Northwest Columbia Plateau PM_{10} Project

Objective 7: ***Evaluating the Profitability and Social Benefits of Alternative Farming Systems for Air Quality Control***

Title: ***Economics of Wind Erosion Control***

Personnel: *Principal Investigator:* ***Douglas Young, School of Economic Sciences, WSU, Emeritus;***
Cooperators: ***William Schillinger, Dept. of Crop and Soil Sciences, WSU; Stephen Machado, Steven Petrie, and Larry Pritchett, OSU; Harry Schafer, Washington Association of Wheat Growers; Brenton Sharratt, Frank Young, Ann Kennedy, Tim Paulitz, USDA-ARS, Pullman; Dennis Roe, WSU and USDA-NRCS retired.***

Abstract of Research Findings
Forty-seven growers in 10 Washington and Oregon counties agreed to purchase undercutter tillage implements on a 50% cost share basis. Growers were personally interviewed in 2008, 2009, and 2010. Although the lack of eight fall 2010 interviews precludes final economic results, data to date indicate a modest profit advantage for the undercutter system. Statistically equivalent yields for the undercutter and conventional fallow/winter wheat systems generated equal gross economic returns. Nearly all individual farmers used the same input rates and other cultural practices for both fallow systems, except for primary tillage and fertilization. This pattern generated similar costs. However, injection of fertilizer with the undercutter provided a modest cost saving. This computed profitability advantage for the undercutter system coincides with the farmers' subjective estimate of an average 2.8% long run profitability advantage. With a profit advantage, the undercutter fallow system represents a win-win outcome for farmers and the environment. On field sites with undercutter versus disk primary tillage, Sharatt and Feng (2009) measured reductions of 15% to 65% in soil loss and 30% to 70% in PM_{10} emissions. The win-win outcome for the environment and farm profitability supports the wisdom of this pilot machinery cost sharing program.

Conventional-fallow and chem-fallow preceding winter wheat dominated preliminary profitability rankings among seven farming systems evaluated over six years at Moro, Oregon. Continuous wheat systems suffered economically and agronomically due to root lesion nematodes and weed competition. Receipt of data on input use and operations will be needed to confirm these preliminary profit rankings.

Interviewees in a related STEEP project reported that the infeasibility of diverse annual rotations in dry regions fosters continuation of the conventional fallow-winter wheat. Many saw new fallow tillage machinery, and improved moisture conservation with direct seeding, as the best hope for wind erosion control in dry regions.

Objectives

1. To complete an economic comparison of undercutter and conventional fallow systems among 47 farmers participating in the Washington Association of Wheat Growers/Natural Resources Conservation Service (WAWG/NRCS) undercutter project.
2. To complete an economic comparison of seven farming systems in a six-year Moro, Oregon experiment conducted by Oregon State University scientists.
3. To report results on wind erosion control systems, including undercutter use, from a related STEEP project.
4. To disseminate research results to growers and others through talks and published materials.

Methods and Materials

Analysis to date has determined that most machine operations and input applications for the undercutter and conventional fallow systems by individual farmers in the WAWG/NRCS undercutter project are the same. Consequently, partial budgeting provides an efficient method for comparing profitability of the two systems. This procedure measures only changes in gross revenue and changes in total costs for the undercutter system relative to the conventional system. For example, if the undercutter system decreases gross revenue by $5/acre, but decreases total costs by $15/acre, profit for the undercutter system gains $10/acre over the conventional system. If there is no statistical difference at the .05 level among participating growers in yields between the two systems, yields and gross revenues will be considered equal. All cost and revenue figures are presented on a rotational acre basis. For example, a rotational acre of wheat/fallow will contain 0.5 acre of winter wheat and 0.5 acre of fallow. Crop prices are averages over the experiment era, while input prices are near term projections. Government payments are excluded in the profitability results because they do not differ by system and require grower-specific assumptions.

