An Economic Comparison of Alternative Bluegrass Residue Management Practices in Oregon's Grande Ronde Valley

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Introduction

Perennial grass seed production has long been a significant contributor to the agricultural sector of the Pacific Northwest economy. Grass seed production accounts for over 560,000 acres in the Pacific Northwest and is a significant contributor to local economies (Muller-Warrant 2004). In 2007, Oregon producers harvested approximately 515,792 acres of grass seed with an economic value of $480 million, making it the state's third highest valued crop group (OAIN 2008). Several species of turf grass are grown for seed production throughout Oregon including Kentucky bluegrass with 19,760 acres harvested with a value of $21.3 million in 2007 (OAIN 2008). In 2006, Oregon ranked third among all states for production (pounds) of Kentucky bluegrass (OASS 2007). The production of high-quality bluegrass seed is important to the local agricultural economy of the Grande Ronde Valley (GRV) of northeastern Oregon. In 2007, 57% of Oregon's Kentucky bluegrass acres were located in Northeastern Oregon (Young 2008).

Burning of grass seed fields with full residue loads began in the 1940s as an effective method of pest and disease control and to facilitate fall re-growth by removal of unwanted residue from harvested fields. Alternative residue management tools have been developed, but not all techniques have been adopted due to higher costs and generally less effective agronomic results. These alternatives include thermal options to open burning, such as removing the full straw load by baling and then flaming the field with propane torches, and nonthermal (mechanical only) alternatives, including baling, flailing, loafing, and vacuuming of residues.

Beginning in the 1970s, the growing controversy regarding the effect of field smoke on air quality, public health, and highway safety resulted in legislation that restricts burning in many of the major grass seed producing areas of the Pacific Northwest, including parts of western Oregon. In 2007, the state of Idaho joined Washington in a complete ban on grass seed field burning. Consequently, interest in the development of effective, alternative grass seed residue management systems has increased in the region.

Oregon's legislative policy directive is to "reduce the practice of open field burning while developing and providing alternative methods of field sanitization and alternative methods for utilizing crop residues" (Oregon Administrative Rules, Chapter 603, Division 77 603-077-0103). As a result of this legislative directive, open field burn acreage limitations have been established for the Willamette Valley and the Oregon Department of Agriculture has been given regulatory authority to oversee the field burn/smoke management program for this densely populated area of western Oregon. Governance for agricultural open burning outside of the Willamette Valley is administered by local smoke management programs and the State Fire Marshall. Regardless of local regulatory oversight, all field burn policy and smoke management programs within Oregon must comply with state and federal laws.

Alternative residue management research conducted in western Oregon has produced mixed results. Initial research found that yields and quality of seed crops could not be maintained without burning (Chilicote 1969; Ensign et al. 1983), while others found similar results from thermal and nonthermal techniques (Pumphrey 1965; Canode 1972). Steiner et al. (2006) compared the effect of a variety of conservation tillage systems combined with nonthermal residue management techniques. Later Oregon studies considered more mechanical advances in residue management, including raking and

