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ECONOMIC COMPARISON OF THE UNDERCUTTER AND TRADITIONAL TILLAGE SYSTEMS FOR WINTER WHEAT-SUMMER FALLOW FARMING

By

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Note

Enterprise costs and returns vary over farms and over time for any particular farm. Variability stems from differences in:

- Capital, labor, land and management resources
- Type and size of machinery complement
- Cultural practices
- Size of farm and enterprise
- Crop yields
- Input prices
- Commodity prices

Costs can also be calculated differently depending on the intended use of the cost estimate. The information in this publication represents costs and returns of a case study Adams County, Washington farmer using both the low-disturbance V-sweep undercutter conservation tillage[*] and traditional tillage systems for summer fallow. To avoid drawing unwarranted conclusions from this case study, you should closely examine the assumptions and data used. If these are not suitable for the situation at hand, you should make appropriate adjustments.

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[*] *The Haybuster™ undercutter implement used in this study has 32-inch wide V-shaped blades with 28-inch spacing between blades (on two tiers) to slice below the soil surface with minimum soil lifting. As a primary spring tillage implement, the undercutter completely severs capillary pores to halt liquid water movement towards the soil surface as required to retain seed-zone moisture in summer fallow. The pitch of each blade can be individually adjusted to ensure uniform horizontal movement (i.e., minimum soil lifting) underneath the soil. This implement can be easily fitted to deliver aqua nitrogen fertilizer at the time of primary spring tillage. Depending on soil texture, farmers may or may not want to attach a finishing implement behind the undercutter to break large soil clods and fill air voids. In addition, the undercutter works well for killing Russian thistles, if needed, after wheat harvest.

THE HAYBUSTER™ UNDERCUTTER IMPLEMENT

ECONOMIC COMPARISON OF THE UNDERCUTTER AND TRADITIONAL TILLAGE SYSTEMS FOR WINTER WHEAT-SUMMER FALLOW

Andrey A. Zaikin, Douglas L. Young, William F. Schillinger[1]

SUMMARY

Wind erosion and blowing dust are major problems for traditional tillage winter wheat-summer fallow in eastern Washington. Wind erosion reduces soil productivity and dust particulates are a major air quality concern. Conservation tillage summer fallow can reduce wind erosion markedly, but is used by relatively few farmers in the low-precipitation (less than 12 inch/year) region of the Inland Pacific Northwest. Barriers to adoption include the cost of conservation tillage implements and reluctance to change “tried and proven” traditional tillage methods. This bulletin compares economic results for the V-sweep undercutter and traditional fallow tillage systems on a case study farm located near Ritzville, WA. The farm’s eight-year average wheat yield is 46 bu/ac. Grain yields are similar for the two systems. This study shows that the undercutter method of summer fallow farming is more profitable than the traditional system on the case study farm due to slightly lower production costs. The undercutter system is eligible for conservation payments, but the traditional system is not. Receipt of these payments further strengthens the profitability advantage of the undercutter system

INTRODUCTION

Winter wheat-summer fallow (WW-SF) is the dominant dryland cropping system in regions of the U.S. Pacific Northwest that receive 14 inches or less annual precipitation. The WW-SF system often offers economic advantages compared to more intensive cropping,

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including reduced financial and production risk and smooth seasonal demand for labor and machinery.

About 30% of the precipitation that occurs during the 13-month-long fallow period is stored in the soil. This additional soil water allows farmers to plant winter wheat in late August or early September to optimize grain yield and reduce the risk of crop failure from drought. Tillage during the spring of the fallow year is employed to break soil capillary continuity from the subsoil to the surface and create a 4- to 6-inch deep dry soil mulch to conserve moisture in the seed zone. Wheat farmers generally do not practice no-till (i.e., chemical) summer fallow because of increased evaporative loss of seed-zone soil moisture during the dry summer months compared to tillage. Elimination or reduction of tilled summer fallow by converting to annual cropping, especially using no-till planting methods, has been shown to greatly reduce air borne dust that is a health concern when inhaled into lung tissue. However, to date, long-term efforts by farmers and researchers have not yet identified alternative cropping systems that can compete economically with winter wheat – summer fallow in the Inland Pacific Northwest (Nail et al., 2005).

Traditional and conservation tillage fallow differ in operations, timing and production costs. Traditional tillage practices are intensive and involve eight or more separate tillage passes over the field during the fallow period. Such intensive tillage operations often bury surface crop residue, pulverize soil clods, and reduce surface roughness. Blowing dust from excessively tilled fields leads to recurrent soil losses and reduces air quality. Development and adoption of agronomically feasible, profitable and more environmentally friendly fallow management methods are needed.

The undercutter method of summer fallow farming employs a wide-blade V-sweep for primary spring tillage plus fertilizer injection, followed by as few as two non-inversion rodweeding operations. Tillage is reduced from the traditional eight operations to as few as three operations using the undercutter method. The undercutter method increases surface residue and roughness generating more protective cover against wind erosion compared to traditional tillage.

Questions remain about the profitability and risk of the undercutter method of summer fallow farming in the Inland Pacific Northwest. This bulletin compares the economic performance of traditional tillage to conservation tillage using the undercutter in a case study farm near Ritzville in Adams County, Washington. The area is characterized by cool-wet winters, hot-dry summers, and frequent sustained winds of 25 miles per hour or more with gusts that can exceed 50 miles per hour.. Annual precipitation averages 10.5 inches.

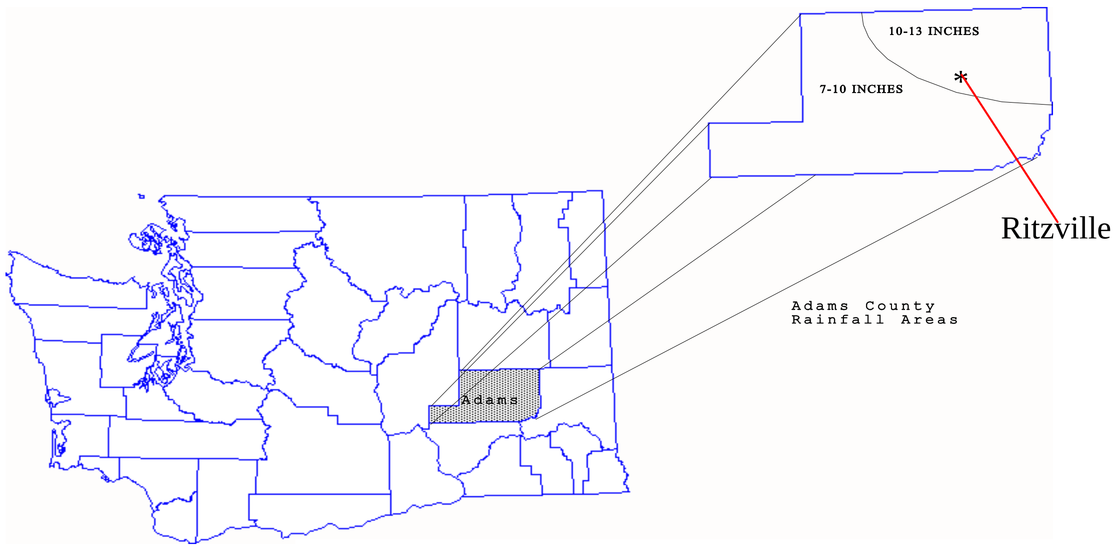

Figure 1. Study site location in Washington State.

