costs. Total returns above establishment costs are calculated by subtracting gross returns from total establishment costs. Conventional planted spring barley has an estimated $44.59/acre total establishment costs and an estimated return above establishment costs of $49.84/acre (Table 9). No-till planted spring barley had an estimated total establishment costs of only $38.42/acre and estimated returns above establishment costs of $44.65/acre.

One factor not included in the economic analysis is the opportunity costs associated with time saved. Using the operations performed on the no-till system, it will take just over eight 10-hour days to plant 520 acres of spring barley (Table 10). Using the operations performed on the conventional system, it will take over thirteen 10-hour days (Table 11).

Conclusions:

Agronomically, no differences were observed in plant populations and tillers per plant in conventional and no-till spring barley. However, conventional spring barley had greater seed yield. Fewer skips in the trial may help reduce differences in seed yield. Economically, conventional spring barley had $11.36/acre higher gross returns than no-till spring barley, but only $5.19/acre higher returns above establishment costs as no-till spring barley cost over $6.00/acre less to establish. Time has the potential to greatly impact both agronomic and economic performance of no-till spring barley in comparison to conventional systems. In this trial both treatments were planted on April 3; however the no-till spring barley has the potential to be seeded 5 days prior to conventional seeding. This early seeding date may also increase yield potential of no-till planted spring barley. It also has the potential to offer Jerry and Les Snyder opportunity costs as they can custom seed, which will bring in extra income and lower no-till costs per acre by increasing the hours of annual use.

Agronomic Data:

Table 1. Plant population and tiller count of no-till and conventional spring barley at Jerry and Les Snyder's in 1998.

Treatment	Population (plants/ft^2)	Tiller Count (tiller/plant)
Conventional	17 a[†]	7 a
No-till	15 a	9 a
LSD $_{(0.05)}$	4	4
CV	30.4%	30.8%

[†] Treatment means within columns followed by the same letter are not significantly different at the 95% probability level (*P*<0.05).

Table 2. No-till and conventional spring barley seed yield (tons/acre) at Jerry and Les Snyder's in 1998.

Treatment	Rep I	Rep II	Rep III	Rep IV	Average
Conventional	1.35	1.28	1.32	1.36	1.33 a[†]
No-till	1.08	1.22	1.17	1.20	1.17 b
LSD $_{(0.05)}$					0.13
CV					4.6%

[†] Treatment means within columns followed by the same letter are not significantly different at the 95% probability level (*P*<0.05).

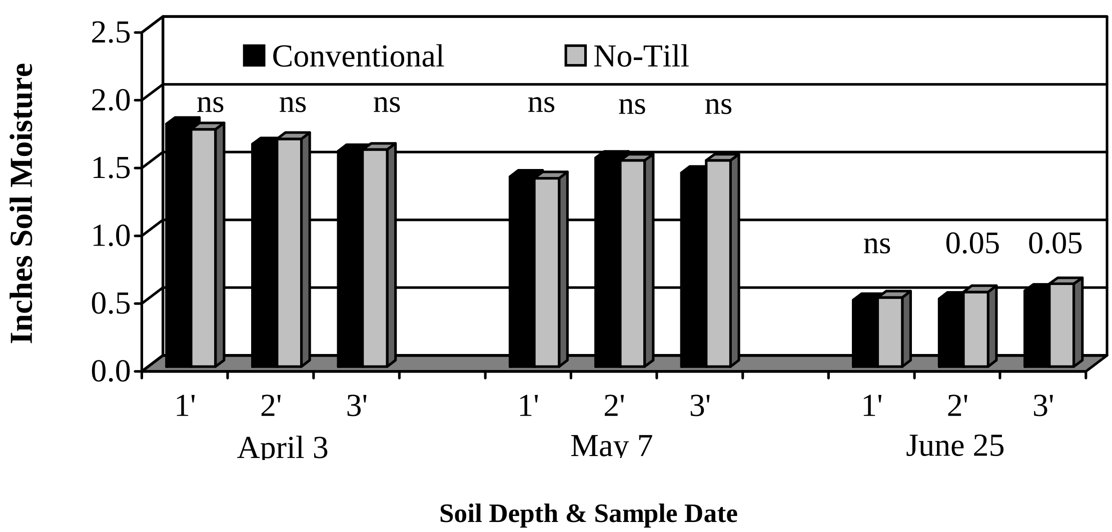

Figure 1. Soil moisture in no-till and conventional planted spring barley at planting, 34, and 83 days after planting in the 1st, 2ed, and 3ed foot at Jerry and Les Snyder's in 1998.

Economic Data:

Table 3. Gross returns per acre of no-till and conventional spring barely in an on-farm test at Jerry and Les Snyder's in 1998.

Treatment	Yield (tons/acre)	Price† ($/ton)	Gross Returns ($/ton)
Conventional	1.33	$71.00	$94.43
No-till	1.17	$71.00	$83.07

† FOB on August 3, 1998 at Ritzville Warehouse.

Table 4. Total costs per acre of input products of both no-till and conventional spring barley in an on-farm test at Jerry and Les Snyder's in 1998.

Product	Rate/acre	Costs/unit	Total Costs/Acre
Roundup®	16 oz	$0.28	$4.48
Salvo®	8 oz	$0.23	$1.84
Baroness Barley	70 lb	$0.08	$5.60
Fertilizer (N,P,S)	*	*	$21.00
Total			$32.92

Table 5. Estimated ownership costs of each operation used to establish no-till spring barley in an on-farm test at Jerry and Les Snyder's in 1998.

Operation	Equipment	Depreciation Costs/Acre	Interest Costs/Acre	Tax, Housing, & Interest/Acre	Total Ownership Costs/Acre
Roundup®	180HP-WT, 60' sprayer	$0.13	$0.21	$0.04	$0.39
Seed & Fertilize	180HP-WT, 20' no-till drill	$0.21	$0.29	$0.10	$0.60
Salvo®	180HP-WT, 60' sprayer	$0.13	$0.21	$0.04	$0.39
Total Ownership Costs		$0.47	$0.71	$0.18	$1.38

Table 6. Estimated ownership costs of each operation used to establish conventional spring barley in an on-farm test at Jerry and Les Snyder's in 1998.

Operation	Equipment	Depreciation Costs/Acre	Interest Costs/Acre	Tax, Housing, & Interest/Acre	Total Ownership Costs/Acre
Roundup®	180HP-WT, 60' sprayer	$0.13	$0.21	$0.04	$0.39
Disk	180HP-WT, 24' disk	$0.24	$0.37	$0.08	$0.69
Cultivate/Fertilize	180HP-WT, 36' cultivator	$0.40	$0.39	$0.08	$0.87
Seed	180HP-WT, 30' disk drill	$1.03	$1.38	$0.59	$2.99
Salvo®	180HP-WT, 60' sprayer	$0.13	$0.21	$0.04	$0.39
Total Ownership Costs		$0.47	$0.71	$0.18	$5.33

Table 7. Estimated operating costs per acre of each operation used to establish no-till spring barley in an on-farm test at Jerry and Les Snyder's in 1998.

Operation	Equipment	Repairs Costs	Fuel Costs	Lubrication Costs	Labor Costs	Total Operating Costs
Roundup®	180HP-WT, 60' sprayer	$0.11	$0.06	$0.01	$0.36	$0.54
Seed & Fertilize	180HP-WT, 20' no-till drill	$0.40	$0.61	$0.09	$1.94	$3.04
Salvo®	180HP-WT, 60' sprayer	$0.11	$0.06	$0.01	$0.36	$0.54
Total Operating Cost s		$0.62	$0.73	$0.11	$2.66	$4.12

Table 8. Estimated operating costs per acre of each operation used to establish conventional spring barley in an on-farm test at Jerry and Les Snyder's in 1998.

Operation	Equipment	Repair Costs	Fuel Costs	Lubrication Costs	Labor Costs	Total Operating Costs
Roundup®	180HP-WT, 60' sprayer	$0.11	$0.06	$0.01	$0.36	$0.54
Disk	180HP-WT, 24' disk	$0.44	$0.43	$0.06	$1.26	$2.19
Cultivate/Fertilize	180HP-WT, 42' cultivator	$0.35	$0.21	$0.03	$0.71	$1.30
Seed	180HP-WT, 36' disk drill	$0.33	$0.27	$0.04	$1.13	$1.77
Salvo®	180HP-WT, 60' sprayer	$0.11	$0.06	$0.01	$0.36	$0.54
Total Operating Cost s		$1.34	$1.03	$0.15	$3.82	$6.34

Table 9. Estimated returns above establishment cost of no-till and conventional spring barley in an on-farm test at Jerry and Les Snyder's in 1998.