Data from the WAWG/NRCS undercutter project are based on spring and fall interviews of participating farmers during 2008, 2009, and 2010 by the project manager, H. Schafer. D. Young developed the economic component of the survey questionnaire. Young also accompanied Schafer on some farmer interviews. Due to family health issues, Schafer had not completed eight 2010 interviews at time of reporting. All available data for 2008, 2009, and 2010 have been entered in spreadsheets. We offer preliminary profitability rankings based on these data in this report.

As possible, returns over variable costs will be used to compare the seven cropping systems in the Moro, Oregon experiment. Cooperators have provided complete yield data for the experiment at this time and gross returns have been computed. Input levels and sequence of operations for the systems are not yet available from cooperators. These data will be required to compute costs and final profitability rankings; however, preliminary profitability ranking estimates based on partial data are offered in this report.

Results and Discussion

WAWG/NRCS Undercutter Project. The WAWG/NRCS Undercutter Project targets the winter-wheat/summer fallow region of Washington and Oregon in counties with less than 12 in/yr average precipitation. The undercutter method of summer fallow employs a wide-blade V-sweep for primary tillage plus fertilizer injection, followed by as few as one non-inversion rodweeding operations. The undercutter method increases surface residue and roughness which better protects against wind erosion compared to traditional tillage.

Forty-seven growers located in 10 counties in Washington and Oregon purchased undercutter tillage implements on a 50% cost share basis. Individual cost-share payments averaged $15,320, including $980 for the fertilizer application equipment. Total payments to growers equaled $720,042.

Growers were interviewed in 2008, 2009, and 2010 with selected results reported below. Table 1 displays the average winter wheat/summer fallow (WW/SF) acreage allocation reported by participating farmers over 2008-2010. Changes in farm size over time are a consequence of changes in leased and owned land holdings. It is encouraging that farmers increased use of the undercutter on other land above their contractual level by 266 acres or 40% over the three years. However, as farm size increased by 21% from 2009 to 2010, conventional fallow acres also grew by 20%.

Table 1. Average WW/SF acreage allocation on participating farms, 2008-2010

Acres	2008	2009	2010
Total farm	5,827	5,154	6,242
Undercutter: contract	195	203	160
Undercutter: other land	670	768	936
CRP	1,000	1,010	1,330
Conventional fallow/WW	3,962	3,173	3,816
SUM (= Total farm)	5,827	5,154	6,242

The third year of 2010 received 108% of normal precipitation compared to 70% in the first two years which boosted yields by 41% (Table 2). Tables 2 and 3 show no statistically significant differences in yields and number of rodweedings with either undercutter fallow or conventional fallow among sample farmers in 2008, 2009, and 2010. Sample sizes vary over time because differing numbers of farmers had sufficient experience with the undercutter to respond to some questions in the earlier years. Also, some 2010 results were not available at the time of this report. Variation in yields, shown by the high coefficients of variation, hampered detecting significant differences in yields. High yield variation is due in part to the large geographic and precipitation dispersion among the participating farmers.

Table 2. Reported winter wheat yields (bu/ac) by system and year

System	Averages			Coefficients of Variation (%)		
	2008	2009	2010	2008	2009	2010
Undercutter	34	30	44	35	59	32
Conventional	31	30	44	27	45	36

Notes: 2008 sample sizes = 17 for undercutter (UC) and 41 for conventional (CON); 2009 sample sizes = 47 for each system; 2010 sample sizes = 37 for UC and 39 for CON. There were no statistically significant yield differences over systems within years.

Dry conditions restricted weed growth and the need for rodweedings to less than two per year regardless of fallow system in 2008 and 2009. Above normal precipitation in 2010 prompted 2.0 and 2.5 rodweedings under the undercutter and conventional systems, respectively (Table 3).

Table 3. Average number of rodweedings by system and year

System	2008	2009	2010
Undercutter	1.3	1.6	2.0
Conventional	1.3	1.8	2.5

Notes: There were no statistically significant differences over systems within years.