Economic cost of production budgets are prepared for both the traditional and undercutter WW-SF systems. Economic budgets produce higher costs than cash budgets because they also include opportunity costs or foregone returns on owned resources. These opportunity costs include a “land rent” on land that is owned, interest on owner’s machinery equity, and a wage for the owner-operator’s labor. This full cost budgeting is necessary to compare costs on a consistent basis for farms that have different mixes of owned versus rented resources. Economic budgeting costs out the complete set of resources required to produce a crop.

The large case study farm providing the data for these budgets had used both the undercutter and traditional tillage systems for WW-SF farming. As stated in the Note at the beginning of this bulletin, differing conditions and practices on other farms may cause costs and profitability to differ from those reported here.

BACKGROUND

Tillage intensive winter wheat – summer fallow became the standard cropping practice in the low-precipitation region of east-central Washington and north-central Oregon soon after land was broken out of native bunch grass and sage brush in the 1880s. Walker and Young (1986) computed significant economic cost of lost soil productivity by long-term soil erosion. Wind erosion also imposes off-site costs by harming human health, reducing recreational values, impairing traffic safety and increasing cleaning costs in downwind areas (Papendick, 2004).

Washington State University (WSU) scientists have sought solutions for reducing wind erosion from irrigated and dryland croplands. Schillinger et al. (2001), in a study in Lind, WA (9.6 inches annual precipitation), showed that undercutter minimum tillage and undercutter delayed minimum tillage performed equally well as traditional fallow tillage in terms of grain yield and weed and disease control. Averaged over the six years of the experiment, soil water content in the seed zone as well as total soil water storage was not affected by tillage treatment. This conservation wheat-fallow system also reduces wind erosion. Nail et al. (2006) computed that the undercutter system was more profitable than traditional tillage fallow at a high level of statistical significance. Its relative profitability advantage was strengthened by the recent increase in diesel price and decline in glyphosate price.

However, conservation-tillage fallow is not widely used in eastern Washington (Janosky et al., 2002). Based on the last reliable estimate, 88% of fallow small grain acreage in Adams County was traditionally tilled (CTIC, 1998). Farmers and researchers have cited several reasons why adoption of conservation-tillage fallow has lagged, including difficulties in controlling grass weeds, plugging of grain drills due to excessive straw, and concern about the financial risk of converting to conservation farming systems (Janosky, et al., 2002; Juergens et al., 2002, Ogg, 1993).

This bulletin is intended to help alleviate some of the economic concerns about conservation tillage fallow and to increase understanding of the undercutter system. Adoption of this system could promote the environmental and economic sustainability of farming in the low precipitation WW-SF region of the Pacific Northwest.

SOURCES OF INFORMATION

The information for this publication was obtained through contacts with an Adams County wheat farmer who had recently used both traditional tillage and the undercutter method for preparing summer fallow over a large acreage. It was necessary to use this case study wheat farmer for this economic comparison because he was the only grower in the region the authors were aware of who had accumulated extensive experience with the new undercutter system. The wheat farmer provided detailed information on machinery, field operations, inputs used, overhead costs and grain yields. The 2006 price information used in this bulletin was obtained from local agricultural supply businesses and from a recent study in the same area (Nail et al., 2005 and 2006).

BUDGET ASSUMPTIONS

The following cost accounting assumptions were followed:

1. The case study farm for undercutter and traditional tillage exceeds 5,000 acres, with 50% of the farm in winter wheat and 50% in summer fallow each year. Two budgets (summer fallow and winter wheat) were developed for both tillage practices. Table 1 describes the timing of field operations and inputs for the case study farm.

2. Winter wheat yields of 46 bu/ac were used for both the undercutter and traditional tillage systems based on the 8-year average grain yield (1998-2005) of primarily traditional tillage yields on the case study farm. Equal grain yields for the two systems were also based on statistically equivalent yields from these two systems in a six-year experiment at Lind, WA (Schillinger, 2001).

3. The utilized soft white wheat price of $3.32/bu is based on five-year (2001-2005) average at the Union Elevator at Lind, WA (www.unionelevator.com/charts.htm). In contrast, wheat had risen to $4.50/bu in the region by October 2006. Government “direct payments” for wheat averaged $6.75/ac/year on the case farm.

4. Averaged over total farm acres, the undercutter tillage system qualified for conservation incentive payments of \$20.40/2 ac/yr because it maintains 30% residue cover on fallow. Machinery types and costs, and input types and rates are from the case farm.

5. The off-road price of diesel for January 2006 is \$1.94/gallon. (http://tonto.eia.doe.gov/oog/info/gdu/dieselpump.html). Price of labor is \$15/hour. The interest rate is 8%. Other input prices are listed in Appendix Table A10.
   The budgets represent the case farm. Where such factors as farm size, machinery type and use, cultural practices, and yields differ from those in this publication, substantially different enterprise costs and returns may result. Furthermore, these budgets contain only production costs and do not consider marketing costs.

DISCUSSION OF BUDGET INFORMATION

Detailed production cost budgets were developed for both tillage systems using Washington State University's Farm Enterprise Budget Simulator (FEBS). Both tillage systems have two budgets: summer fallow and winter wheat after summer fallow. Generalized field operations and timing for the undercutter and traditional tillage systems are presented in Table 1.

Table 1. General field operations and inputs for summer fallow and winter wheat after summer fallow by tillage system, Ritzville, WA.