Treatment	Input Costs	Ownership Costs	Operating Costs	Total Establishment Costs	Gross Returns	Returns above Establishment Costs
Conventional	$32.92	$5.33	$6.34	$44.59	$94.43	$49.84
No-till	$32.92	$1.38	$4.12	$38.42	$83.07	$44.65

Table 10. Estimated 10-hour days to establish 520 acres of spring barley in a no-till system at Jerry and Les Snyder's in 1998.

Operation	Implement Width	Field Speed	Field Efficiency	Hours/Operation	10-Hour Days
Roundup®	60	6	85%	13.70	1.4
Seed & Fertilize	20	4	70%	69.71	7.0
Total 10-Hour Days					8.3

Table 11. Estimated 10-hour days to establish 520 acres of spring barley in a conventional system at Jerry and Les Snyder's in 1998.

Operation	Implement Width	Field Speed	Field Efficiency	Hours/Operation	10-Hour Days
Roundup®	60	6	85%	13.7	1.4
Disk	24	4	90%	49.16	4.9
Cultivate/Fertilize	36	5	85%	27.41	2.7
Seed	30	4	80%	42.90	4.3
Total 10-Hour Days					13.3

No-Till and Conventional Planted Spring Barley in Northern Lincoln County

Rick Brunner
with Aaron Esser, WSU Cooperative Extension

Objective:

The objective of this research is to utilize on-farm testing to examine no-till planted spring barley in comparison with conventional planted spring barley and help reduce the steep learning curve often associated with no-till for Lincoln County growers.

Study Location:

Location: About 6 miles north of Almira, WA
Annual Precipitation: 12-14 inches
Soil Type: Bagdad silt loam
Previous Crop: 83 bu winter wheat

Treatments and Operations:

Spring harrowing was used on both no-till and conventional spring barley plots to manage residue and level the ground after fall sub-soiling. Roundup® was applied about one week prior to seeding at 16 oz/acre on the no-till treatment. The conventional treatment was cultivated approximately 10 days prior to seeding, and cultivated and fertilized in one-pass two days prior to seeding. Baroness spring barley was planted on April 23-24, at a rate of 70 lb/acre. The no-till spring barley was seeded with a Flexi-Coil 820 no-till drill with 9-inch spaced Stealth openers, and the conventional spring barley was seeded with 10-inch hoe drills.

No-till spring barley was fertilized with a dry blend fertilizer, and conventional spring barley was fertilized with aqua and a dry blend starter fertilizer. Both treatments had 60 lb/acre of nitrogen and 13 lb/acre of sulfur. The conventional spring barley had 17 lb/acre of potassium, 8 lb/acre of chloride, 0.5 lb/acre of boron, and 1 lb/acre of zinc. The no-till spring barley had only 9 lb/acre of potassium and 0.50 lb/acre of zinc. Harmony Extra® was applied post-emergence to both treatments to control broadleaf weeds. The trial was a randomized complete block design with 4 replications.

Agronomic Results:

Little differences were observed in the agronomic performance of no-till and conventional spring barley in northern Lincoln County. There was no significant difference in plant populations and tillers in no-till and convention spring barley (Table 1). Hail damage greatly decreased seed yield in both treatments (Table 2). Seed yield for no-till spring barley averaged 0.54 tons/acre, significantly (P<0.05) less than conventional spring barley that had an average seed yield of 0.59 tons/acre. Soil moisture at planting was not significantly different, and 40 days after planting, no-till spring barley had significantly ($P<0.05$) more moisture in the 1st and 2ed foot (Table 3).

Economic Results:

Gross returns were calculated using $63.00/ton, the FOB price on August 18, 1998 at Odessa Union. Gross returns for conventional barley were estimated at $37.17/acre, and Gross returns for no-till barley were estimated at $34.02/acre (Table 4).

Baroness barley seed and Harmony Extra® plus MCPA costs remained constant over both treatments at $11.20/acre and $5.75/acre (Table 4). Roundup® costs were estimated at $4.00/acre and allocated only to the no-till treatments. Fertilizer costs for the conventional spring barley was an estimated $21.25/acre, and fertilizer cost for the no-till spring barley was estimated at $21.86/acre

Ownership and operating costs were estimated using MACHCOST, a machinery cost analysis program developed by the University of Idaho. No-till ownership costs were estimated at only $3.25/acre (Table 6), opposed to an estimated $14.46/acre for conventional ownership costs (Table 7). Operating costs were nearly the opposite of the ownership cost as no-till-operating costs were estimated at $21.36/acre (Table 8), and conventional operating costs were estimated at only $12.04/acre (Table 9).

Total establishment costs are comprised of total input product costs, ownership, and operating costs. Total returns above establishment costs were calculated by subtracting gross returns from total establishment costs. Conventional planted spring barley has an estimated $65.05/acre total establishment costs and an estimated return above establishment costs of ($27.88)/acre (Table 10). No-till planted spring barley had an estimated total establishment costs of $67.77/acre and estimated returns above establishment costs of ($33.75)/acre.

One factor not included in the economic analysis is the opportunity costs associated with time saved. Using the operations performed on the no-till system, it will take just over nine 10-hour days to plant 900 acres of spring barley (Table 11). Using the operations performed on the conventional system, it will take over seventeen 10-hour days (Table 12).

Conclusions:

Agronomically, no differences were observed in plant populations and tillers per plant in conventional and no-till spring barley. However, conventional spring barley had greater seed yield, although the difference was very small.

Economically, conventional spring barley had $3.15/acre higher gross returns than no-till spring barley, and $5.87/acre better returns above establishment costs. Time has the potential to impact both the agronomic and economic performance of no-till spring barley in comparison to conventional systems. In this trial treatments were seeded on April 23-24; however, the no-till spring barley potentially could have seeded 8 days prior to conventional seeding. This early seeding date may increase yield of no-till planted spring barley.

Reduced, or no harrowing in a no-till system will save time and reduce cost. In this study both treatments were harrowed once in the fall (not included in economic analysis) and twice in the spring to level the ground after fall sub-sub-soiling (not included in the economical analysis). Under no-till sub-soiling may not be needed in northern Lincoln County.

Agronomic Data:

Table 1. Plant population and tiller count of no-till and conventional spring barley in an on-farm test at Rick Brunner's in 1998.

Treatment	Population (plants/ft^2)	Tiller Count (tiller/plant)
Conventional	8.4 a[†]	6.3 a
No-till	7.4 a	7.3 a
LSD $_{(0.05)}$	2.1	2.2
CV	15.4%	18.5%

[†] Treatment means within columns followed by the same letter are not significantly different at the 95% probability level (*P*<0.05).

Table 2. No-till and conventional spring barley seed yield (tons/acre) in an on-farm test at Rick Brunner's in 1998. This location had severe hail damage to both treatments.

Treatment	Rep I	Rep II	Rep III	Rep IV	Average
Conventional	0.53	0.45	0.65	0.74	0.59 a[†]
No-till	0.50	0.37	0.57	0.70	0.54 b
LSD $_{(0.05)}$					0.04
CV					3.5%

[†] Treatment means within columns followed by the same letter are not significantly different at the 95% probability level (*P*<0.05).

Table 3. Inches of total moisture in no-till and conventional spring barley at planting and 40 days after planting in an on-farm test at Rick Brunner's in 1998.

April 23, 1998				
Treatment	Inches Moisture 1'	Inches Moisture 2'	Inches Moisture 3'	Inches Moisture 4'
Conventional	1.93 a†	1.85 a	1.79 a	1.75 a
No-till	2.06 a	1.90 a	1.82 a	1.75 a
LSD $_{(0.05)}$	0.16	0.10	0.09	0.26
CV				

June 2, 1998				
Treatment	Inches Moisture 1'	Inches Moisture 2'	Inches Moisture 3'	Inches Moisture 4'
Conventional	1.63 b	1.59 b	1.53 a	1.51 a
No-till	1.81 a	1.69 a	1.57 a	1.53 a
LSD $_{(0.05)}$	0.15	0.07	0.16	0.14
CV	3.8%	1.9%	4.5%	4.2%

† Treatment means within columns followed by the same letter are not significantly different at the 95% probability level (P<0.05).

Economic Data:

Table 4. Gross returns per acre of no-till and conventional spring barely in an on-farm test at Rick Brunner's in 1998.

Treatment	Yield (tons/acre)	Price† ($/ton)	Gross Returns ($/ton)
Conventional	0.59	$63.00	$37.17
No-till	0.54	$63.00	$34.02

† FOB on August 18, 1998 at Odessa Union.

Table 5. Total costs per acre of input products of both no-till and conventional spring barley in an on-farm test at Rick Brunner's in 1998.

Product	Rate/acre	Costs/unit	Total Costs/Acre (Conventional)	Total Costs/Acre (No-till)
Roundup®	16 oz	$0.25	$0.00	$4.00
Harmony Extra® & MCPA†	*	*	$5.75	$5.75
Baroness Barley	70 lb	$0.16	$11.20	$11.20
Fertilizer (N,P,S)	*	*	$21.25	$21.86
Total			$38.20	$43.16

† Applied for broadleaf weed control.