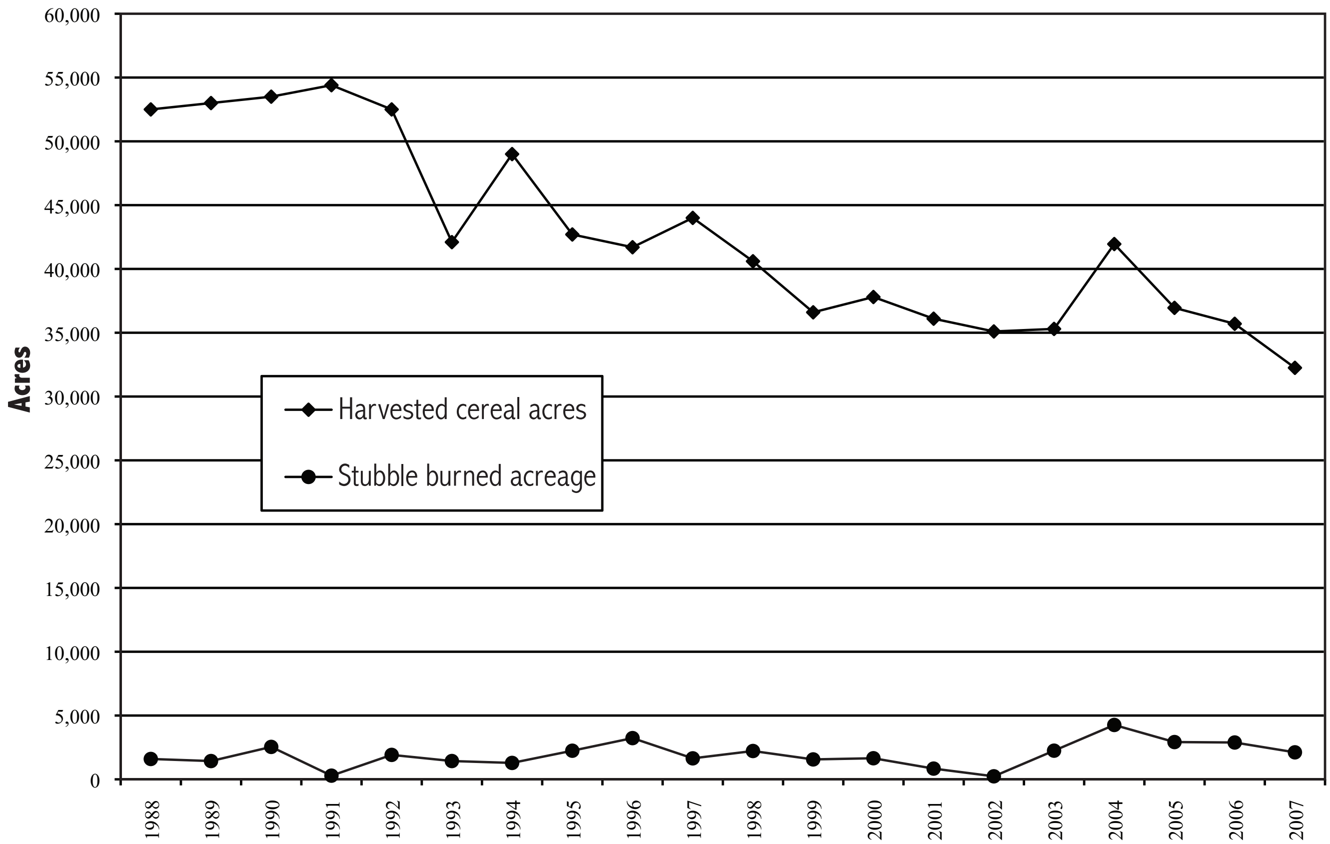

Figure 1. Cereal grain production and stubble burned acreage in Union County, Oregon, 1988–2007.

flailing, along with controlled propane flaming (Mueller-Warrant et al. 1995; Young et al. 1999). Recent Washington and Idaho studies have found that costs of producing Kentucky bluegrass seed under a complete no-burn policy are highly variable due to agronomic factors such as a reduction in the viable life of established grass fields and yields, as well as the price of baled residue straw. Hinman and Schreiber (2001) found that the increased cost of production varied from \$0.20/lb to over \$0.25/lb. Their study also concluded that a significant part of increased costs would be a reduction in the viable life of an established grass field, but these additional costs were not included in their estimates. Van Tassell (2002) included these factors by using seven yields and stand life scenarios under burn and no-burn policies. He estimated annualized differences between burn and no-burn residue management alternatives of \$22.58/acre to \$166.06/acre in Washington. These results were highly sensitive to prices for bluegrass residue/straw.

