

RESEARCH PROJECT TITLE: Strategies for Profitable Conservation Tillage Farming in the Pacific Northwest

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FINAL REPORT

PROJECT OBJECTIVES:

1. To evaluate the economic feasibility of oil seeds, food legumes, and spring grains in conservation tillage crop rotations.
2. To identify equitable farmland leases for conservation tillage farming systems.
3. To assess the potential for precision weed control to cut costs in conservation tillage.
4. To identify effective financial risk management strategies for adopting conservation tillage.
5. To disseminate the results on profitable strategies for conservation farming to growers, policy makers and others.

KEY WORDS: Conservation tillage, crop rotations, economics, risk

STATEMENT OF PROBLEM: The STEEP advisory committee communicated several research priorities for fiscal year 2002 proposals which relate to concerns about the economic viability of conservation tillage systems. These include the feasibility of various alternative crops, strategies for improving farmland leases, and concerns about grass weed control costs. Surveys also show growers are worried about the financial risks of no-till drill acquisition. This project will provide economic analysis on all four of these issues. Long term collaboration between the PI and scientist cooperators ensures that economic results will be based on a foundation of quality biological and physical data. This collaboration will improve the value of the results to the region's farmers. Responding to growers' priority research requests on key barriers to adoption of conservation tillage in the Pacific Northwest (PNW) will reduce the long run economic and environmental losses from soil erosion in the region.

ZONE OF INTEREST: Dryland farming agro-climatic zones with 10- 22 in/yr av. ppt.

ABSTRACT OF RESEARCH FINDINGS: No-till continuous spring grains are clearly an environmental success. They are predicted to cut dust emissions during severe events by 94% compared to winter wheat-fallow (WW-F). However, no-till hard red spring wheat (HRSW) at Ralston and at the Horse Heaven Hills has lagged WW-F by about \$40/ac. These soil saving systems have also had more economic risk. No-till rotations with soft white spring wheat (SWSW) at Ritzville also lagged WW-F in profitability over 1997-2004. Profitability rankings based on two years data of six direct-seeded 3-year rotations at the Cunningham Farm in Pullman showed only hard red spring wheat-hard red winter wheat-winter barley earned positive returns over total costs. Survey results showed that farmers operating larger farms and with more wheat were more likely to perceive landlords as opposed to direct-seeding or intensive spring cropping.

Farmers were more pessimistic regarding landlords' acceptance of direct-seeding than were landlords themselves, possibly due to landlords' reluctance to adjust rental rates for direct-seeding. Modeling showed speed of adoption had a larger effect on successful financial transition to no-till than did the drill acquisition method. For large farmers, rapid purchase of a no-till drill was effective. Early custom or rental drill acquisition are recommended for small farmers. A site-specific herbicide decision model for winter wheat boosted projected profitability by 65% compared to other recommendations. The estimated \$2.43/ac cost for using the weed decision model could be absorbed by the model's projected profitability advantage \$16/ac over farmer applications. However, the costs of weed monitoring and adjusting herbicide application might be higher in real world conditions. Other analysis showed that reducing replications of a field experiment would have altered economic rankings of different cropping systems less than cutting the duration of the experiment or failing to plant all crops in a rotation each year.

RESULTS AND INTERPRETATION:

Objective 1. To evaluate the economic feasibility of oil seeds, food legumes, and spring grains in conservation tillage crop rotations. No-till continuous spring grains are clearly an environmental success. Modeling has indicated that these systems can reduce predicted dust emissions during severe wind events by 94% compared to traditional winter wheat-fallow (WW-F). However, no-till hard red spring wheat (HRSW) at Ralston and at the Horse Heaven Hills have lagged WW-F by about \$40/ac and have shown more economic variability. No-till spring crop rotations with soft white spring wheat (SWSW) at Ritzville were the most profitable among annual no-till rotations, but still showed considerable year-to-year risk. Furthermore, during the entire 1997-2004 period, the SWSW systems failed to match the profitability of conventional tillage WW-F. Safflower and yellow mustard in a no-till rotation with SWSW at Ritzville were less profitable than continuous SWSW.. It appears that the threshold in terms of average annual precipitation for successful annual cropping is somewhere above the 11 to 12 inch levels examined in experimental sites at Ritzville and Ralston in Adams County.