Table 6. Estimated ownership costs of each operation used to establish no-till spring barley in an on-farm test at Rick Brunner's in 1998.

Operation	Equipment	Depreciation Costs	Interest Costs	Tax, Housing, & Interest	Total Ownership Costs
Harrow	300HP-Challenger, 50' harrow	$0.85	$0.74	$0.17	$1.76
Roundup®	Custom Application	$0.00	$0.00	$0.00	$0.00
Seed & Fertilize	300HP-Challenger, 43' no-till drill	$0.66	$0.66	$0.17	$1.49
Broadleaf Control	Custom Application	$0.00	$0.00	$0.00	$0.00
Total Ownership Costs		$1.51	$1.40	$0.34	$3.25

Table 7. Estimated ownership costs of each operation used to establish conventional spring barley in an on-farm test at Rick Brunner's in 1998.

Operation	Equipment	Depreciation Costs	Interest Costs	Tax, Housing, & Interest	Total Ownership Costs
Harrow	300HP-Challenger, 50' sprayer	$0.85	$0.74	$0.17	$1.76
Harrow	300HP-Challenger, 50' sprayer	$0.85	$0.74	$0.17	$1.76
Cultivate	300HP-Challenger, 41' cultivator	$1.49	$1.29	$0.29	$3.07
Cultivate/fertilize	300HP-Challenger, 41' cultivator	$2.05	$1.77	$0.40	$4.22
Seed†	300HP-Challenger, 40' drills	$1.67	$1.44	$0.54	$3.65
Broadleaf Control	Custom Application	$0.00	$0.00	$0.00	$0.00
Total Ownership Costs		$6.91	$5.98	$1.57	$14.46

† Seed operating costs incorporate conventional drills and Flexi-Coil air cart.

Table 8. Estimated operating costs per acre of each operation used to establish no-till spring barley in an on-farm test at Rick Brunner's in 1998.

Operation	Equipment	Repairs Costs	Fuel Costs	Lube Costs	Labor Costs	Rental Costs	Total Operating Costs
Harrow	300HP-Challenger, 50' harrow	$0.19	$0.32	$0.05	$0.38	$0.00	$0.94
Roundup®	Custom Application	$0.00	$0.00	$0.00	$0.00	$4.25	$4.25
Seed & Fertilize	300HP-Challenger, 43' no-till drill	$0.33	$0.73	$0.11	$0.75	$10.00	$11.92
Broadleaf Control	Custom Application	$0.00	$0.00	$0.00	$0.00	$4.25	$4.25
Total Operating Costs		$0.52	$1.05	$0.16	$1.13	$18.50	$21.36

Table 9. Estimated operating costs per acre of each operation used to establish conventional spring barley in an on-farm test at Rick Brunner's in 1998.

Operation	Equipment	Repair Costs	Fuel Costs	Lube Costs	Labor Costs	Rental Costs	Total Operating Costs
Harrow	300HP-Challenger, 50' sprayer	$0.19	$0.32	$0.05	$0.38	$0.00	$0.94
Harrow	300HP-Challenger, 50' sprayer	$0.19	$0.32	$0.05	$0.38	$0.00	$0.94
Cultivate	300HP-Challenger, 41' cultivator	$0.33	$0.55	$0.08	$0.57	$0.00	$1.54
Cultivate/fertilize	300HP-Challenger, 41' cultivator	$0.46	$0.76	$0.11	$0.79	$0.00	$2.12
Seed†	300HP-Challenger, 40' drills	$0.94	$0.60	$0.09	$0.62	$0.00	$2.25
Broadleaf Control	Custom Application	$0.00	$0.00	$0.00	$0.00	$4.25	$4.25
Total Operating Costs		$2.11	$2.55	$0.38	$2.74	$4.25	$12.04

Table 10. Estimated returns above establishment cost of no-till and conventional spring barley in an on-farm test at Rick Brunner's in 1998.

Treatment	Input Costs	Ownership Costs	Operating Costs	Total Establishment Costs	Gross Returns	Returns above Establishment Costs
Conventional	$38.55	$14.46	$12.04	$65.05	$37.17	($27.88)
No-till	$43.16	$3.25	$21.36	$67.77	$34.02	($33.75)

Table 11. Estimated 10-hour days to establish 900 acres of spring barley in a no-till system at Rick Brunner's in 1998.

Operation	Implement Width	Field Speed	Field Efficiency	Hours/Operation	10-Hour Days
Harrow	50	6.2	93%	25.63	2.6
Roundup	-	-	-	-	-
Seed & Fertilize	43	5.5	61%	43.64	4.4
Total 10-Hour Days					7.0

Table 12. Estimated 10-hour days to establish 900 acres of spring barley in a conventional system at Rick Brunner's in 1998.

Operation	Implement Width	Field Speed	Field Efficiency	Hours/Operation	10-Hour Days
Harrow	50	6.2	93%	25.63	2.6
Harrow	50	6.2	93%	25.63	2.6
Cultivate	41	5.0	93%	38.75	3.9
Cultivate/fertilize	41	5.2	65%	47.02	4.7
Seed	40	5.2	83%	41.77	4.2
Total 10-Hour Days					17.9

No-Till and Conventionally Planted Spring Barley in Northern Lincoln County

Rick and Roxanne Jones
with Aaron Esser, WSU Cooperative Extension

Introduction and Objective:

The transition from a winter wheat – summer fallow rotations to a three year rotation of winter wheat, spring grain, and summer fallow is an effective method for controlling downey brome (cheatgrass) for some growers in Northern Lincoln County. However, with the adoption of a three-year rotation made more favorable conditions for wild oat. The objective of this research is to utilize on-farm testing to examine no-till planted spring barley in comparison with conventionally planted spring barley in hopes of controlling wild oat and helping to reduce the learning curve associated with no-till annual cropping.

Study Location:

Location: About 5 miles north, northwest of Wilbur, WA
Annual Precipitation: 14 inches
Soil Type: Bagdad silt loam
Previous Crop: 2.25 ton spring barley

Soil Test Results:

Soil pH = 6.4

		Available Nitrogen (lb N/acre)
N mineralization	=	34[†]
NO_3 (3')	=	43
NH_4 (1')	=	11
Total Available N	=	88

[†] Estimated N released from 1.7% organic matter.

Treatments and Operations:

Multiple harrowing early in the spring were used on both no-till and conventional spring barley plots to stimulate wild oat seed germination and to level the ground after fall sub-soiling. No wild oat or volunteer barley was emerged prior to harrowing. Roundup® was applied about one week prior to seeding at 16 oz/acre on no-till spring barley treatments. A sweep was used approximately one week prior to seeding in the conventional spring barley and cultiweeded and fertilized in one-pass two days prior to seeding. Baroness spring barley planting was delayed until April 22-24, and was seeded at 65 lb/acre. The no-till spring barley was seeded with a Flexi-coil 5000 no-till drill with 9-inch row spacing, and the conventional spring barley was seeded with JD 9350 drills with 10-inch row spacing.

No-till spring barley was fertilized with anhydrous at rates of 78 and 98 lb/acre of nitrogen, and conventional planted barley treatments were fertilized with aqua at a rate of 78 lb/acre of nitrogen. Table 1 shows the breakdown of available nitrogen in the top 3 feet for each treatment. All treatments had 20 lb/acre of phosphorus, and 15 lb/acre of sulfur applied. No wild oat herbicide was applied to either treatment, and 2,4-D Amine was applied post-emergence at 1 pint/acre on both treatments to control broadleaf weeds. The trial was a randomized complete block design with 4 replications. Treatments are as follows:

Treatments	N Applied (lb/acre)	Soil Test N (3') (lb/acre)	Available N (lb N/acre)[†]
Conventional –76	76	88	164[†]
No-till –76	76	88	164
No-till –96	96	88	184

[†] No additional nitrogen fertilizer was applied to help breakdown incorporated barley straw.

Agronomic Results:

Differences were detected in the agronomic performance of no-till and conventional spring barley at Rick and Roxanne Jones. Conventional-76 seeded barley had significantly (P<0.01) more plants than the no-till-76 seeded barley, but not significantly more than the no-till-96 (Table 1).

Both no-till-76 and no-till-96 spring barley treatments had significantly (P<0.05) more tillers/plant than conventional-76 barley (Table 1). There was no difference in tillers/plant within the 2 no-till treatments.

There was no significant difference in total wild oat populations or wild oat tillers/plant in conventional and both no-till spring barley treatments (Table 2).

There was also no significant difference in seed yield between conventional and no-till spring barley, and increased nitrogen fertility on first year no-till spring barley did not significantly increase grain yield (Table 3).