Producers in the less densely populated eastern Oregon area face fewer restrictions for open field burning, and there has been little incentive for agronomic or economic analysis of alternative residue management practice in the GRV. However, because of increased difficulty in obtaining timely field burn permits and in meeting safety requirements (labor, water trucks, field preparation, etc.), producers have been voluntarily reducing their reliance on open burning and shifted to other residue management methods. Propane flaming in the GRV increased from 4% of Kentucky bluegrass acres in 1993 to 42% of acres in 2004 and is currently the most common alternative residue management technique used in GRV grass seed production (OAIN 2006).

The few studies completed in central and eastern Oregon show that alternative residue management strategies can maintain seed yield and quality in the absence of open field burning when straw removal is thorough and stubble height is reduced (Chastain et al. 1997, 2000; Butler and Campbell 2004).

In this publication, we compare the economic budgets of thermal (propane flaming) and nonthermal (mechanical only) grass seed residue management techniques currently used by producers in the GRV of Oregon. Our focus is on estimating the economic returns to variable costs using a three-year on-farm study of yields and quality of seed under these alternative techniques. We also forecast the economic returns using three possible stand lengths of established grass seed, yield trends from the on-farm data, and high-low average grass seed prices.

On-Farm Agronomic Study of Alternative Residue Management

Methods

The three-year on-farm study was established in 2001 to determine the effect of alternative thermal and nonthermal residue management practices on seed yield of irrigated Kentucky bluegrass in the GRV. Irrigated Kentucky bluegrass fields are considered to have a productive life stand of four to six years depending on the type of residue removal technique used. The GRV field burn/smoke management program operates from July 15 to September 30 of each year when conditions are optimal for efficient burning and smoke dispersal prior to the onset of fall precipitation events. Thermal residue techniques used in late September may be delayed by rainfall, and/or vegetative re-growth may reduce effectiveness and smoke dispersal.

Treatments in the study included four residue management techniques: two mechanical treatments, (1) bale only and (2) bale/flail; and two thermal treatments, (3) bale/propane early and (4) bale/propane late. An open field burning management technique was not investigated in this study. During the post-harvest period in each of the study years, the two mechanical and the bale/propane early residue management treatments were conducted in early August within a few days of each other; however, the bale/propane late treatment always occurred about month later in early-mid September. Each study plot was 25 feet by 400 feet long, and residue treatments were replicated across three production years. Seed yield data were collected from each residue management treatment for three consecutive years by swathing at maturity (July 7–10) and combining harvesting (July 25–26) seed with commercial-scale equipment. Seed from each plot was weighed using a yield cart to determine pre-cleaned seed yield. Clean seed yield was determined by collecting subsamples during harvest, processing the seed with a debearder and a three-screen cleaner, and calculating clean seed yield for each plot. Clean seed samples were subjected to germination and purity analysis at the Oregon State University Seed Laboratory and compared to Oregon Seed Certification Service standards. GRV growers and contractors reviewed production practices and budget data for accuracy and appropriateness.

Results and Analysis

Annual seed harvest results for each treatment are summarized in table 1. Over the three study years of harvest, seed yield declined significantly across years but little within years (Walenta et al. 2004). Seed yields in 2002 were significantly reduced when residue was baled off and stubble was left intact (bale only) when

Table 1. Three-year on-farm yields of Kentucky bluegrass seed with different residue management techniques.

	On-farm yield (lb/acre)			
	Nonthermal		Thermal	
Year	Bale	Bale/flail	Bale/propane early	Bale/propane late
2002	1,078[1]	1,226[1,2]	1,245[1,2]	1,404[2]
2003	848[1]	783[1]	903[1]	873[1]
2004	465[1]	467[1]	530[1]	446[1]

Notes: Row values followed by the same superscript are not statistically significant from one another at the 0.05 level.

compared to baling followed by late thermal treatment (bale/propane late). A slight increase in seed yield was observed when baling was followed by flailing or early thermal treatment of the remaining stubble; however, these yields were not significantly different. Early and late thermal reduction of stubble resulted in equivalent seed yields. Although results indicate that mechanical residue removal followed by late thermal treatment produced greater seed yields than any other treatment, it is unclear whether the yield increase is a varietal response due to late thermal treatment. In 2002, seed purity and germination levels were unaffected by mechanical or thermal residue management methods. Seed samples collected in 2002 did not contain any weed seed contaminants.