Date	Undercutter	Traditional
Summer Fallow		
Aug	Undercut at 2 inches (every five cycles) for post-harvest control of Russian thistle	Undercut at 2 inches (every five cycles) for post-harvest control of Russian thistle
Nov	Rip (once every three cycles) to a depth of 15 inches on 30-inch-wide shank spacing	Rip (once every three cycles) to a depth of 15 inches on 30-inch-wide shank spacing
Mar	Apply herbicide to stubble:14 oz glyphosate/acre, 0.65lb ammonia sulfate/acre and 0.05 gal surfactant/acre (every year)	Apply herbicide to stubble:14 oz glyphosate/acre, 0.65lb ammonia sulfate/acre and 0.05 gal surfactant/acre (every year)
Mar		First cultivation with field cultivator (every year)
Apr	Apply herbicide to stubble: 10 oz glyphosate/acre (every five cycles)	Second cultivation with field cultivator (every year)
Apr	Undercut at 5-inch depth plus fertilize: 50lb N and 5lb S/acre (using undercutter) (every year)	
May	First rod weed (every year)	
Jun	Second rod weed (every year)	Fertilize: 50lb N and 5lb S/acre (every year)
Jun		First rod weed (every year)
Jul	Third rod weed (every two cycles)	Second rod weed (every two cycles)
Winter Wheat		
Late Aug	Plant 40lb/ac certified seed and fertilize at 10lb of P_2O_5/ac	Plant 40lb/ac certified seed and fertilize at 10lb of P_2O_5/ac
Mar	Apply in-crop herbicide: 10 oz 2,4-D/acre (every year) and 0.9 oz Olympus/ac (every two cycles)	Apply in-crop herbicide: 10 oz 2,4-D/acre (every year) and 0.9 oz Olympus/ac (every two cycles)
Jul	Harvest & transport grain	Harvest & transport grain

Appendix tables

Detailed budget information for the summer fallow and winter wheat budgets by tillage system are presented in the Appendix. The “Schedule of Operations” tables (Appendix Tables A2, A4, A6, and A8) outline the schedule of field operations by calendar month, the type of machinery used, the machine and labor hours per acre and total production costs for summer fallow and winter wheat. The production costs are divided into two categories. The first category is fixed costs that include costs related to fixed machinery ownership and land costs. The second category is known as variable costs that are associated with operating machinery, hiring labor, and purchasing services and materials. Fixed and variable costs sum to total costs.

Machinery fixed costs include depreciation, interest on investment, property taxes, insurance, and housing costs as detailed in Appendix Tables A1, A3, A5, and A7. For a given machinery complement, annual fixed costs for the farm do not vary with the acres of crop produced. The per-hour fixed costs are determined by dividing the total annual fixed costs by the annual hours of machinery use for the farm. Machinery fixed costs for a specific field operation are determined by multiplying the machinery hours per acre times the per-hour fixed costs (Appendix Table A9). In Appendix Tables A3 and A4, the previous year's summer fallow costs, plus interest, are included as part of the fixed cost of raising winter wheat. These are costs that must be covered by the sale of wheat if the enterprise is to remain profitable over the long run.

Variable costs vary directly with the crop grown and the number of acres produced. Variable costs include fuel, fertilizer, pesticides, machinery repair, custom hire services, crop insurance and interest on operating capital. Machine operating labor, including that provided by the owner-operator, is also a variable cost. Management costs are not included in the budgets.

Land fixed costs include property taxes and net land rent. Net rent is based on rental agreements typical for the area minus expenditures typically covered by the landlord. The "typical" lease agreement for wheat is a one-third landlord crop share with the landlord paying land taxes, one-third of the fertilizer cost, one-third of the crop insurance and one-third of the herbicide cost for in-crop control of downy brome. The tenant covers all other production expenses. As an example, the net land rent per two acres for summer fallow-winter wheat with undercutter tillage is calculated as follows:

$50.91	(one-third gross receipts from production)
- $10.66	(2 years land tax; summer fallow and winter wheat)
- $0.67	(one-third herbicide costs for in-crop control of downy brome)
- $8.14	(one-third fertilizer)
- $2.00	(one-third crop insurance costs)
$29.43	Net rent per two acres

While the owner-operator does not actually experience a land rental cost, the net rent cost represents the minimum return the owner-operator needs to justify growing the crop on his/her land. This return represents the income the owner-operator foregoes by producing this crop rather than renting to a tenant who produces the crop. Land cost is an opportunity cost for an owner-operator rather then an out-of-pocket expense. Appreciation in land value is not considered as part of the returns to the owner-operator in this wheat enterprise budget.

Appendix Tables A1 and A3 itemize the undercutter method costs for summer fallow and winter wheat, respectively. Most of the items are self-explanatory or have been previously explained. One entry, "Interest on Machinery," warrants additional explanation. Fixed machinery interest costs are calculated on the average annual investment in the machine:

$$\text{Interest Cost} = (8\%)\ \frac{(\text{Purchase Cost} + \text{Salvage Value})}{2}$$

Interest cost represents either an opportunity cost (return foregone by investing in the machine rather than in an alternative investment) or interest paid on money borrowed to finance the machine purchase. Machinery interest costs for one acre of summer fallow or winter wheat is determined by multiplying the respective machine hours per acre times the per hour interest costs (Appendix Table A9).

Machinery Complement and Hourly Machinery Costs

Table A9 identifies the equipment and building complement from the case study farm used to derive machinery and buildings costs. Typically, machinery on Adams County farms is purchased both new and used depending on what is available and desired. This table includes the type of machinery used on the case study farm, their current “average” replacement value (new or used), years of use before trade-in, salvage value at trade-in, and annual repair costs. The data in Appendix Table A9 are used to estimate the per-hour fixed and variable machinery costs.

PROFITABILITY AND SENSITIVITY RESULTS

Table 2 compares net return over total costs for the traditional versus undercutter tillage fallow systems with and without conservation payments. Production costs are based on the detailed budgets in Appendix Tables A1-A8. Total costs represent both cash and opportunity costs for land and machinery, owner’s labor and other inputs. Three measures of net return without conservation payments are reported in Table 2: net return over total costs, net return to operator labor (with labor opportunity costs excluded), and net return to operator labor and equity in machinery (with the opportunity cost of interest on machinery equity also excluded). Because management costs are not charged, net returns to total costs could be interpreted as returns to management and risk bearing. Only the undercutter method qualifies for conservation payments. For both systems, government commodity “direct payments” for wheat growers are added to market returns to compute gross returns. No countercyclical or loan deficiency payments under the 2002 Farm Bill had been received by soft white wheat growers at the study site.