There was no significant difference in soil moisture at planting, and 44-days after planting. Both no-till treatments had significantly (P<0.10) more moisture in the 1st and 2^{ed} foot than conventional spring barley (data not presented).

Economic Results:

Gross returns were calculated using $61.50/ton, the FOB price on August 21, 1998 at Odessa Union. Gross return for all treatments were calculated using the average yield of 1.70 tons/acre, and were estimated at $104.55/acre (Table 4).

Baroness barley seed and 2,4-D costs remained constant over all three treatments (Table 5). Baroness barley seed was estimated at $6.24/acre, and 2,4-D was estimated at $1.80/acre. Roundup® cost, allocated to only the 2 no-till treatments, applied at 16 oz/acre, was estimated at $4.48/acre. Fertilizer costs for the 3 treatments were varied as u-haul aqua was used in conventional planted spring barley, and full service anhydrous was used in no-till planted spring barley. Conventional-76 had an estimated fertility cost of only$30.14/acre, no-till 76 had an estimated fertility cost of $34.21/acre, and notill-96 had an estimated fertility cost of $40.32/acre (Table 6).

Ownership and operating costs were estimated using MACHCOST, a machinery cost analysis program developed by the University of Idaho. No-till ownership costs were estimated at only $3.61/acre (Table 7), opposed to an estimated $11.98/acre for conventional ownership costs (Table 8). Operating costs were much different than ownership cost as no-till operating costs were estimated at $22.64/acre (Table 9), and conventional operating costs were estimated at only $9.97/acre (Table 10).

Total establishment costs are comprised as the total input product, ownership, and operating costs. Total returns above establishment costs are calculated by subtracting net returns from total establishment costs. Conventional –76 has an estimated $60.13/acre total establishment cost and an estimated return above establishment cost of $44.42/acre (Table 11). No-till-76 had an estimated total establishment cost of $72.98/acre and estimated returns above establishment costs of $31.57/acre. No-till-96 had an estimated total establishment cost of $79.09/acre and returns above establishment cost of only an estimated $25.46.

One factor not included in the economic analysis is the opportunity cost associated with time saved. Using the operations performed on the conventional system, it will take over twelve 10-hour days to plant 500 acres of spring barley (Table 12). Using the operations performed on the no-till system, it will take just over 1 week to plant 500 acres of spring barley (Table 13).

Conclusions:

Agronomically, conventional and no-till spring barley were very comparable as wild oat populations, wild oat tillers, and barley yields were not significantly different, and both no-till spring barley treatments had significantly more tillers/plant. Economically, conventional spring barley yielded nearly $16.00/acre more than no-till-76, and over $30.00/acre more than no-till-96. Time has potential to greatly impact both the agronomic and economic performance of no-till spring barley in comparison to conventional systems. In this trial, the conventional spring barley was planted on April 22, and the no-till spring barley was planted on April 24. With the time save, the no-till has the potential to be seeded 5 days prior to seeding (April 17) conventional spring barley. This earlier seeding date may increase yield of no-till spring barley greater than conventional spring barley.

Reduced, or not harrowing, in a no-till system may potentially save time and reduce cost. In this study the ground was harrowed multiple times in both treatments to level the ground after fall sub-soiling and to stimulate wild oat germination. Under no-till conditions sub-soiling (not included in the cost comparison) may not be needed in the northern Lincoln County area, and the degree of wild oat that germinated due to harrowing was not examined. Increased nitrogen on first year no-till was not significantly different agronomically from no-till-76, but economically, returns above establishment costs were $14.72/acre less. Higher nitrogen rates may also reduce field efficiency, as higher nitrogen rates require more frequent filling. This research did not examine the quantity of nitrogen remaining after each treatment, which may directly impact fertility required and fertility cost in subsequent crops.

Agronomic Data:

Table 1. Plant population and tiller count of no-till and conventional spring barley in an on-farm test at Rick and Roxanne Jones in 1998.

Treatment	Population (plants/ft^2)	Tiller Count (tiller/plant)
Conventional –76	8.7 a[†]	5.8 a
No-till –76	5.8 b	9.5 b
No-till –96	7.0 ab	8.9 b
LSD $_{(0.05)}$	2.50	2.23
CV	20.3%	38.9%

[†] Treatment means within columns followed by the same letter are not significantly different at the 95% probability level (*P*<0.05).

Table 2. Wild oat population and tiller count in no-till and conventional spring barley in an on-farm test at Rick and Roxanne Jones in 1998.

Treatment	Population (plants/ft^2)	Tiller Count (tiller/plant)
Conventional –76	0.96 a[†]	1.8 a
No-till –76	1.08 a	1.7 a
No-till –96	1.32 a	2.3 a
LSD $_{(0.05)}$	5.49	4.51
CV	284.2%	160.5%

[†] Treatment means within columns followed by the same letter are not significantly different at the 95% probability level (*P*<0.05).

Table 3. No-till and conventional spring barley seed yield (tons/acre) in an on-farm test at Rick and Roxanne Jones in 1998.

Treatment	Rep I	Rep II	Rep III	Rep IV	Average
Conventional –76	2.09	1.72	1.65	1.65	1.78 a†
No-till –76	1.98	1.77	1.62	1.57	1.73 a
No-till –96	1.61	1.72	1.44	1.58	1.59 a
LSD $_{(0.05)}$					0.20
CV					6.8%

† Treatment means within columns followed by the same letter are not significantly different at the 95% probability level ($P<0.05$).

Economic Data:

Table 4. Gross returns per acre of no-till and conventional spring barely with an average yield of 1.70 ton/acre in an on-farm test at Rick and Roxanne Jones in 1998.

Treatment	Average Yield (tons/acre)	Price† ($/ton)	Gross Returns ($/acre)
Conventional-76	1.70	$61.50	$104.55
No-till-76	1.70	$61.50	$104.55
No-till-96	1.70	$61.50	$104.55

† FOB on August 21, 1998 at Odessa Union.

Table 5. Total cost per acre of herbicide and seed for no-till and conventional spring barley in an on-farm test at Rick and Roxanne Jones in 1998.

Product	Rate per acre	Cost/unit	Total Costs /Acre
Roundup®	16 oz	$0.28	$4.48†
2,4-D Amine	1 pint	$1.80	$1.80
Baroness Barley Seed	65 lb	$0.096	$6.24
Total			$12.52

† Roundup was only applied to the no-till treatments.

Table 6. Total fertilizer costs per acre for each of the three treatments of spring barley in an on-farm test at Rick and Roxanne Jones in 1998.

Fertilizer	Conventional-76	No-till-76	No-till-96
16-20-0-14	$15.90	$15.90	$15.90
Aqua	$14.24	$0.00	$0.00
Anhydrous	$0.00	$18.31	$24.42
Total	$30.14	$34.21	$40.32

Table 7. Estimated ownership costs of each operation used to establish no-till spring barley in an on-farm test at Rick and Roxanne Jones in 1998.

Operation	Equipment	Depreciation Costs/Acre	Interest Costs/Acre	Tax, Housing, & Interest/Acre	Total Ownership Costs/Acre
Harrow	285HP-WT, 85' harrow	$0.38	$0.32	$0.07	$0.77
Harrow	285HP-WT, 85' harrow	$0.38	$0.32	$0.07	$0.77
Harrow	285HP-WT, 85' harrow	$0.38	$0.32	$0.07	$0.77
Harrow	285HP-WT, 85' harrow	$0.38	$0.32	$0.07	$0.77
Roundup	285HP-WT, 80' sprayer	$0.20	$0.26	$0.07	$0.53
Seed & Fertilize	400HP-WT, 33' no-till drill	$0.00	$0.00	$0.00	$0.00
2,4-D Amine	Aerial applied	$0.00	$0.00	$0.00	$0.00
Total Ownership Costs		$1.72	$1.54	$0.35	$3.61

Table 8. Estimated ownership costs/acre of each operation used to establish conventional spring barley in an on-farm test at Rick and Roxanne Jones in 1998.

Operation	Equipment	Depreciation Costs	Interest Costs	Tax, Housing, & Interest	Total Ownership Costs
Harrow	285HP-WT, 85' harrow	$0.38	$0.32	$0.07	$0.77
Harrow	285HP-WT, 85' harrow	$0.38	$0.32	$0.07	$0.77
Harrow	285HP-WT, 85' harrow	$0.38	$0.32	$0.07	$0.77
Harrow	285HP-WT, 85' harrow	$0.38	$0.32	$0.07	$0.77
Sweep	285HP-WT, 33' sweep	$1.08	$1.08	$0.23	$2.39
Cultiweed/Fertilize	285HP-WT, 36' cultiweeder	$0.70	$0.84	$0.20	$1.74
Seed	285HP-WT, 40' hoe drills	$1.83	$2.10	$0.84	$4.77
2,4-D Amine	aerial applied	$0.00	$0.00	$0.00	$0.00
Total Ownership Costs		$5.13	$5.30	$1.55	$11.98

Table 9. Estimated operating costs per acre of each operation used to establish no-till spring barley in an on-farm test at Rick and Roxanne Jones in 1998.