Statistical analysis did not detect any significant differences in seed yield, purity, or germination due to residue management treatments in 2003 or 2004. A late 2003 May frost affected seed yield and quality, which, in turn, may have negated any differences due to residue management treatment. Analysis of seed samples from the 2003 harvest detected low levels of weed seed contamination, primarily rattail fescue, in all residue management treatments except in the bale/propane late treatment. There was a significant decline between 2003 and 2004 in seed purity. All seed samples from the 2004 harvest did not meet Oregon Seed Certification Service purity standards (Walenta et al. 2004).

Economic Study

Methods

Cost and Return Analysis

Economic budgets typically include revenues, variables costs, fixed costs, and various other economic costs. In this analysis, no grass seed establishment costs were included as they were assumed to be fixed across residue management techniques and other economic costs were held constant across all management techniques as well. Consequently, the analysis of this research focused on differences in returns to variable costs across residue management techniques.

Economic budgets were constructed to determine differences in the returns to variable costs across residue management techniques. Returns to variable costs were calculated by subtracting per-acre variable costs from per-acre gross revenues. These budgets were constructed using a combination of on-farm data gathered from the three-year residue management study and average cost and price data in the GRV production area during that time period. Per-acre gross revenues calculated in these budgets included grass seed revenue and straw revenue. No government payments or subsidies were included in revenues. Grass seed revenue was calculated as average per-acre grass seed yields multiplied by the average grass seed price received. Grass seed yield data were determined from the results of residue management data collected from on-farm trials for three consecutive years. Yield levels reflect the average amount of clean seed yield per acre to be expected. Grass seed yields were then multiplied by the average price per pound received by Union County grass seed growers for the years investigated.

Straw revenue was calculated for nonthermal management budgets only, and it was assumed that producers did not bale their own grass straw, as is common in the GRV, and sold the standing straw at $10.00/ton to the custom baler. Straw revenue was calculated by the average expected straw residue tonnage per acre of grass seed multiplied by the average expected price per ton of standing straw sold to custom balers. GRV growers and contractors reviewed production practices and yield data for accuracy and appropriateness.

Variable costs are those that are a direct result of production activities and change only with changes in the level of production activities. If production levels were to drop to zero, variable costs would also drop to zero with only fixed costs remaining. In this analysis, per-acre variable costs were divided into four categories based upon the time these costs were incurred. This was done to evaluate the types of cost differences that existed and the timeframe in which these cost differences occurred. The variable cost categories included in these budgets were pre-harvest (January 1–June 30), harvest (July 1–August 15), residue management (August 16–September 30), and post-residue management (October 1–December 31). Variable cost differences were observed between nonthermal and thermal techniques during pre-harvest, harvest, and residue management periods of the production year. The majority of the cost differences can be attributed to differences in propane, irrigation, and pesticide costs.

All variable costs in each category were determined by calculating the average expected level of use (i.e., tons, pounds, quarts, hours, etc.) and multiplying it by the average price level per unit observed during the study period. Input usage levels were determined by a combination of actual on-farm level usage and interviewing GRV grass seed growers on commonly accepted application practices for grass seed production in the GRV. Per-unit cost data were collected from local suppliers, GRV growers, and published machinery/equipment cost estimates (OSU Extension; ASAE Standards).

Pre-harvest variable costs across all residue management techniques included fertilizer, herbicide, insecticide, field certification, irrigation, farm truck, owner labor, and hand weeding crew costs that were incurred from January 1 to June 30. Harvest variable costs across all residue management techniques included swathing, combining, grain truck, seed handling, owner labor, and farm truck costs that were incurred from July 1 to August 15. Residue management variable costs for the bale-only budget included only minimal farm truck and owner labor costs that were incurred from August 16 to September 30. Residue management costs for the bale/flail budget included flailing, farm truck, and owner labor costs. Residue management costs for the propane burn and propane late management techniques included field preparation, field burning, farm truck, and owner labor costs. Post-residue management variable costs across all residue management techniques included fertilizer, herbicide, insecticide, irrigation, farm truck, and owner labor costs that were incurred from October 1 to December 31.