Survey results showed farmers' satisfaction with the undercutter has improved over time with an average of 4.7 on a scale of 1 to 5 in 2010, from 4.1 in 2009, and 4.5 in 2008. In 2009, 52% of sampled farmers subjectively perceived their long run profit to increase with the undercutter versus the conventional system, up from 36% of sampled farmers in 2008. But in 2010 the ratio of farmers perceiving profit increases fell back to 35%. In all years, a substantial percentage of farmers expected equal profitability with the two systems. Few farmers expected the undercutter to decrease long run profit over time: 10% in 2008, 7% in 2009, and 6% in 2010. Averaged over three years, farmers expected long run profitability to increase by 2.8% with the undercutter system.

Participating growers were contractually required to apply a minimum of 16 oz/ac of glyphosate in late winter to control grass weeds. They averaged 16.8 oz/ac. Growers were required to inject nitrogen (N) fertilizer with the undercutter. A handful of growers applied fertilizer in a separate operation due to tractor horsepower limitations. N applications by individual farmers were nearly always identical for the two fallow systems averaging 46 lbs/ac in 2009 and 49 lbs/ac in 2010. About half the growers applied sulphur at an average rate of 9 lbs/ac. Very few applied phosphate. Winter wheat seeding rates for individual farmers were nearly always identical between the two systems. Seeding rates averaged 54 to 60 lbs/ac depending on the year, and were statistically equal over systems.

All data for 2008, 2009, and available data for 2010 have been entered on spreadsheets and analysis has been initiated. Although the lack of eight fall 2010 interviews precludes final economic results, data to date indicate a slight profit advantage for the undercutter system. Statistically equivalent yields for the two systems implied equal gross returns. In summary, nearly all farmers used the same input rates and other cultural practices for both systems except for primary tillage and fertilization. Statistically equivalent glyphosate, fertilizer, and seed costs implied equal costs for these inputs. Furthermore, statistically equivalent rodweeding operations yielded no cost savings in post-primary tillage between systems. However, injection of fertilizer with the undercutter by most farmers represented a cost saving for this system on average. This saving was moderated slightly because some farmers also injected fertilizer with non-undercutter primary tillage. The exact numerical cost saving with the undercutter will be computed when all data are in hand. A small computed profitability advantage for the undercutter system is consistent with the farmers' subjective estimate of an average 2.8% long run profitability advantage.

With a profit advantage, the undercutter fallow system represents a win-win for farmers and the environment. Sharatt and Feng (2009) measured 15% to 65% reductions in soil loss and 30% to 70% less PM_{10} emissions on field sites with undercutter versus disk primary tillage. The preliminary win-win outcome would seem to confirm the policy wisdom of this pilot program for cost sharing for the undercutter. Indeed, some equipment dealers have reported selling more undercutters since 2007 outside the cost sharing program than they sold under the program (Harry Schafer, personal communication, November 2010).

On the other hand, farmers reported a "learning curve" with the undercutter and variable performance on different soils. Participants complained most frequently about maintaining depth control in dry ground, costly blade wear, difficulty operating in heavy residue, kickbacks not setting properly, and problems in filling air voids in dry ground.

Funding has been received by the P.I. to resurvey participating farmers and to survey a random sample of other farmers in the 10 sample counties in 2013 in order to monitor the continuing use of, and satisfaction with, the undercutter. The P.I.'s recent experience with an ongoing $184,000 STEEP Project has confirmed that conducting a statistically valid random sample survey of all USDA- Farm Services Agency listed farmers in just six PNW counties is a very expensive and complex task. However, a survey of Extension, NRCS, and Conservation District personnel on the extent of undercutter use among the general farm population in the 10 participating counties could provide a relatively accurate and affordable alternative.