Before conservation payments, Table 2 shows the undercutter tillage method has a net return over total costs of $10.92 per two acres versus $7.61 for the traditional method. These results are based on the long term $3.32/bu wheat price. The undercutter has a modest advantage of $3.31/2 ac over traditional tillage. The profit advantage comes from total cost savings of $3.31/2 ac for the undercutter. Recall that both systems have the same yield, wheat price, and commodity payment. On the case farm, both systems were able to generate sufficient market returns at the low $3.32/bu wheat price to cover total costs without conservation payments. But autumn 2006 wheat prices rose to $4.50/bu. These higher wheat prices would generate substantially higher net returns as shown in Tables 4 and 5 later in this section. Net returns to operator’s labor and machinery equity showed net returns over total costs of $29.52/2 ac and $27.77/2 ac for the undercutter and traditional systems, respectively (Table 2). Some farmers may consider this latter measure a more appropriate measure of "profit" because they consider the return to their own unpaid labor and their machinery equity as part of their "take home" earnings. Ultimately, however, the returns to machinery equity will be needed to finance replacement machinery. And returns to labor will often be needed to finance family living expenses. The undercutter system's net returns over total costs is markedly strengthened by conservation payments that raise the profitability comparison for undercutter versus traditional to $31.32 versus $7.61 per two acres (Table 2). This raises the undercutter's advantage to $23.71/2 ac. These case farm results with and without conservation payments show that the undercutter tillage system can be economically competitive relative to traditional fallow tillage.

Table 2. Comparing gross returns and net returns over total costs for traditional versus undercutter tillage for a farm case study, winter wheat-summer fallow with and without conservation payments on a Ritzville, WA wheat farm.

	Unit[a]	Undercutter Method	Traditional Method[b]
Gross Returns:			
Wheat yield	bu/ac	46	46
Wheat price	$/bu	3.32	3.32
Market return (yield x price)	$/2ac	152.72	152.72
Direct government payments	$/2ac	13.50	13.50
Gross return	$/2ac	166.22	166.22
Total Costs	$/2ac	155.30	158.61
Net Return (without conservation payments):			
Net return over total costs (TC)	$/2ac	10.92	7.61
Net return to operator labor	$/2ac	18.68	15.62
Net return to operator labor & equity in machinery	$/2ac	29.52	27.77
Conservation Payments			
EQIP	$/2ac	20.40	NA[b]
Net Return over TC(with conservation payments)	$/2ac	31.32	NA[b]

[a]Values/2ac include both the fallow and winter wheat year. If desired, values per rotational acre (0.5 ac of WW and 0.5 ac of SF) could be obtained by dividing by two.

[b]Undercutter tillage method qualifies for conservation payment, but traditional tillage method does not.

Table 3 presents required breakeven prices and yields for both systems' gross wheat returns (and direct payments) to cover total costs. With an equal wheat yield of 46 bu/ac, direct payments of $13.50/2 ac, no conservation payments, and total costs as listed in Table 2, breakeven wheat prices are $3.08/bu for undercutter tillage and $3.15/bu for traditional tillage to cover total costs. With a wheat price of $3.32/bu, $13.50 direct payments, total costs from Table 2 and no conservations payments, breakeven yields are 42.7 bu/ac for the undercutter and 43.7 bu/ac for traditional tillage to cover total costs (Table 3). These results show that the case farm can produce soft white wheat at the very competitive cost of production of only $3.08/bu using the undercutter method. Other farms may experience different costs of production.

The break-even analysis shows that the conservation payment provides a substantial benefit to the undercutter system. A break-even wheat price of only $2.64/bu is required to cover total costs for this system with the payment (Table 3). This is $0.51/bu lower than for traditional tillage that does not qualify for the conservation payment. Breakeven yield for the undercutter system drops to 36.6 bu/ac with the conservation payment. As expected, gaining a conservation payment substantially reduces the financial and production risk of using the undercutter system.

Table 3. Prices and yields required for gross returns to cover total costs (break-even values) for undercutter versus traditional method of winter wheat-summer fallow production with and without conservation payments on a Ritzville, WA wheat farm.

	Unit[a]	Undercutter Method	Traditional Method[b]
Without Conservation Payments			
Price	$/bu	3.08	3.15
Yield	bu/ac	42.7	43.7
With Conservation Payments			
Price	$/bu	2.64	NA[b]
Yield	bu/ac	36.6	NA[b]

[a]Values/2ac include both the fallow and winter wheat year.

[b]The traditional method does not qualify for a conservation payment.

Variability in net returns is caused by changes in production costs, wheat yields, government payments and wheat prices. Wheat and diesel prices, for example, have both fluctuated widely in response to market forces. Tables 4 and 5 display the effect of wheat price and diesel price variation on net returns (with eligible payments) for the undercutter and traditional tillage systems.

Table 4. Net returns over total costs ($/2 acres) for undercutter winter wheat-summer fallow tillage (assuming conservation and direct payments) at varying wheat prices and off-road diesel prices.

Wheat Price ($/bu)	Change in Diesel Price					
	%	-50%	-25%	0%	+25%	+50%
	$/gal	0.97	1.46	1.94	2.43	2.92
2.00		-3.23	-6.18	-9.16	-12.11	-15.09
2.50		12.10	9.15	6.17	3.22	0.24
3.00		27.43	24.48	21.50	18.55	15.57
3.50		42.77	39.82	36.84	33.89	30.91
4.00		58.10	55.15	52.17	49.22	46.24
4.50		73.43	70.48	67.50	64.55	61.57
5.00		88.77	85.82	82.84	79.89	76.91

As shown by the shaded area of Table 4, undercutter tillage with conservation payments earns positive profits except when wheat sells for less than $2.50/bu.

Table 5. Net returns over total costs ($/2 acres) with direct payments for the traditional tillage system at varying wheat prices and off-road diesel prices.

Wheat Price ($/bu)	Change in Diesel Price					
	%	-50%	-25%	0%	+25%	+50%
	$/gal	0.97	1.46	1.94	2.43	2.92
2.00		-26.45	-29.66	-32.87	-36.07	-39.28
2.50		-11.12	-14.33	-17.54	-20.74	-23.95
3.00		4.22	1.01	-2.20	-5.40	-8.61
3.50		19.55	16.34	13.13	9.93	6.72
4.00		34.88	31.67	28.46	25.26	22.05
4.50		50.22	47.01	43.80	40.60	37.39
5.00		65.55	62.34	59.13	55.93	52.72

Table 5 presents a similar price sensitivity analysis for the traditional tillage WW-SF system; however, this system is not eligible for conservation payments. The traditional system fails to cover total costs whenever wheat price is $2.50/bu or lower for all diesel prices and at $3.00/bu at the current and increased diesel price. Again, all these sensitivity results are based on the production costs for the case farm presented in Table 2.

SUMMARY AND CONCLUSIONS

Fragile soils, drought and high winds combine to cause dust storms and soil erosion on tilled summer fallow in the Inland Pacific Northwest. This study compared the profitability of the undercutter method of summer fallow farming (conservation tillage) and traditional intensive tillage summer fallow. Based on a large case farm in Adams County, WA that had used both systems, the undercutter system outearned the traditional tillage system by $3.31 per two acres (fallow year and winter wheat year). The profit advantage was due to modest production cost savings as yields and wheat prices were the same for both systems. Adding conservation payments, net returns over total costs were $23.71 per two acres higher for the undercutter system.