Operation	Equipment	Repairs Costs	Fuel Costs	Lubrication Costs	Labor Costs	Rental Costs	Total Operating Costs
Harrow	285HP-WT, 85' harrow	$0.05	$0.03	$0.00	$0.21	$0.00	$0.29
Harrow	285HP-WT, 85' harrow	$0.05	$0.03	$0.00	$0.21	$0.00	$0.29
Harrow	285HP-WT, 85' harrow	$0.05	$0.03	$0.00	$0.21	$0.00	$0.29
Harrow	285HP-WT, 85' harrow	$0.05	$0.03	$0.00	$0.21	$0.00	$0.29
Roundup	285HP-WT, 80' sprayer	$0.03	$0.07	$0.01	$0.52	$1.00	$1.63
Fertilize&Seed	400HP-WT, 33' no-till drill	$0.00	$0.24	$0.00	$1.61	$14.00	$15.85
2,4-D Amine	aerial applied	$0.00	$0.00	$0.00	$0.00	$4.00†	$4.00
Total Operating Costs		$0.23	$0.43	$0.01	$2.97	$19.20	$22.64

† Cost to aerial apply herbicide.

Table 10. Estimated operating costs per acre of each operation used to establish conventional spring barley in an on-farm test at Rick and Roxanne Jones in 1998.

Operation	Equipment	Repair Costs	Fuel Costs	Lubrication Costs	Labor Costs	Rental Costs	Total Operating Costs
Harrow	285HP-WT, 85’ harrow	$0.05	$0.03	$0.00	$0.21	0.00	$0.29
Harrow	285HP-WT, 85’ harrow	$0.05	$0.03	$0.00	$0.21	0.00	$0.29
Harrow	285HP-WT, 85’ harrow	$0.05	$0.03	$0.00	$0.21	0.00	$0.29
Harrow	285HP-WT, 85’ harrow	$0.05	$0.03	$0.00	$0.21	0.00	$0.29
Sweep	285HP-WT, 33’ sweep	$0.24	$0.18	$0.03	$0.63	0.00	$1.08
Cultiweed/Fertilize	285HP-WT, 36’ cultiweeder	$0.95	$0.27	$0.04	$0.96	0.00	$2.22
Seed	285HP-WT, 40’ disk drill	$0.39	$0.13	$0.02	$0.97	0.00	$1.51
2,4-D Amine	aerial applied	$0.00	$0.00	$0.00	$0.00	$4.00†	$4.00
Total Operating Costs		$1.78	$0.70	$0.09	$3.40	$4.00	$9.97

† Cost to aerial apply herbicide.

Table 11. Estimated returns per acre above establishment cost per acre of no-till and conventional spring barley in an on-farm test at Rick and Roxanne Jones in 1998.

Treatment	Herbicide & Seed Costs	Fertilizer Costs	Ownership Costs	Operating Costs	Total Establishment Costs	Gross Returns	Returns above Establishment Costs
Conventional-76	$8.04	$30.14	$11.98	$9.97	$60.13	104.55	$44.42
No-till-76	$12.52	$34.21	$3.61	$22.64	$72.98	104.55	$31.57
No-till-96	$12.52	$40.32	$3.61	$22.64	$79.09	104.55	$25.46

Table 12. Estimated 10-hour days to establish 500 acres of spring barley crop in a conventional tillage system at Rick and Roxanne Jones in 1998.

Operation	Implement Width	Field Speed	Field Efficiency	Hours/Operation	10 hour Days
Harrow	85	6.5	95%	7.84	0.8
Harrow	85	6.5	95%	7.84	0.8
Harrow	85	6.5	95%	7.84	0.8
Harrow	85	6.5	95%	7.84	0.8
Sweep	33	5.5	95%	23.86	2.4
Cultiweed	36	4.5	70%	33.10	3.3
Seed	40	4.0	70%	33.52	3.4
Total 10 Hour Days					12.2

Table 13. Estimated 10-hour days to establish 500 acres of spring barley crop in a no-till system at Rick and Roxanne Jones in 1998.

Operation	Implement Width	Field Speed	Field Efficiency	Hours/Operation	10 hour Days
Harrow	85	6.5	95%	7.84	0.8
Harrow	85	6.5	95%	7.84	0.8
Harrow	85	6.5	95%	7.84	0.8
Harrow	85	6.5	95%	7.84	0.8
Spray	80	6.5	70%	10.31	1.0
Fertilize/Seed	33	5.0	70%	32.50	3.3
Total 10 Hour Days					7.4

Conventional vs. No-Till Planted Spring Barley and No-Till Nitrogen Fertility in Northern Lincoln County

Tim and Dennis Herdrick
with Aaron Esser, WSU Cooperative Extension

Objectives:

The objectives of this research is to utilize on-farm testing to examine no-till planted spring barley with varied nitrogen fertility in comparison with conventional planted spring barley and reduce the "no-till" learning curve for Lincoln County growers.

Study Location:

Location: about 12 miles northwest of Wilbur, WA
Annual Precipitation: 12 inches
Soil Type: Bagdad silt loam
Previous Crop: winter wheat

Soil Test Results:

Soil pH = 6.3

		Available Nitrogen (lb N/acre)
N mineralization	=	40†
NO_3 (3')	=	20
NH_4 (1')	=	13
Total Available N	=	73

† Estimated N released from 2.0% organic matter.

Treatments and Operations:

Spring harrowing was used on both no-till and conventional spring barley plots to manage residue and level the ground after fall sub-soiling. Roundup® was applied about one week prior to seeding at 16 oz/acre on the no-till treatment. The conventional treatment was cultivated approximately 10 days prior to seeding, and cultiweeded and fertilized in one-pass two days prior to seeding. Baroness spring barley was planted on April 23-24, at a rate of 70 lb/acre. The no-till spring barley was seeded with a Flexi-Coil 500 no-till drill with 9-inch spaced and the conventional spring barley was seeded with 10-inch hoe drills.

No-till spring barley was fertilized with a dry blend fertilizer, and conventional spring barley was fertilized with aqua and a dry blend starter fertilizer. Both treatments had 60 lb/acre of nitrogen and 13 lb/acre of sulfur. The conventional spring barley had 17 lb/acre of potassium, 8 lb/acre of chloride, 0.5 lb/acre of boron, and 1 lb/acre of zinc. The no-till spring barley had only 9 lb/acre of potassium and 0.50 lb/acre of zinc. Harmony Extra® was applied post-emergence to both treatments to control broadleaf weeds. The trial was a randomized complete block design with 4 replications. Treatments are as follows:

Treatments	N Applied (lb/acre)	Soil Test N (3') (lb/acre)	Available N (lb/acre)
Conventional-70	70	73	143†
No-till-50	50	73	123
No-till-70	70	73	143
No-till-90	90	73	163

† Does not include 30 lb/acre nitrogen needed for incorporated cereal straw breakdown.

Agronomic Results:

Little differences were detected in the agronomic performance of no-till and conventional spring barley at Tim and Dennis Herdrick's. There was no significant difference in spring barley plant population and tillers per plant among treatments (Table 1). Conventional spring barley had significantly (P<0.05) greater seed yield then the no-till spring barley and there was no significant difference among the three no-till fertility treatments this year (Table 2). Conventional-70 spring barley yielded 1.93 tons/acre. No-till spring barley yields were 1.76, 1.73, and 1.70 tons/acre with the application 50, 70, and 90 lb/acre of applied N. The $LSD_{(0.05)}$ was 0.15 tons/acre There was no significant difference in soil moisture at planting, and 41-days after planting in the top 4 feet (data not presented).

Economic Results:

Gross returns were calculated using $64.00/ton, the FOB price on August 21, 1998 at Odessa Union. Gross return for 1.93 tons/acre conventional seeded spring barley was estimated at $123.52/acre, and no-till spring barley with an average yield of 1.73 tons/acre was estimated at $110.72/acre (Table 3).

Baroness barley seed remained constant over all four treatments (Table 4). Baroness barley seed was estimated at $9.98/acre. Roundup® cost, allocated to only the no-till treatments, applied at 16 oz/acre, was estimated at $4.00/acre. Fertilizer costs for all treatments were varied as u-haul aqua was used in conventional planted spring barley, and full service anhydrous was used in no-till planted spring barley. Conventional-70 had an estimated fertility cost of $27.23/acre, no-till 50 had an estimated fertility cost of only $23.12/acre, no-till-70 had an estimated fertility cost of $29.23/acre, and no-till-90 had an estimated fertility cost of $35.33/acre (Table 5).

