2004 STEEP PROGRESS REPORT

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

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INTERIM 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. Modeling has indicated that these systems can reduce predicted dust emissions during severe wind 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 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 showed equivalent average profitability with WW-F , but still exhibited more year-to-year risk.

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 at $3.38/ac.

Statistical analysis of new 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 farmers.

Analysis of data from a large duration weed management-conservation system experiment concluded that reducing replications would have 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 were especially sensitive to downsizing experiment length and to failing to plant all crops in a rotation annually.

A new risk measure confirmed that 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 had a reasonable chance of success. Early custom or rental drill acquisition are recommended for small farmers.

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 has shown more economic variability. No-till spring crop rotations with soft white spring wheat (SWSW) at Ritzville were more competitive with WW-F in terms of average profitability, but still showed more year-to-year risk. Safflower and yellow mustard in a no-till rotation with SWSW at Ritzville were less profitable than continuous SWSW. Similar average profitability between a no-till spring grains system and WW-SF is a very welcome result given the $40 shortfall in annual profitability shown in previous research comparisons of no-till HRSW to WW-SF. Detailed economic results of this no-till spring cropping research, which has been co-funded by STEEP and other projects, has been presented previously. Final economic results of the Horse Heaven Hills and Ritzville projects were published in 2004 both in *Agronomy Journal* and in extension outlets.

This report provides a new evaluation, 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. Both HRWW and HRSW were grown on approximately 30-acre parcels. Alternative crops were planted on (1/6) of the 30-acre parcel or approximately 5-acre parcels. 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 Cunningham Agronomy Farm uses full size machinery and large plots to represent

commercial farming conditions. Crop yields from 2002 and 2003 were used in this preliminary report. Crop yields from 2001 were not available.

Table 1 summarizes net returns (profitability) 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). Second was HRSW-HRWW-SB at -$2.62. HRSW-HRWW-SC and HRSW-HRWW-WP averaged -$7.01 and -$8.54, respectively. The fifth ranked rotation was HRSW-HRWW-SP at -$20.58. HRSW-HRWW-WC came in last at -$53.24. The two rotations with lowest average net returns per rotational acre, HRSW-HRWW-SP and HRSW-HRWW-WC, both had alterative crops that were not harvested in 2002.

Readers should regard these economic results as preliminary. They are based on only two years data and are subject to strong influence from atypical weather conditions and the early stage of the experiment during these two years. Future analysis might also provide a more precise measure of long run cropping system costs and income risk.

Table 1, Average Net Returns Per Rotational Acre for 2001-2002 and 2002-2003 Crop Years

Rotation	$/Rotational Acre
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 recent professional leave with Agriculture and Agri-Food Canada in Lethbridge, Alberta. Both the U.S. Great Plains and the Canadian Prairies have increased conservation tillage more than has 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 8% of cropland by 2000. 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 landlord and 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. Farmer perceptions of landlord influence on no-till adoption were ascertained by the question: (1) What do you feel are the main barriers, and/or encouragements which landlords represent with regard to switching to no-till, or to more intensive rotations, in your area? 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. The primary attitudinal question in the landlord questionnaire was: "What do you feel are the main advantages, and/or disadvantages, associated with your tenants switching either to no-till, or to more intensive rotations, on your cropland?" Responses to this question were then used to divide the small sample of 11 landlords between (1) those where no-till or intensive rotations' *advantages* predominated and (2) for those where *disadvantages* predominated**.**

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 had an unacceptable statistical significance levels.

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 or other sources.

Objective 3. To assess the potential for precision weed control to cut costs in conservation tillage. Previous research to determine economically optimal precision weed management in conservation cropping systems used results from a long duration field experiment administered by Frank Young. This research evolved into to determining cost-effective experimental designs for field research. Our published work on this topic concluded that downsizing the replications of a 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 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. 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 (per the GA criterion) 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 technology 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. The P.I. has responded to requests for information from growers, industry, newspapers and magazines as requested. Four reports on conservation economics topics were written for WSU's *2004 Field Day Proceedings.* These were disseminated to growers, industry, and scientists in the form of written abstracts and web postings of the complete reports. Results of research on conservation cropping systems and cost-effective field research design were published in three 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. Field travel in Canada was undertaken to gain a better understanding of soil, water, and air quality practices and policies throughout the country. One assignment was to provide input on the role of economics in multi-disciplinary conservation systems research. Agriculture and Agri-Food Canada personnel were visited at LaCombe, Alberta; Swift Current, Saskatchewan; Saskatoon, Saskatchewan; Brandon, Manitoba; Frederickton, New Brunswick; and Charlottetown, Prince Edward Island. Most visits involved a two-way exchange of information regarding the importance of economics input on soil, water, and air quality research and outreach. Visited centers had two or fewer economists per center, but agricultural scientists recognized the value of involving economists in order to focus scarce resources on areas of high payoff, to make recommendations palatable to farmers, and to secure support for extramural funding.

INTERACTION (COOPERATION) WITH OTHER SCIENTISTS CONDUCTING RELATED ACTIVITY: John Burns, WSU-Extension and Dennis Roe, USDA-NRCS, were particularly helpful in the selection of farmers who could provide information on the no-till transition. Dr. Bill Schillinger and Dr. Frank Young have provided crucial data and interpretation for their long run no-till and min-till cropping systems at Lind and Ralston in Adams County. Dr. Dave Huggins provided valuable data and interpretation of the results of the Cunningham Farm trials. Dr. Frank Young provided data and collaboration related to experimental design for weed management experiments.

PUBLICATIONS AND PRESENTATIONS:

STEEP (publications 5-8 were co-funded by STEEP and the Air Quality project)

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