An evaluation was provided, based on data available to date, of the profitability of six 3-year rotations grown under direct seeding at the Cunningham Agronomy Farm, Pullman, Washington. Field Experiments were established in fall 2000 in a 19-21 inch rainfall zone. Hard red spring wheat (HRSW) and hard red winter wheat (HRWW) were always the first-year and second-year crops followed by six different alternative crops. Alternative crops were: Winter barley (WB), spring barley (SB), winter peas (WP), spring peas (SP), winter canola (WC), and spring canola (SC). The spring canola was Roundup Ready. All six complete rotations were grown every year to accurately reflect a producer's annual income from a diversified rotation. Rotational crops were not replicated within years. The available crop yields from 2002 and 2003 were used in this preliminary report. Table 1 summarizes net returns by crop rotation based on average crop prices. HRSW-HRWW-WB averaged the highest net returns over total costs of \$3.38 per rotational acre (Table 1). The two rotations with lowest average net returns per rotational acre, HRSW-HRWW-SP and HRSW-HRWW-WC, both had alternative crops that were not harvested in 2002. These economic results are preliminary as they are based on only two years data.

<p>Table 1, Average Net Returns Per Rotational Acre for 2001-2002 and 2002-2003 Crop Years, Cunningham Farm, Pullman, WA</p>
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<u>Rotation</u>	<u>\$/Rotational Acre</u>
HRSW-HRWW-WB	3.38
HRSW-HRWW-SB	-2.62
HRSW-HRWW-WP	-8.54
HRSW-HRWW-SP*	-20.58
HRSW-HRWW-WC*	-53.24
HRSW-HRWW-SC	-7.01
HRSW-Hard Red Spring Wheat, HRWW-Hard Red Winter Wheat, WB-Winter Barley, SB-Spring Barley, WP-Winter Peas, SP-Spring Peas, WC-Winter Canola, SC-Spring Canola * No harvest of third crop in 2001-2002.	

Other research on conservation cropping systems was conducted during the PI's professional leave with Agriculture and Agri-Food Canada in Lethbridge, Alberta during 2003-2004. The U.S. Great Plains, the U.S. Corn Belt and the Canadian Prairies all have a higher proportion of conservation tillage than the U.S. Pacific Northwest. For example, Saskatchewan, Canada's leading wheat producing province, quadrupled no-till during 1991-2001, with 39% of the total cropland under the practice by 2001. In contrast, Washington farmers were no-tilling only 8% of cropland by 2000 based on statistics from the Conservation Tillage Information Center. Nationwide, U.S. no-till adoption, which is dominated by the Corn Belt and the Great Plains, reached 17.5% in 2000. Over 30% of Canadian cropland is no-tilled.

Canada has profitably incorporated broadleaf oilseeds and pulses into rotations with no-till spring wheat. Indeed, canola sometimes "carries" spring wheat economically in Canada, whereas winter wheat is the economic mainstay in the U.S. Pacific Northwest. Pulses have also moved northward and eastward. Until the late 1970's, eastern Washington and northern Idaho dominated the North American lentil market. Since then much of the acreage for this desirable rotation crop has expanded to the Canadian prairies and, in recent years, also to North Dakota. Canadian farmers and scientists attribute part of their success with no-till to the use of agronomically beneficial and profitable broadleaf crops in rotation with cereals. Canadians have adapted cultural practices appropriate to their conditions, such as swathing prior to harvesting. They have also been successful in breeding varieties adapted to their conditions and now are reaping cost savings with GMO ("Roundup ready") canola. Canada's success with conservation tillage in diversified crop rotations reinforces the incentives for research to develop or identify alternative crops and cultural practices for no-till adapted to Pacific Northwest conditions.