Preliminary economic comparison of Moro, Oregon Cropping Systems. In cooperation with Stephen Machado and Steven Petrie, Oregon State University crop science researchers, the P.I. is initiating an economic evaluation of seven cropping systems evaluated in a 11 in/yr ppt. region at Moro, Oregon. The experiment was conducted during 2004/2005 through 2009/2010. The seven systems are:

1. Continuous Winter Wheat (Contin. WW)
2. Continuous Spring Wheat (Contin. SW)
3. Continuous Spring Barley (Contin. SB)
4. Conven. Fallow-WW (Conven. F-WW)
5. Chem-Fallow-WW (ChemF-WW)
6. Winter Wheat-Winter Peas (WW-WP)
7. Chem-Fallow-WW-SB (ChemF-WW-SB)

All systems except Conven. F-WW are direct seeded.

Gross revenues per rotational acre are presented in Table 4. Cooperator, S. Machado, provided the six-year average yields for soft white winter wheat and other crops. Average local crop prices for the experimental era were collected by the P.I. Average WP yields were reduced by crop failures in 2008 and 2009. Cooperators attributed the high WW yield in the 3-year ChemF-WW-SB rotation to lower root lesion nematode and less weed competition. Both continuous wheat rotations 1 and 2 suffered severely from root lesion nematodes.

Table 4. Results by cropping system, Moro, Oregon experiment, 2004/2005-2009/2010

System	Av. Yield (bu/ac)	Av. Price ($/bu)	Av. GR ($/rotat. ac)	GR rank	Est. Profit Rank
1. Contin. WW	20.3	5.22	105.97	7	7
2. Contin. SW	25.4	5.22	132.59	4	4
3. Contin. SB	35.4	3.16	111.86	6	6
4. Conven. F-WW	53.7	5.22	140.16	1	1 or 2
5. ChemF-WW	51.3	5.22	133.89	2	1 or 2
6. WW-	33.0	5.22			
WP	10.3	8.60	130.42	5	5
7. ChemF-WW-	57	5.22			
SB	32	3.16	132.75	3	3

Cooperators had not provided input levels and sequence of operations for the systems at the time of reporting. These data, which are necessary to compute costs, will determine final profitability rankings. However, based on some fragmentary cost data and familiarity with the economics of similar systems in the PNW, the author is able to offer some profit ranking estimates at this time. With the lowest gross revenue, Contin. WW will assuredly remain in last place because it incurs substantial fertilizer, seed, herbicide, and machine operation costs every year. Profitability ranks for Contin. SB and and Contin. SW will also match their low gross revenue ranks because these systems also incur high annual costs. W-WP and ChemF-WW-SB generated reasonable revenue, but incur intermediate levels of annual cost.

Furthermore, there is a very thin market for winter pea seed to use for cover crop or feed crop plantings. ChemF-WW-SB and WW-WP are expected to occupy profit ranks 3 or 4. Conven. F-WW and ChemF-WW are expected to compete for top profitability. Both Conven. F-WW and ChemF-WW are low cost systems on an annual basis and generated relatively high revenues. Also, wheat prices are expected to hold up better than barley prices. Growers have chosen the Conven. F-WW system to maximize profit with acceptable risk for 120 years in this region. Again, cost data will determine the final rankings for Systems 4 and 5, and 6 and 7.

Wind erosion control results on a related STEEP Project. The PI and cooperators conducted lengthy personal interviews with 20 PNW farmers and other stakeholders in Phase I of this project. Interviewees reported that the infeasibility of diverse annual rotations in dry regions encourages continuation of the conventional fallow-winter wheat system. Researchers' past failures with continuous rotations has cemented this viewpoint. Some growers saw improved conservation tillage machinery and moisture conservation as potential boosts for direct seeding in dry areas. The P.I and cooperators are currently conducting a mail survey of over 600 farmers in six counties in this project. The survey elicits undercutter use, among other practices, in WW-SF areas. Preliminary results will be available by mid-summer 2011.

References

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