This farm case study indicates that adopting a soil conserving undercutter tillage fallow system can be accomplished while increasing net returns. Diminished wind erosion with this system would protect public health and the environment in downwind areas. If conservation payments are available, profitability could be further increased relative to traditional fallow and thereby motivate adoption. It should be noted that the annual conservation payment of $20.40/2 acres assumed in this study case is still less then one fourth the typical annual Conservation Reserve Program rents in Adams County. Current USDA funding is insufficient for conservation payments of this magnitude for all farmers in the study area. However, in summer 2006 the Washington Association of Wheat Growers (WAWG) secured a $905,000 federal grant to provide a 50% cost-share for providing V-sweep undercutters to 50 wheat growers in the less than 12 inch precipitation zone. The program will extend to summer 2009 and include 14 counties in Washington and Oregon. The results of the case study in this bulletin indicate that this

WAWG program should have good chance of economic success for participating growers.

Future research should measure the precise reduction in dust emissions with the undercutter and other conservation fallow systems. These emission predictions will permit comparing the cost effectiveness (taxpayer cost per unit of dust abated) of these fallow systems to other conservation programs. This information could facilitate acquisition of additional funding to encourage adoption of conservation tillage practices by farmers in the WW-SF region of the Inland Pacific Northwest.

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Appendix

Budget Table

TABLE A1. ITEMIZED COST PER ACRE FOR SUMMER FALLOW, UNDERCUTTER METHOD, RITZVILLE, WA, 2005

	UNIT	PRICE OR COST/UNIT	QUANTITY	VALUE OR COST	YOUR FARM
VARIABLE COSTS		$		$	
GLYPHOSATE	OZ	.13	14.00	1.76	________
SURFACTANT	GAL	13.00	.05	.65	________
AMM.SULFATE	LB	1.10	.65	.72	________
GLYPHOSATE	OZ	.13	2.00	.25	________
AQUA-NITROGEN	LB	.34	50.00	17.00	________
SULFER	LB	.36	5.00	1.80	________
MACHINERY FUEL/LUBE†	ACRE	5.03	1.00	5.03	________
MACHINERY REPAIRS*†	ACRE	2.39	1.00	2.39	________
LABOR(TRAC/MACH)	HOUR	15.00	.21	3.22	________
OVERHEAD	ACRE	5.00	1.00	5.00	________
INTEREST ON OP. CAP.	ACRE	1.25	1.00	1.25	________

TOTAL VARIABLE COST				39.08	________
FIXED COSTS		$		$	
MACHINE DEPRECIATION*	ACRE	1.75	1.00	1.75	________
MACHINE INTEREST*	ACRE	5.05	1.00	5.05	________
MACHINE INSURANCE*	ACRE	.38	1.00	.38	________
MACHINE TAXES*	ACRE	1.14	1.00	1.14	________
MACHINE HOUSING*	ACRE	.63	1.00	.63	________
LAND TAX	ACRE	5.33	1.00	5.33	________

TOTAL FIXED COST				14.28	________
TOTAL COST				53.36	________

†INCLUDING TRACTORS.

*INCLUDING BUILDINGS, TOOLS AND TANKS.

TABLE A2. SCHEDULE OF OPERATIONS AND ESTIMATED COSTS PER ACRE FOR SUMMER FALLOW, UNDERCUTTER METHOD, RITZVILLE, WA, 2005

							VARIABLE COST						
OPERATION	TOOLING	MTH YEAR	MACH HOURS	LABOR HOURS	TOTAL FIXED COST	FUEL, LUBE, & REPAIRS	MACH LABOR	SERVICE	MATER.	INTER.	TOTAL VARIABLE COST	TOTAL COST
					$	$	$	$	$	$	$	$
UNDERCUT AT 2"	85E CHLNGR, 32' UNDERCUTTER	AUG 2003	.01	.01	.20	.40	.17	.00	.00	.01	.58	.78
RIP	85E CHLNGR, 22' RIPPER	NOV 2003	.03	.03	.81	1.08	.48	.00	.00	.09	1.65	2.46
SPRAY ONE	45 CHLNGR, 90' SPRAYER	MAR 2004	.01	.01	.38	.28	.20	.00	3.13(1)	.14	3.75	4.13
SPRAY TWO	45 CHLNGR, 90' SPRAYER	APR 2004	.00	.00	.08	.06	.04	.00	.25(2)	.01	.36	.43
UNDERCUT &FERTIL	85E CHLNGR, 32' UNDERCUTTER	APR 2004	.07	.08	1.60	2.72	1.25	.00	18.80(3)	.74	23.51	25.11
ROD WEED ONE	45 CHLNGR, 70' RODWEEDER	MAY 2004	.03	.03	.58	.65	.43	.00	.00	.03	1.11	1.69
ROOD WEED TWO	45 CHLNGR, 70' RODWEEDER	JUN 2004	.03	.03	.58	.65	.43	.00	.00	.02	1.10	1.69
ROD WEED THREE	45 CHLNGR, 70' RODWEEDER	JUL 2004	.01	.01	.29	.32	.22	.00	.00	.01	.55	.84
MISC. USE	MACHINE SHED & SHOP BUILDING	ANN 2004	.00	.00	3.53	1.03	.00	.00	.00	.03	1.06	4.59
MISC. USE	SHOP TOOLS	ANN 2004	.00	.00	.58	.16	.00	.00	.00	.01	.16	.74
MISC. USE	FUEL & MISCELLANEOUS TANKS	ANN 2004	.00	.00	.32	.09	.00	.00	.00	.00	.09	.41
LAND TAX	LAND TAX	ANN 2004	.00	.00	5.33	.00	.00	.00	.00	.00	.00	5.33
OVERHEAD	UTILITIES, LEGAL, ACCT., ETC.	ANN 2004	.00	.00	.00	.00	.00	5.00	.00	.16	5.16	5.16
TOTAL PER ACRE			.18	.21	14.28	7.42	3.22	5.00	22.18	1.25	39.08	53.36

MATERIALS:
1. 14 OZ. GLYPHOSATE ($1.76/AC), 0.05 GAL. SURFACTANT ($0.65/AC), 8 OZ. AMM.SULFATE ($0.72/AC)
2. 2 OZ. GLYPHOSATE ($0.25/AC)
3. 50 LBS. AGUA-NITROGEN ($17/AC), 5 LBS. SULFUR ($1.80/AC)

TABLE A3. ITEMIZED COST PER ACRE FOR SOFT WHITE WINTER WHEAT AFTER SUMMER FALLOW, UNDERCUTTER METHOD, RITZVILLE, WA, 2005