Ownership and operating costs were estimated using MACHCOST, machinery cost analysis program developed by the University of Idaho. No-till ownership costs were estimated at only $3.52/acre (Table 6), opposed to an estimated $16.27/acre for conventional ownership costs (Table 7). Operating costs were much different than ownership cost as no-till-operating costs were estimated at $17.62/acre (Table 8), and conventional operating costs were estimated at only $6.28/acre (Table 9).

Total establishment costs are comprised as the total input product, ownership, and operating costs. Total returns above establishment costs are calculated by subtracting net returns from total establishment costs. Conventional-70 has an estimated $59.77/acre total establishment cost and an estimated return above establishment cost of $63.75/acre (Table 10). No-till-50 had the lowest estimated total establishment cost of only $58.24/acre and estimated returns above establishment costs of $52.48/acre. No-till-70 had an estimated total establishment cost of $64.35/acre and returns above establishment cost of only an estimated $46.37/acre, and no-till-90 had the greatest estimated total establishment cost of $70.45/acre and the lowest returns above establishment cost of only $40.27/acre.

One factor not included in the economic analysis is the opportunity cost associated with time saved. Using the operations performed on the no-till system, it will take just over eleven 10-hour days to plant 800 acres of spring barley (Table 11). Using the operations performed on the conventional system, it will take over eighteen 10-hour days to plant 800 acres of spring barley (Table 12).

Conclusions:

Agronomically, conventional and no-till spring barley were very comparable as establishment and spring barley tillers were not significantly different, and conventional seeded spring barley had a greater yield than the no-till treatments. Economically, no-till-50 had the lowest estimated establishment cost/acre, but conventional-70 spring barley netted just over $11.00/acre more than no-till-50, $17.35/acre more than no-till-70, and over $23.00/acre more than no-till-90.

Time has potential to greatly impact both the agronomic and economic performance of no-till spring barley in comparison to conventional systems. In this trial, the conventional spring barley was planted on April 22, and the no-till spring barley was planted on April 21. With the time save, the no-till has the potential to be seeded 7 days prior to seeding (April 17) conventional spring barley. This earlier seeding date may increase yield of no-till spring barley greater than conventional spring barley.

Reduced, or not harrowing, in a no-till system may potentially save time and reduce cost. In this study the ground was harrowed multiple times in both treatments to level the ground after fall sub-soiling. Under no-till conditions sub-soiling (not included in the cost comparison) may not be needed in the northern Lincoln County area.

Nitrogen on first year no-till was not significantly different agronomically. Economically; returns above establishment costs on the no-till-50 were $8.03/acre greater than the application of 70 lb N/acre, and over $16.00/acre greater than the application of 90 lb N/acre. This research did not examine the quantity of nitrogen remaining after each treatment, which may impact fertility required and cost in subsequent crops.

Agronomic Data:

Table 1. Plant population and tiller count of no-till and conventional planted spring barley in an on-farm test at Tim and Dennis Herdrick's in 1998.

Treatments	Barley Establishment ($plants/ft^2$)	Barley Tillers (tillers/plant)
Conventional – 70	7.8 a[†]	5.9 a
No-till – 50	6.3 a	5.0 a
No-till – 70	6.2 a	5.2 a
No-till – 90	6.2 a	5.1 a
$LSD_{(0.05)}$	3.4	2.2
CV	32.01%	28.74%

† Treatment means within columns followed by the same letter are not significantly different at the 95% probability level (*P*<0.05).

Table 2. No-till and conventional planted spring barley yield (tons/acre) in an on-farm test at Tim and Dennis Herdrick's in 1998.

Treatments	Rep I	Rep II	Rep III	Rep IV	Average
Conventional – 70	2.04	1.92	1.93	1.81	1.93 a[†]
No-till – 50	1.68	1.77	1.75	1.81	1.76 b
No-till – 70	1.73	1.89	1.69	1.61	1.73 b
No-till – 90	1.72	1.64	1.67	1.75	1.70 b
$LSD_{(0.05)}$					0.15
CV					3.83%

† Treatment means within columns followed by the same letter are not significantly different at the 95% probability level (*P*<0.05).

Economic Data:

Table 3. Gross Returns per acre for 1.73 tons/acre no-till spring barley and 1.93 tons/acre conventional spring barely in an on-farm test at Tim and Dennis Herdrick's in 1998.

Treatment	Yield (tons/acre)	Price[†] ($/ton)	Gross Returns ($/acre)
Conventional-70	1.93	$64.00	$123.52
No-till-50	1.73	$64.00	$110.72
No-till-70	1.73	$64.00	$110.72
No-till-90	1.73	$64.00	$110.72

† FOB on August 21, 1998 at Odessa Union.

Table 4. Total cost per acre of herbicide and seed for no-till and conventional spring barley in an on-farm test at Tim and Dennis Herdrick's in 1998.

Product	Rate per acre	Cost/unit	Total Costs /Acre
Roundup®	16 oz	$0.25	$4.00†
Baroness Barley	70 lb	$0.1425	$9.98
Total			$13.98

† Roundup costs were only allocated to the no-till treatments.

Table 5. Total fertilizer costs per acre for each of the four treatments of spring barley in an on-farm test at Tim and Dennis Herdrick's in 1998.

Fertilizer	Conventional-70	No-till-50	No-till-70	No-till-90
Aqua	$14.71	$0.00	$0.00	$0.00
11-52	$5.37	$0.00	$0.00	$0.00
Thiosul	$7.15	$0.00	$0.00	$0.00
Anhydrous	$0.00	$11.29	$17.40	$23.50
16-20-0-14	$0.00	$11.83	$11.83	$11.83
Total	$27.23	$23.12	$29.23	$35.33

Table 6. Estimated ownership costs/acre of each operation used to establishing no-till spring barley in an on-farm test at Tim and Dennis Herdrick's in 1998.

Operation	Equipment	Depreciation Costs	Interest Costs	Tax, Housing, & Interest	Total Ownership Costs
Harrow	285HP-Challenger, 67' harrow	$0.33	$0.32	$0.07	$0.72
Harrow	285HP-Challenger, 67' harrow	$0.33	$0.32	$0.07	$0.72
Harrow	285HP-Challenger, 67' harrow	$0.33	$0.32	$0.07	$0.72
Roundup	285HP-Challenger, 96' sprayer	$0.63	$0.60	$0.13	$1.36
Fertilize & Seed	400HP-WT, 33' no-till drill	$0.00	$0.00	$0.00	$0.00
Total Ownership Costs		$1.62	$1.56	$0.34	$3.52

Table 7. Estimated ownership costs/acre of each operation used to establishing conventional spring barley in an on-farm test at Tim and Dennis Herdrick's in 1998.

Operation	Equipment	Depreciation Costs	Interest Costs	Tax, Housing, & Interest	Total Ownership Costs
Harrow	285HP-Challenger, 67' harrow	$0.33	$0.32	$0.07	$0.72
Harrow	285HP-Challenger, 67' harrow	$0.33	$0.32	$0.07	$0.72
Harrow	285HP-Challenger, 67' harrow	$0.33	$0.32	$0.07	$0.72
Cultivate	285HP-Challenger, 43' cultivator	$1.73	$1.84	$0.39	$3.97
Cultiweed/Fert.	285HP-Challenger, 36' cultiweeder	$1.10	$1.25	$0.28	$2.63
Coilpack	285HP-Challenger, 50' coilpacker	$1.08	$1.09	$0.23	$2.41
Seed†	285HP-Challenger, 48' drills	$2.03	$2.18	$0.89	$5.10
Total Ownership Costs		$6.93	$7.32	$2.00	$16.27

† Seed ownership costs incorporate 7100 International drills and Flexi-Coil 2320 air cart.

Table 8. Estimated operating costs per acre of each operation used to establishing no-till spring barley in an on-farm test at Tim and Dennis Herdrick's in 1998.

Operation	Equipment	Repairs Costs	Fuel Costs	Lube Costs	Labor Costs	Rental Costs	Total Operating Costs
Harrow	285HP-Challenger, 67' harrow	$0.11	$0.07	$0.01	$0.26	$0.00	$0.45
Harrow	285HP-Challenger, 67' harrow	$0.11	$0.07	$0.01	$0.26	$0.00	$0.45
Harrow	285HP-Challenger, 67' harrow	$0.11	$0.07	$0.01	$0.26	$0.00	$0.45
Roundup	285HP-Challenger, 96' sprayer	$0.17	$0.05	$0.01	$0.19	$0.00	$0.42
Fertilize & Seed	400HP-WT, 33' no-till drill	$0.00	$0.24	$0.00	$1.61	$14.00	$15.85
Total Operating Costs		$0.50	$0.50	$0.04	$2.58	$14.00	$17.62

Table 9. Estimated operating costs per acre of each operation used to establishing conventional spring barley in an on-farm test at Tim and Dennis Herdrick's in 1998.