Objective 2. To identify equitable farmland leases for conservation tillage farming systems. Data for this study of leasing influences on conservation tillage farming came from an exploratory survey of participants attending field days and farm meetings in Benton, Lincoln, and Whitman Counties in Washington. The sample included 27 completed one-page questionnaires from farmer-tenants and 11 from landlords. Logit regression analysis was used to statistically measure how closely the different farm and farmer characteristics were related to the farmers' perceptions of how supportive landlords were of no-till. Statistical analysis of survey results showed that farmers operating larger acreages and with more wheat were more likely to perceive landlords to be opposed to no-till or intensive spring cropping. Not surprisingly, farmers with a cash lease were more likely to perceive landlords to support no-till and spring cropping. Producer's education and percent of farm rented were negatively associated with perceptions of landlord

supportiveness of no-till; however, they both displayed very low levels of statistical significance. Type of lease (cash or crop share) and percent of farm rented from relatives responded positively to landlord encouraging no-till, but the latter was not statistically significant.

Seventy two percent of the 11 surveyed landlords favored no-till as an advantageous practice while 28% of the landlords considered no-till as a disadvantageous practice. Of landlords considering no-till as advantageous, about 75% reported that one of the primary benefits of more intensive rotations or no-till was “erosion control.” Interestingly 67% of those viewing no-till as disadvantageous also reported erosion control as an advantage, but felt that “risk” and “weed infestation” made more intensive rotations or no-till unappealing. Based on survey responses, farmers were more pessimistic regarding landlords’ acceptance of no-till than were landlords themselves, possibly due to landlords’ reluctance to adjust rental rates for no-till farmers.

Earlier analysis confirmed that flexible share leases which adjusted landlords’ and tenants’ crop shares proportionate to resource contributions provided appropriate incentives for farmers wishing to move to more intensive spring cropping under no-till. Such flexibility was not always found in our survey data.

Objective 3. To assess the potential for precision weed control to cut costs in conservation tillage.

A computerized site-specific herbicide decision model for winter wheat proved easy to use and showed potential to increase profit while reducing postemergence grass herbicides, but not broadleaf herbicides, in the eastern Palouse study region. The model increased broadleaf herbicide rates by an average of 0.45 to 0.91 label rates compared to competing recommendations, but reduced the more expensive grass herbicides by an average of 0 to 1.0 label rates, depending on conditions. The projected costs of weed control using the model were slightly higher than for the farmer and extension recommendations, but much lower than for the weed scientist and label rate recommendations. On average, the model recommendations boosted projected profitability (which accounted for yield and revenue increases as well as cost changes) by 65% compared to the farmer, extension consultant, weed scientist and label rate recommendations. The estimated \$2.43/ac cost for using the weed decision model could be easily absorbed by the model’s projected profitability advantage \$16/ac over farmer applications. However, the costs of weed monitoring and adjusting herbicide application to irregular subfields might be higher in real world conditions. More research and field testing is needed to develop cost effective procedures for monitoring weed densities and other site characteristics and for adjusting herbicides to subfield management units.

Other research based on a multi-year large experiment examined cost-effective experimental designs for field research. Downsizing the replications of the field experiment altered economic rankings of different cropping systems less than cutting the duration of the experiment. However, failing to plant all crops in a rotation each year altered economic rankings the most. Estimates of system profit variability, and associated economic rankings, were especially sensitive to downsizing experiment length and to failing to plant all crops in a rotation annually. Considering the degree of aversion to risk of farmers did not have a consistent effect on economic rankings. Despite the scientific importance of long duration full rotation experiments, short run publication pressures favoring “new data” and methodological innovations might discourage such rich experiments. On the positive side, some USDA-funded projects have provided long term funding to solve particular environmental and production priorities. Furthermore, some multi-disciplinary journals invite joint submissions from agricultural scientists and economists. These journals often welcome assessments of the risk, spatial adaptability, and social-environmental acceptability of

cropping systems. These preferences provide a favorable forum for long term research which includes risk assessments.