	UNIT	PRICE OR COST/UNIT	QUANTITY	VALUE OR COST	YOUR FARM
VARIABLE COSTS		$		$	
S.W. WHEAT SEED	LB	.13	40.00	5.32	________
PHOSPHORUS	LB	.49	10.00	4.90	________
2,4-D	OZ	.14	10.00	1.38	________
OLYMPUS	OZ	10.50	.45	4.73	________
SURFACTANT	GAL	13.00	.05	.65	________
RENT HRVST COMB	ACRE	11.98	1.00	11.98	________
INSURANCE WWSF	ACRE	6.00	1.00	6.00	________
MACHINERY FUEL/LUBE†	ACRE	6.16	1.00	6.16	________
MACHINERY REPAIRS*†	ACRE	1.83	1.00	1.83	________
LABOR(TRAC/MACH)	HOUR	15.00	.29	4.33	________
OVERHEAD	ACRE	5.00	1.00	5.00	________
INTEREST ON OP. CAP.	ACRE	1.05	1.00	1.05	________
TOTAL VARIABLE COST				53.33	________
FIXED COSTS		$		$	
MACHINE DEPRECIATION*	ACRE	1.80	1.00	1.80	________
MACHINE INTEREST*	ACRE	5.45	1.00	5.45	________
MACHINE INSURANCE*	ACRE	.41	1.00	.41	________
MACHINE TAXES*	ACRE	1.23	1.00	1.23	________
MACHINE HOUSING*	ACRE	.68	1.00	.68	________
SF+INTEREST	ACRE	57.63	1.00	57.63	________
LAND TAX	ACRE	5.33	1.00	5.33	________
LAND RENT**	ACRE	29.43	1.00	29.43	________
TOTAL FIXED COST				101.97	________
TOTAL COST				155.30	________

†INCLUDING TRACTORS.

*INCLUDING BUILDINGS, TOOLS AND TANKS.

** 1/3 CROP – 1/3 FERTILIZER COSTS – 1/3 CROP INSURANCE – 2 YR LAND TAXES.

WHEAT YIELD IS 46 BU/AC.
FIVE AVERAGE FARM GATE PRICE OF WHEAT IS $3.32/BU.

TABLE A4. SCHEDULE OF OPERATIONS AND ESTIMATED COSTS PER ACRE SOFT WHITE WINTER WHEAT AFTER SUMMER FALLOW, UNDERCUTTER METHOD, RITZVILLE, WA, 2005

OPERATION	TOOLING	MTH	YEAR	MACH HOURS	LABOR HOURS	TOTAL FIXED COST	VARIABLE COST: FUEL, LUBE, & REPAIRS	MACH LABOR	SERVICE	MATER.	INTER.	TOTAL VARIABLE COST	TOTAL COST
						$	$	$	$	$	$	$	$
SEED & FERTILIZE	85E CHLNGR, 48' IH DRILL 7100	SEP	2004	.07	.09	1.81	2.63	1.34	.00	10.22(1)	.08	14.27	16.08
SPRAY ONE	45 CHLNGR, 90' SPRAYER	MAR	2005	.01	.01	.38	.28	.20	.00	6.76(2)	.27	7.51	7.90
HARVST RENT COMB	JD 9760STS COMBINE (RENTED)	JUL	2005	.00	.07	.00	1.49	.99	11.98	.00	.24	14.70	14.70
HAUL WHEAT	85E CHLNGR, GRAINCART	JUL	2005	.05	.06	1.02	1.71	.90	.00	.00	.04	2.65	3.67
HAUL WHEAT	HARVEST TRUCK	JUL	2005	.05	.06	1.93	.61	.90	.00	.00	.02	1.53	3.46
SUMMER FALLOW	SUMMER FALLOW COST + INTEREST	ANN	2005	.00	.00	57.63	.00	.00	.00	.00	.00	.00	57.63
CROP INSURANCE	CROP INSURANCE	ANN	2005	.00	.00	.00	.00	.00	6.00	.00	.20	6.20	6.20
MISC. USE	MACHINE SHED & SHOP BUILDING	ANN	2005	1.00	.00	3.53	1.03	.00	.00	.00	.03	1.06	4.59
MISC. USE	SHOP TOOLS	ANN	2005	1.00	.00	.58	.16	.00	.00	.00	.01	.16	.74
MISC. USE	FUEL & MISCELLANEOUS TANKS	ANN	2005	1.00	.00	.32	.09	.00	.00	.00	.00	.09	.41
LAND TAX	LAND TAX	ANN	2005	.00	.00	5.33	.00	.00	.00	.00	.00	.00	5.33
LAND RENT	LAND RENT (OPPORTUNITY COST)	ANN	2005	.00	.00	29.43	.00	.00	.00	.00	.00	.00	29.43
OVERHEAD	UTILITIES, LEGAL, ACCT., ETC.	ANN	2005	.00	.00	.00	.00	.00	5.00	.00	.16	5.16	5.16
TOTAL PER ACRE				3.18	.29	101.97	7.98	4.33	22.98	16.98	1.05	53.33	155.30

MATERIALS:

1. 40 LBS. SWWW. SEED ($5.32/AC), 10 LBS. PHOSPHORUS ($4.90/AC)
2. 10 OZ. LV-6 (2,4-D ESTER) ($1.38/AC), 0.45 OZ. OLYMPUS ($4.73/AC), 0.05 GAL. SURFACTANT ($0.65/AC)

TABLE A5. ITEMIZED COST PER ACRE FOR SUMMER FALLOW, TRADITIONAL METHOD, RITZVILLE, WA, 2005

	UNIT	PRICE OR COST/UNIT	QUANTITY	VALUE OR COST	YOUR FARM
VARIABLE COSTS		$		$	
GLYPHOSATE	OZ	.13	14.00	1.76	________
SURFACTANT	GAL	13.00	.05	.65	________
AMM.SULFATE	LB	1.10	.65	.72	________
AQUA-NITROGEN	LB	.34	50.00	17.00	________
SULFUR	LB	.36	5.00	1.80	________
MACHINERY FUEL/LUBE†	ACRE	5.92	1.00	5.92	________
MACHINERY REPAIRS*†	ACRE	2.41	1.00	2.41	________
LABOR(TRAC/MACH)	HOUR	15.00	.23	3.45	________
OVERHEAD	ACRE	5.00	1.00	5.00	________
INTEREST ON OP. CAP.	ACRE	1.07	1.00	1.07	________
TOTAL VARIABLE COST				39.78	________
FIXED COSTS		$		$	
MACHINE DEPRECIATION*	ACRE	2.30	1.00	2.30	________
MACHINE INTEREST*	ACRE	6.28	1.00	6.28	________
MACHINE INSURANCE*	ACRE	.47	1.00	.47	________
MACHINE TAXES*	ACRE	1.41	1.00	1.41	________
MACHINE HOUSING*	ACRE	.79	1.00	.79	________
LAND TAX	ACRE	5.33	1.00	5.33	________
TOTAL FIXED COST				16.57	________
TOTAL COST				56.35	________

†INCLUDING TRACTORS.