Operation	Equipment	Repair Costs	Fuel Costs	Lube Costs	Labor Costs	Rental Costs	Total Operating Costs
Harrow	285HP-Challenger, 67' harrow	$0.11	$0.07	$0.01	$0.26	$0.00	$0.45
Harrow	285HP-Challenger, 67' harrow	$0.11	$0.07	$0.01	$0.26	$0.00	$0.45
Harrow	285HP-Challenger, 67' harrow	$0.11	$0.07	$0.01	$0.26	$0.00	$0.45
Cultivate	285HP-Challenger, 43' cultivator	$0.26	$0.30	$0.05	$0.63	$0.00	$1.24
Cultiweed/Fert.	285HP-Challenger, 36' cultiweeder	$0.48	$0.31	$0.05	$0.71	$0.00	$1.55
Coilpack	285HP-Challenger, 50' coilpacker	$0.19	$0.11	$0.02	$0.42	$0.00	$0.73
Seed†	285HP-Challenger, 48' drills	$0.63	$0.20	$0.03	$0.56	$0.00	$1.41
Total Operating Costs		$1.89	$1.13	$0.18	$3.10	$0.00	$6.28

† Seed operating costs incorporate 7100 International drills and Flexi-Coil 2320 air cart.

Table 10. Estimated returns per acre above establishment cost per acre of no-till and conventional spring barley in an on-farm test at Tim and Dennis Herdrick's in 1998.

Treatment	Herbicide & Seed Costs	Fertilizer Costs	Ownership Costs	Operating Costs	Total Establishment Costs	Gross Returns	Returns above Establishment Costs
Conventional-70	$9.98	$27.23	$16.27	$6.28	$59.77	$123.52	$63.75
No-till-50	$13.98	$23.12	$3.52	$17.62	$58.24	$110.72	$52.48
No-till-70	$13.98	$29.23	$3.52	$17.62	$64.35	$110.72	$46.37
No-till-90	$13.98	$35.33	$3.52	$17.62	$70.45	$110.72	$40.27

Table 11. Estimated 10-hour days to establish 800 acres of spring barley crop in a no-till system at Tim and Dennis Herdrick's in 1998.

Operation	Implement Width	Field Speed	Field Efficiency	Hours/Operation	10 hour Days
Harrow	67	6.5	95%	15.91	1.6
Harrow	67	6.5	95%	15.91	1.6
Harrow	67	6.5	95%	15.91	1.6
Spray	96	6.5	90%	11.63	1.5
Fertilize/Seed	33	5.0	70%	52.00	5.2
Total 10 Hour Days					11.1

Table 12. Estimated 10-hour days to establish 800 acres of spring barley crop in a conventional system at Tim and Dennis Herdrick's in 1998.

Operation	Implement Width	Field Speed	Field Efficiency	Hours/Operation	10 hour Days
Harrow	67	6.5	95%	15.91	1.6
Harrow	67	6.5	95%	15.91	1.6
Harrow	67	6.5	95%	15.91	1.6
Cultivate	43	4.5	90%	37.52	3.8
Cultiweed/Fertilize	36	5.0	90%	40.33	4.0
Coilpack	50	5.5	95%	25.20	2.5
Seed	48	4.5	90%	33.61	3.4
Total 10 Hour Days					18.4

Alternative Crop Rotations Using No-Till in Adams County

Ron Jirava, grower
with Bill Schillinger, Jim Cook, Ann Kennedy, Harry Schafer, Bob Gilliespie,
Joe Yenish, Keith Saxton, Bob Papendick and Doug Young
Washington State University and USDA-ARS

Introduction and Objective:

For most of a century the wide-spread practice of growing only one crop every other year in a tillage-based wheat-fallow rotation had degraded soils and contributed to environmental problems in dryland areas of the Inland Pacific Northwest. Growers are interested in no-till planting techniques and potential alternative crop rotations which reduce erosion, decrease soil-born diseases of cereals, enhance crop marketing potential opportunities, and hold potential to increase soil quality. The objective of this research is to determine the long-term feasibility of diverse, no-till cropping systems for low-rainfall dryland areas of eastern Washington.

Study Location:

Location: 5 miles west of Ritzville, WA
Average Annual Precipitation: 11.4 inches
Soil Type: Ritzville silt loam

Treatments and Operations:

This project, which began in April 1997, is evaluating diverse, annual, no-till cropping systems as a substitute for winter wheat-summer fallow. It compares a continuous spring wheat rotation, wheat-barley rotation, and a four-year rotation with wheat, wheat, safflower, and yellow mustard following in this sequence. The study, in its second of six years, is seeded with a Flexicoil 6000 no-till disc drill with 7.5" row spacing. Plots are fertilized at time of planting with nitrogen, phosphorous, and sulfur as indicated by early spring soil tests. Wheat is seeded between 70-to 90 lb/a, barley 65-to-70 lb/a, safflower 20 lb/a, and yellow mustard 7-to-10 lb/a. Pre-plant herbicide application and registered "in-crop" herbicides are used as needed for each crop. The trial is a randomized block design with 4 replications, and each portion of the rotation is planted each year. A long-term study identical to this one is ongoing at the Brad Wetli farm in Douglas County, Washington.

Agronomic Results and Interpretation:

Plant stands for all crops in 1997 and 1998 are shown in Table 1. Despite large seed size, stands of safflower have been relatively thin during both years. Yellow mustard stands were thin in 1998 which made us wonder if safflower residue might have a phytotoxic effect on mustard seedlings. However, in a 1999 greenhouse study, yellow mustard seedlings grown in soil collected from recently harvested safflower plots were as healthy as those grown in soil from spring wheat plots. Acceptable stands of wheat and barely have been achieved both years.

Russian thistle, horse tail, and prickly lettuce were problem weeds in yellow mustard and safflower crops in 1997 and 1998. There are no registered “in-crop” broadleaf weed herbicides in yellow mustard or safflower, therefore control measures are limited to pre-plant herbicide application and competition. Broadleaf weed dry biomass in 1998 at harvest for yellow mustard and safflower averaged 700 lb/a (data not shown). Good weed control in barley and wheat was achieved using “in-crop” herbicides. There were no differences in 1998 in weed populations in wheat when the previous crop was either yellow mustard or wheat, which shows that an elevated weed population in broadleaf crops can be brought back under control when the crop rotation returns to cereals.

The percentage of Rhizoctonia infection on both seminal roots and crown roots of cereals was lowest when yellow mustard was the preceding crop (Table 2). We are very encouraged with these data because Rhizoctonia can be devastating to cereals under no-till a, and we believe broadleaf rotation crops are necessary to control this disease in continuous ultra low-disturbance no-till systems.

Yields for all for crops were reduced in 1998 compared to the bumper harvest in 1997 (Table 3). Stored over-winter soil water and growing season rainfall were greater than average in 1997 and in 1998 (data not shown), but hot air temperatures exceeding 90^0 F in late June and July 1998 stressed and reduced yields of all crops. Where yellow mustard was the preceding crop, yield was 1.6 bu/a higher compared with wheat following wheat.

Agronomic Data:

Table 1. Plant stand establishment of four crops sown with a Flexicoil 6000 no-till drill at Ron Jirava’s in 1997 and 1998.

Crops	1997†	1998
	---------------------------- Plants per ft^2	--------------------------
Safflower after y. mustard	2.5	3.2
Y mustard after safflower	1.8	0.7
Barley after wheat	8.6	15.3
Wheat after barley	---	20.7
Wheat after y. mustard	---	20.0
Wheat after wheat	9.6	18.6

† All crops were planted into spring wheat stubble in 1997, the first year of the study.

Table 2. Incidence of Rhizoctonia root rot on seminal and crown roots of spring wheat and spring barley in response to rotation at Ron Jirava's in 1998.

Rotation Crop		Rhizoctonia Infection (%)	
1997	1998	Seminal Roots	Crown Roots
Wheat	Wheat	18.5 ± 2.3	5.3 ± 1.0
Y mustard	Wheat	10.8 ± 1.5	2.2 ± 0.4
Wheat	Barley	16.9 ± 2.2	5.2 ± 0.7
Barley	Wheat	17.2 ± 1.9	5.3 ± 0.6

Table 3. Yield of four crops planted no-till at Ron Jirava's in 1997 and 1998. These are the first and second year results of a planned six-year alternative cropping systems project.

Crops	Units	1997†	1998
Safflower after y. mustard	lb/acre	1420	720
Y mustard after safflower	lb/acre	1430	340
Barley after wheat	t/acre	2.30	1.13
Wheat after barley	bu/acre	---	40.6
Wheat after y. mustard	bu/acre	---	41.1
Wheat after wheat	bu/acre	64.3	40.5

† All crops were planted into spring wheat stubble in 1997, the first year of the study.