Objective 4. To identify effective financial risk management strategies for adopting conservation tillage. Analysis of a survey of nine successful long term no-till farmers in eastern Washington and northern Idaho revealed that they cut their costs and risks substantially by purchasing rather than renting no-till drills. Figure 1 displays the present cost of actual purchased and hypothetical rented drills by annual acres no-tilled for the sample of nine farms. The cost of a purchased drill includes down payments, principal payments, interest, property tax and repairs, net of tax savings versus a flat rental charge per acre for rented drills. In this sample, a cost advantage for purchased drills was observed for each farm. Figure 1 displays triangles representing the actual costs of surveyed no-till farmers who purchased their drills. These costs all fall below the higher rental cost line. The relative cost advantage of purchased drills increased with acres no-tilled. The survey data also showed that no-till farmers from low precipitation regions realized somewhat greater economies from drill ownership than those from the higher precipitation regions.

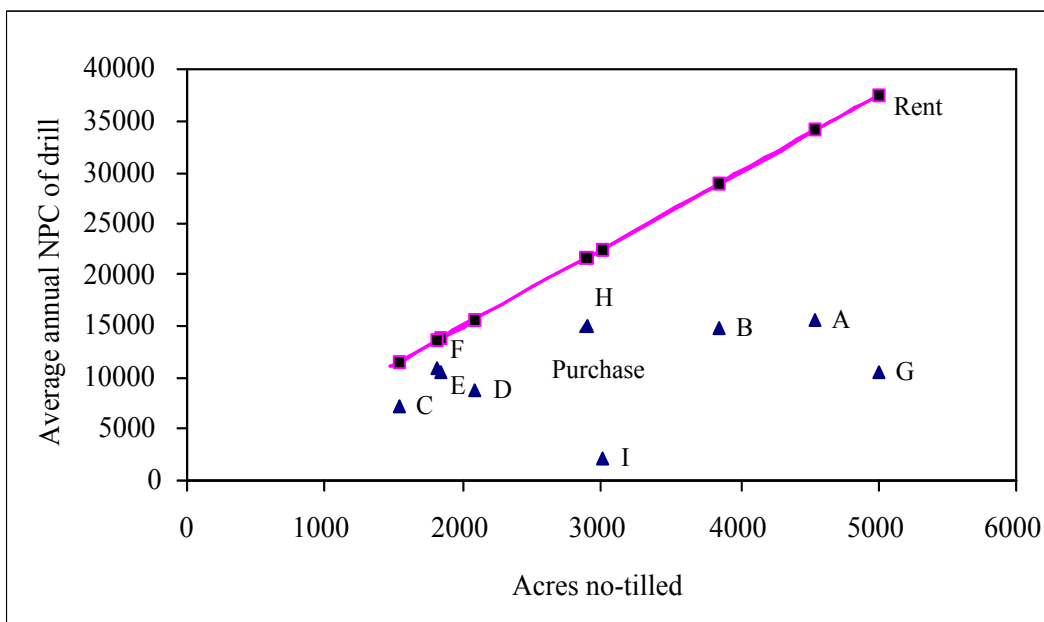


Figure 1. Relationship between annual cost of purchased and rented drills in the sample no-till farms. Note: Squares equal costs for rented drills. Triangles equal costs for purchased drills of surveyed farmers A through I.

New uses of the Simetar farm management risk simulation program developed at Texas A&M University provided additional measures of financial riskiness of different no-till transition strategies. These strategies involve combinations of rate of adoption of no-till over total farm acreage and different sequences of custom-rent-buy for no-till drill acquisition. The program was applied to eastern Palouse wheat-barley-pea farms of different sizes and equity structures. No-till was assumed to begin with a 10% yield penalty due to a “learning curve” associated with the technology. Required terminal no-till yield premiums (relative to conventional tillage) were computed for five drill investment strategies. Results were prepared for four types of farms using both long and short term criteria for shouldering risk. Strategies involving early purchase of the drill required lower no-till yield premiums with immediate adoption, but a higher yield premium

with gradual adoption. The reason is that an early purchased drill enjoys economies of scale (efficient machinery utilization) for immediate adoption, but inefficiencies for gradual adoption. Over many scenarios, gradual adoption requires a lower yield premium.