*INCLUDES BUILDINGS, TOOLS AND TANKS.

TABLE A6. SCHEDULE OF OPERATIONS AND ESTIMATED COSTS PER ACRE FOR SUMMER FALLOW, TRADITIONAL METHOD, RITZVILLE, WA, 2005

							VARIABLE COST						
OPERATION	TOOLING	MTH	YEAR	MACH HOURS	LABOR HOURS	TOTAL FIXED COST	FUEL, LUBE, & REPAIRS	MACH LABOR	SERVICE	MATER.	INTER.	TOTAL VARIABLE COST	TOTAL COST
						$	$	$	$	$	$	$	$
UNDERCUT AT 2"	85E CHLNGR, 32' UNDERCUTTER	AUG	2003	.01	.01	.20	.40	.17	.00	.00	.01	.58	.78
RIP	85E CHLNGR, 22' RIPPER	NOV	2003	.03	.03	.81	1.08	.48	.00	.00	.09	1.65	2.46
SPRAY ONE	45 CHLNGR, 90' SPRAYER	MAR	2004	.01	.01	.38	.28	.20	.00	3.13(1)	.14	3.75	4.13
CULTIVATE ONE	85E CHLNGR, 52' JD CULTIVATOR	MAR	2004	.04	.04	1.75	1.53	.66	.00	.00	.08	2.27	4.03
CULTIVATE TWO	85E CHLNGR, 52' JD CULTIVATOR	APR	2004	.04	.04	1.75	1.53	.66	.00	.00	.07	2.26	4.01
FERTILIZE	85E CHLNGR, 60' CULTER WEEDER	JUN	2004	.03	.04	1.04	1.26	.63	.00	18.80(2)	.45	21.14	22.18
ROD WEED ONE	45 CHLNGR, 70' RODWEEDER	JUN	2004	.03	.03	.58	.65	.43	.00	.00	.02	1.10	1.69
ROD WEED TWO	45 CHLNGR, 70' RODWEEDER	JUL	2004	.01	.01	.29	.32	.22	.00	.00	.01	.55	.84
MISC. USE	MACHINE SHED & SHOP BUILDING	ANN	2004	1.00	.00	3.53	1.03	.00	.00	.00	.03	1.06	4.59
MISC. USE	SHOP TOOLS	ANN	2004	1.00	.00	.58	.16	.00	.00	.00	.01	.16	.74
MISC. USE	FUEL & MISCELANEOUS TANKS	ANN	2004	1.00	.00	.32	.09	.00	.00	.00	.00	.09	.41
LAND TAX	LAND TAX	ANN	2004	.00	.00	5.33	.00	.00	.00	.00	.00	.00	5.33
OVERHEAD	UTILITIES, LEGAL, ACCT., ETC.	ANN	2004	.00	.00	.00	.00	.00	5.00	.00	.16	5.16	5.16
TOTAL PER ACRE				3.20	.23	16.57	8.33	3.45	5.00	21.93	1.07	39.78	56.35

MATERIALS:

1. 14 OZ. GLYPHOSATE ($1.76/AC), 0.05 GAL. SURFACTANT ($0.65/AC), 8 OZ. AMM.SULFATE ($0.72/AC)
2. 50 LBS. AQUA-NITROGEN ($17/AC), 5 LBS. SULFUR ($1.80/AC)

TABLE A7. ITEMIZED COST PER ACRE FOR SOFT WHITE WINTER WHEAT AFTER SUMMER FALLOW, TRADITIONAL METHOD, RITZVILLE, WA, 2005

	UNIT	PRICE OR COST/UNIT	QUANTITY	VALUE OR COST	YOUR FARM
VARIABLE COSTS		$		$	
S.W. WHEAT SEED	LB	.13	40.00	5.32	________
PHOSPHORUS	LB	.49	10.00	4.90	________
LV-6	OZ	.14	10.00	1.38	________
OLYMPUS	OZ	10.50	.45	4.73	________
SURFACTANT	GAL	13.00	.05	.65	________
RENT HRVST COMB	ACRE	11.98	1.00	11.98	________
INSURANCE WWSF	ACRE	6.00	1.00	6.00	________
MACHINERY FUEL/LUBE†	ACRE	8.00	1.00	8.00	________
MACHINERY REPAIRS*†	ACRE	1.83	1.00	1.83	________
LABOR(TRAC/MACH)	HOUR	15.00	.29	4.33	________
OVERHEAD	ACRE	5.00	1.00	5.00	________
INTEREST ON OP. CAP.	ACRE	1.05	1.00	1.05	________
TOTAL VARIABLE COST				53.32	________
FIXED COSTS		$		$	
MACHINE DEPRECIATION*	ACRE	1.80	1.00	1.80	________
MACHINE INTEREST*	ACRE	5.45	1.00	5.45	________
MACHINE INSURANCE*	ACRE	.41	1.00	.41	________
MACHINE TAXES*	ACRE	1.23	1.00	1.23	________
MACHINE HOUSING*	ACRE	.68	1.00	.68	________
SF+INTEREST	ACRE	60.86	1.00	60.86	________
LAND TAX	ACRE	5.33	1.00	5.33	________
LAND RENT**	ACRE	29.52	1.00	29.52	________
TOTAL FIXED COST				105.29	________
TOTAL COST				158.61	________

†INCLUDING TRACTORS.

*INCLUDING BUILDINGS, TOOLS AND TANKS.

** 1/3 CROP – 1/3 FERTILIZER COSTS – 1/3 CROP INSURANCE – 2 YR LAND TAXES.

WHEAT YIELD IS ASSUMED TO BE 46.0 BUSHELS.
FIVE AVERAGE FARM GATE PRICE OF WHEAT IS $3.32/BUSHEL.