The Wilke Project: Annual Cropping, Direct Seeding Systems for the Intermediate Rainfall Area of Eastern Washington

Dale Dietrich, Bill Dreger, Hal Johnson, Karl Kupers, Chris Laney,
Doug Reinbold, and Tom Zwainz, growers
with Ag Horizons Team, WSU Cooperative Extension

Introduction and Objective:

Many growers in the intermediate rainfall area of eastern Washington are interested in no-till planting systems and potential alternative crop rotations which reduce erosion, decrease soil-born diseases of cereals, enhance crop marketing potential opportunities, and hold potential to increase soil quality. The objective of the Wilke project, which is based at the Wilke Research and Extension Farm in Davenport, Washington, is to demonstrate agronomically and economically viable rotations, including diversified crop systems, using no-till-farming methods.

Study Location:

Location: Davenport and throughout Lincoln County
Average Annual Precipitation: 12 to 16 inches
Soil Type: silt loam

Treatments and Operations:

Currently the Wilke farm is testing two crop rotations: a four-year crop rotation including two cool season cereals, one warm season grass, and one broadleaf crop, and a three-year crop rotation including two cool season cereals and one broadleaf crop. Both rotations are being grown on the farm in three replications of approximately 8-acre strips. In 1998 the four-year rotation included “Alpowa” spring wheat, “Meltan” barley, “Colorado Red” millet, and safflower. The three-year rotation included “Alpowa” spring wheat, “Meltan” barley, and yellow mustard.

In addition, agronomic and economic data is being collected on 3 area grower cooperators who are replicating the four-year rotation, 3 area grower cooperators who are replicating the three-year rotation, and 3 area grower cooperators who are using conventional tillage and cropping systems for an agronomic and economic check. All plots at the Wilke farm and grower cooperators (except the 3 check farms) were seeded with a no-till drill that each grower chose. No-till seeding systems included drill that would be considered both high and low soil disturbance.

Data being collected from the Wilke farm and participating grower cooperators include extensive soil sampling, weed and insect (pest/beneficial) populations, disease, crop yields, post harvest residue, water infiltration rates, and economic data.

1998 Agronomic Results and Interpretation:

Agronomic results from 1998 are the first of at least four years, or a complete cropping cycle. Most of the agronomic data collected in 1998 is for a baseline to document changes within a cropping system. Because of this, yield data is the only agronomic perimeter presented.

At the Wilke farm, all crops were seeded into 71 bu/acre conventional winter wheat residue, 1.8 T/acre no-till spring barley residue, and 71.5 bu/acre no-till spring wheat residue (the 1998 crop was planted north to south, and the 1997 crop was planted east to west). Table 1 lists the crop harvested in 1998, the crop with seed yield in 1997, and how many years the field has been no-tilled for the 3 grower cooperators in a 4-year crop rotation. Table 2 presents the crop harvested in 1998, the crop with seed yield in 1997, and how many years the field has been no-tilled for the 3 grower cooperators in a 3-year crop rotation.

In the 4-year rotation, between the Wilke farm and the 3 grower cooperators, 9 different crops were produced including 3 cool season grasses, 3 broadleaf crops, and 3 warm season grasses. Yields at the Wilke farm in 1998 were similar to grower cooperators yields in the 4-year rotation (Table 3).

In the 3-year rotation, between the Wilke farm and the 3 grower cooperators, 6 different crops were produced including 3 cool season grasses and 3 broadleaf crops. Yields at the Wilke farm in 1998 were also similar to grower cooperators yields in the 3-year crop rotation (Table 4).

The 3 area grower cooperators who are using conventional tillage and cropping systems planted only 3 different crops, all cool season grasses. Seed yield ranged from 42 to 50 bu/acre for spring wheat, 54 to 69 bu/acre for winter wheat, and one grower planted barley that yielded 1.2 ton/acre (Table 5).

Economic Results and Interpretation:

Economic results from 1998 are the first of at least four years, or for a complete cropping cycle and are summarized in table 6. Net returns in 1998 for the 4-year rotation, 3-year rotation, and the conventional systems at the Wilke farm and the grower cooperators was calculated using the formula:

Net Returns	=	Gross Returns	-	Input Costs	-	Operating Costs	-	Equipment Costs
		yield x mkt price		fertilizer seed pesticides		fuel lubrication repair labor		replacement cost taxes housing insurance rent if required

Net returns **exclude** harvest-trucking cost, land costs, real estate taxes, returns to management or interest on machinery or opportunity cost of interest on equity. Gross returns were calculated by taking the actual crop yield times a market price. For the alternative crops the market price used was often specified in the growers contract. For cereal grains, wheat price was assumed to be $ 2.77/bu., the loan rate at the time of harvest, and barley was assumed to be $ 84/ton, also the loan rate at harvest. Gross returns do not include farm support program income.

Input variable costs used were the actual costs encountered by the grower, and not average cost estimations. Machinery ownership and operating costs were estimated using MACHCOST, machinery cost analysis program developed by the University of Idaho. Machinery cost analysis incorporates all the farm equipment utilized to complete a cropping cycle, including planting and harvest equipment, and grain trucks.

Agronomic Data:

Table 1. Current crop, 1997 crop with seed yield and years in no-till of the 3 grower cooperators in a 4-year crop rotation.

Cooperators	1998 Crop	1997 Yield/Crop	Years in No-Till
1	S. Wheat	53 bu S. Wheat	3
	Oats	53 bu S. Wheat	3
	Mustard	53 bu S. Wheat	3
	Millet	53 bu S. Wheat	3
2	S. Barley	1.8 T S. Barley	1
	S. Wheat	1.8 T S. Barley	1
	Corn	45 bu S. Wheat	1
	Sudan	45 bu S. Wheat	1
3	S. Barley	2.2 T S. Barley	1
	S. Wheat	65 bu S. Wheat	1
	Canola	2.2 T S. Barley	1
	Millet	65 bu S. Wheat	1

Table 2. Current crop, 1997 crop with seed yield and years in no-till of the 3 grower cooperators in a 3-year crop rotation.

Cooperators	1998 Crop	1997 Yield/Crop	Years in No-Till
1	S. Barley	55 bu W. Wheat	1
	W. Wheat	67 bu S. Wheat	1
	Safflower	55 bu W. Wheat	1
2	S. Barley	65 bu W. Wheat	1
	S. Wheat	560 lb Canola – 1 T S. Barley	1
	Canola	60 bu W. Wheat	1
3	S. Barley		
	S. Barley	61 bu W. Wheat	4
	W. Wheat	Summer Fallow	1

Table 3. Yields (per acre) of the 4-year rotation at the Wilke farm and the grower cooperators in 1998.

		Cooperators		
Crop	Wilke	1	2	3
S. Barley	1.47 T		1.33 T	1.94 T
S. Wheat	31 bu	31 bu	20 bu	50 bu
Oats		1,650 lb		
Canola				1,570 lb
Mustard		550 lb		
Safflower	593 lb			
Millet	596 lb	400 lb		800 lb
Corn			45 bu	
Sudan Grass			3,000 lb†	

† Sudan grass was harvested as forage for livestock.

Table 4. Yields (per acre) of the 3-year rotation at the Wilke farm and the grower cooperators in 1998.

Crop	Wilke	Cooperators 1	2	3
S. Barley	1.39 T	1.50 T	1.38 T	1.50 T
S. Barley				1.25 T
S. Wheat	31 bu		34 bu	
W. Wheat		61 bu†		90 bu‡
Canola			1,000 lb	
Mustard	513 lb			
Safflower		100 lb		

† Recrop no-till winter wheat seeded into spring wheat and barley residue.
‡ Traditional planted winter wheat - summer fallow rotation.

Table 5. Yields (per acre) of 3 area grower cooperators who are using conventional tillage and cropping systems in 1998.

Crop	Cooperators 1	2	3
S. Barley	1.20 T		
S. Wheat		42 bu	50 bu
S. Wheat		47 bu	
W. Wheat	62 bu	54 bu	69 bu

Economic Data:

Table 6. 1998 net returns for the 4-year rotation, 3-year rotation, and the conventional system at the Wilke farm and the grower cooperators. This data is the first year of at least four years.

Cropping System	Wilke	Cooperators 1	2	3
4-year rotation	$-42.00	$-74.00	$-34.00	$21.00
3-year rotation	$-38.00	$-37.00	$-27.00	$29.00
Conventional	-	$-8.00	$13.00	$50.00

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Aaron D. Esser
On-Farm Testing Associate
Washington State Cooperative Extension
210 W. Broadway
Ritzville, WA 99169
Phone: (509) 659-3210
Fax: (509) 659-3303
e-mail: aarons@wsu.edu

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