Yield premiums were generally larger when growers could withstand only a short period of risky negative returns. For farmers tolerant to risk over a longer period, late-occurring favorable cash flows could sometimes “bail them out” from earlier negative cash flows. Again, immediate purchase of a direct seed drill was less risky than custom or rental options for large farms which immediately converted to direct seeding. In contrast, high equity small farms could cut risk of investment failure by custom hiring drill services versus purchasing a drill at the outset when direct seeding was gradually adopted. When small farms adopted direct seeding immediately, the yield premium was about the same for purchase, rental, and custom options.

This study shows that regardless of farm type, speed of adoption has a larger effect on navigating the direct seeding transition successfully than does the drill acquisition method. If a farmer is still learning to make direct seeding work, go slow in acreage expansion. Not surprisingly, higher equity farmers require lower no-till yield premiums. If large farmers have the cash or financing, rapid purchase of a direct seed drill has a reasonable chance of success; however, gradual acreage expansion is still recommended until any yield penalty is eliminated. Small low equity farmers are at greatest risk. Farmers renting a high proportion of their cropland may want to wait until they can pay cash for a (possibly lower cost) direct seeding drill. Custom and rental drill acquisition in early years of the transition is recommended for small farmers, especially when they are adopting direct seeding immediately. Of course, farmers who are willing or able to wait longer periods for direct seeding to produce a positive cash flow will be less likely to give up on the practice. In this study, the assumption of an initial 10% initial yield penalty for direct seeding increased the yield premiums. Farmers who can master the direct seeding learning curve more quickly will require smaller yield premiums.

Objective 5. To disseminate the results on profitable strategies for conservation farming to growers, policy makers and others. We responded to requests for information from growers, newspapers and magazines. Examples include the *Capital Press* and *Pullman-Moscow Daily News*. One of our research reports was selected by the U.S. Certified Crop Advisors for their continuing education program. A major presentation on managing the risk of the no-till transition was made to over 700 participants at the 2003 Direct Seed Meetings in Pasco, WA. Ten reports on conservation economics topics were written for WSU’s *2004 Field Day Proceedings*. Our research has represented the only social science input in these widely disseminated proceedings. Reports of research results were also published in *Conservation Tillage Update*, *Wheat Life*, and in WSU Extension Bulletins. Many of these publications have been disseminated to growers, industry, and scientists in both hard copies and as Internet postings. Results of research on conservation cropping systems and cost-effective field research design were published in several professional journal articles. As a member of the Washington State NRCS Advisory Committee, the P.I. has presented input on a range of conservation policy issues including the EQIP and CRP programs. The P.I. also participated in and presented research results on several conservation economics topics in Alberta, Canada during a professional leave with Agriculture and Agri-Food Canada during 2003-2004.

INTERACTION (COOPERATION) WITH OTHER SCIENTISTS CONDUCTING

RELATED ACTIVITY: Adams County farmers Ron Jirava and Curtis Hennings and Benton County farmer Doug Rowell provided land for conservation farming experiments. These farmers

also provided valuable information on machinery use, production costs, crop performance, and farm programs in their areas. John Burns, WSU-Extension and Dennis Roe, NRCS, were particularly helpful in the selection of farmers who could provide information on the no-till transition. Several project cooperators also have provided data on no-till yield levels, yield variability, and input requirements. Drs. Bill Schillinger and Frank Young have been especially helpful in providing data from their long run no-till and min-till cropping systems at Lind and Ralston in Adams County. Drs. Dave Huggins and William Pan provided essential data and collaboration on N fertilization of hard red spring wheat. Drs. Frank Young and Tae-Jin Kwon also provided valuable data and collaboration for the site-specific weed management model. Dr. James Richardson, Texas A&M University, provided software for modeling the economic risk of no-till transition strategies. Drs. Elwin Smith and Mani Upadhyay of Agriculture and Agri-Food Canada collaborated on research on conservation economics. Dr. Dave Huggins provided valuable data and interpretation on the results of the Cunningham Farm trials. Dr. Frank Young provided data and collaboration related to experimental design for weed management experiments.

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