TABLE A8. SCHEDULE OF OPERATIONS AND ESTIMATED COSTS PER ACRE SOFT WHITE WINTER WHEAT AFTER SUMMER FALLOW, TRADITIONAL METHOD, RITZVILLE, WA, 2005

OPERATION	TOOLING	MTH	YEAR	MACH HOURS	LABOR HOURS	TOTAL FIXED COST	VARIABLE COST: FUEL, LUBE, & REPAIRS	MACH LABOR	SERVICE	MATER.	INTER.	TOTAL VARIABLE COST	TOTAL COST
						$	$	$	$	$	$	$	$
SEED & FERTILIZE	85E CHLNGR, 48' IH DRILL 7100	SEP	2004	.07	.09	1.81	2.63	1.34	.00	10.22(1)	.08	14.26	16.07
SRAY ONE	45 CHLNGR, 90' SPRAYER	MAR	2005	.01	.01	.38	.28	.20	.00	6.76(2)	.27	7.51	7.90
HARVST RENT COMB	JD 9760STS, COMBINE (RENTED)	JUL	2005	.00	.07	.00	1.49	.99	11.98	.00	.24	14.70	14.70
HAUL WHEAT	85E CHLNGR, GRAINCART	JUL	2005	.05	.06	1.02	1.71	.90	.00	.00	.04	2.65	3.67
HAUL WHEAT	HARVEST TRUCK	JUL	2005	.05	.06	1.93	.61	.90	.00	.00	.02	1.53	3.46
SUMMER FALLOW	SUMMER FALLOW COST + INTEREST	ANN	2005	.00	.00	60.86	.00	.00	.00	.00	.00	.00	60.86
CROP INSURANCE	CROP INSURANCE	ANN	2005	.00	.00	.00	.00	.00	6.00	.00	.20	6.20	6.20
MISC. USE	MACHINE SHED & SHOP BUILDING	ANN	2005	1.00	.00	3.53	1.03	.00	.00	.00	.03	1.06	4.59
MISC. USE	SHOP TOOLS	ANN	2005	1.00	.00	.58	.16	.00	.00	.00	.01	.16	.74
MISC. USE	FUEL & MISCELLANEOUS TANKS	ANN	2005	1.00	.00	.32	.09	.00	.00	.00	.00	.09	.41
LAND TAX	LAND TAX	ANN	2005	.00	.00	5.33	.00	.00	.00	.00	.00	.00	5.33
LAND RENT	LAND RENT (OOPORTUNITY COST)	ANN	2005	.00	.00	29.52	.00	.00	.00	.00	.00	.00	29.52
OVERHEAD	UTILITIES, LEGAL, ACCT., ETC.	ANN	2005	.00	.00	.00	.00	.00	5.00	.00	.16	5.16	5.16
TOTAL PER ACRE				3.18	.29	105.29	8.00	4.33	22.98	16.98	1.05	53.32	158.61

MATERIALS:

1. 40 LBS. SWWW SEED ($5.32/AC), 10 LBS. PHOSPHORUS ($4.90/AC)
2. 10 OZ. LV-6 (2,4-D ESTER) ($1.38/AC), 0.45 OZ. OLYMPUS ($4.73/AC), 0.05 GAL. SURFACTANT ($0.65/AC)

TABLE A9. PER HOUR AND PER ACRE MACHINERY COSTS, UNDERCUTTER AND TRADITIONAL TILLAGE, RITZVILLE, WA, 2005

MACHINERY	PURCHASE PRICE	YEARS TO TRADE	ANNUAL HOURS	DEPREC-IATION	INTER-EST	INSUR-ANCE	TAXES	HOUSING	TOTAL FIXED COST	REPAIR	FUEL AND LUBE	TOTAL VARIABLE COST	TOTAL COST
	$			COST PER HOUR									
85E CHALL. 375HP	140,000.00	10	1200	4.58	7.50	.56	1.69	.94	15.27	1.40	32.06	33.46	48.73
45 CHALLEN 200HP	75,000.00	10	700	4.29	6.86	.51	1.54	.86	14.06	.75	21.37	22.12	36.18
30'JD2200 CULTIV	32,000.00	15	132	6.06	15.76	1.18	3.55	1.97	28.52	4.81	.00	4.81	33.33
IH 7100,48'DRILL	22,000.00	30	225	1.48	6.04	.45	1.36	.76	10.09	3.31	.00	3.31	13.40
HARVEST TRUCK	25,000.00	20	72	6.94	22.22	1.67	5.00	2.78	38.61	1.50	10.69	12.19	50.80
GRAIN CART	13,000.00	12	300	.83	3.07	.23	.69	.38	5.20	.65	.00	.65	5.85
CALKINS TANKCART	5,500.00	20	158	.63	2.28	.17	.51	.28	3.88	.82	.00	.82	4.70
60'CULTER WEEDER	18,000.00	25	119	2.69	9.41	.71	2.12	1.18	16.10	4.49	.00	4.49	20.59
CALKINS RODWEEDR	15,600.00	25	216	.67	5.11	.38	1.15	.64	7.95	2.34	.00	2.34	10.29
22'RIPPER	24,000.00	15	201	2.99	7.76	.58	1.75	.97	14.04	5.99	.00	5.99	20.03
90' SPRAYER 2005	23,000.00	10	144	5.56	10.56	.79	2.38	1.32	20.60	3.44	.00	3.44	24.04
32' UNDERCUTTER	13,000.00	20	298	.67	2.95	.22	.66	.37	4.88	6.50	.00	6.50	11.38
			ACRES COVERED	COST PER ACRE									
FARM BUILDING	300,000.00	50	>5000	.46	2.15	.16	.48	.27	3.53	1.03	.00	1.03	4.56
SHOP TOOLS	45,000.00	30	>5000	.12	.32	.02	.07	.04	.58	.16	.00	.16	.73
FUEL &MISC TANKS	25,000.00	30	>5000	.06	.18	.01	.04	.02	.32	.09	.00	.09	.41

Table A10: Input and Commodity Price List, 2005.

Material	Unit	Price ($/unit)
Seed[1]		
Soft white winter wheat, certified	Pound	0.133
Chemicals[2]		
Ammonia sulfate	Pound	1.10
Aqua – nitrogen	Pound	0.34
Phosphorus (P_2O_5)	Pound	0.49
Sulfur (S)	Pound	0.36
Glyphosate	Ounce	0.126
2,4-D, LV-6	Ounce	0.138
Olympus	Ounce	10.50
Surfactants	Gallon	13.00
Other Costs[3]		
Diesel[4]	Gallon	1.94
Interest rate	Percent	8.00
Machinery labor	Hour	15.00
Crop insurance	Acre	6.00
Land tax	Acre	5.33
Combine rental	Acre	11.98
Commodity Prices (5-year average)		
Soft White Winter Wheat[5]	Bushel	3.32
Conservation Payment	$/2 Ac/Yr	20.40

[1]Seed price was provided by the case-study farmer.

[2]Chemical input prices were supplied by the case-study farmer.

[3]Cost of crop insurance and land tax were provided by the case-study farmer.

[4]Excluding road taxes.

[5]Five-year (2001-2005) average farm gate price of wheat from Lind, WA Union Elevator.