In addition to the on-farm data, several forecasted production scenarios were examined. These included four-year and six-year stand life scenarios under constant yield levels (past the third year), declining yields, low seed market prices, and high seed market prices. Only thermal management techniques were used in the six-year analysis based on the low likelihood a viable nonthermal stand would be sustained past four years in the GRV. Forecasted price scenarios were estimated using the reported Union County average grass seed price of $0.79/lb from 2004 for the high-price scenario and $0.68/lb from 2005 for the low-price scenario (OAIN 2006).

Net Present Value Analysis

Using the constructed enterprise budgets, the net present value (NPV) of per-acre net returns to variable costs were calculated for the three-year on-farm study and for the forecasted scenarios. The NPV analysis used a discount rate of 4%. In NPV analysis, the discount rate represents the minimum required level of return that is considered acceptable. This is often gauged by what the capital invested in the activity could potentially earn elsewhere.

NPV is used to economically rank and choose alternative scenarios. NPV is calculated by the difference between the present value of cash inflows and the present value of cash outflows. NPV compares the value of a dollar today to the value of that same dollar in the future, taking inflation and returns into account. If the NPV of a prospective project is positive, it should be accepted. However, if NPV is negative, the project should probably be rejected because cash flows will also be negative. In this research, it was assumed that all management scenarios have the same level of investment costs and NPV results can be compared directly across scenarios.

Results and Analysis

Cost and Return Analysis

The method used in this analysis cannot be used to determine overall profitability of grass seed production. The method is used to compare the effects on returns due to the residue management technique. Therefore, positive returns to variable costs may be possible while returns to total costs (variable + fixed) may be negative.

During the pre-harvest and post-residue management production periods, annual variable costs were lower for thermal management. During the harvest and residue management production period, variable costs were higher for thermal management. There were some differences in variable costs within the thermal and nonthermal categories due to alternative activities, such as a flailing activity or second, late propane flaming in residue management (table 2).

Analysis of the returns to variable costs from the on-farm data indicated differences across and within thermal and nonthermal categories (table 3). The thermal techniques resulted in the highest and lowest three-year total returns to variable costs with a difference of $125/acre. Bale/propane late exhibited the highest returns to variable cost in year one and the lowest in year three and had the lowest total returns to variable cost for the three-year period. Bale/propane early had the highest three-year returns to variable costs. Nonthermal techniques had the second and third highest returns to variable costs. Although annual returns yielded mixed results, the three-year total return and NPV of the three-year total return analysis resulted in the bale/propane early scenario consistently being significantly higher at the $\alpha = 0.05$ level. There was no statistical difference between the other three alternatives.

Table 2. Average nominal variable costs for three-year on-farm study of Kentucky bluegrass residue management techniques.

	Average nominal variable costs ($/acre)			
	Nonthermal		Thermal	
Period	Bale	Bale/flail	Bale/propane early	Bale/propane late
Pre-harvest (Jan. 1–June 30)	$209	$209	$177	$177
Harvest (July 1–Aug. 15)	$115	$128	$129	$141
Residue management (Aug. 16–Sept. 30)	$5	$7	$51	$91
Post-residue management (Oct. 1–Dec. 31)	$98	$98	$109	$109

Table 3. Returns to variable cost results for three-year on-farm study of Kentucky bluegrass residue management techniques.

	Nonthermal		Thermal	
Year	Bale	Bale/flail	Bale/propane early	Bale/propane late
Annual revenues ($)				
2002	$847	$962	$967	$1,090
2003	$651	$603	$683	$661
2004	$381	$382	$422	$355
Annual variable costs ($/acre)				
2002–2004	$429	$444	$463	$516
Annual returns to variable costs ($/acre)				
2002	$418	$518	$504	$574
2003	$222	$159	$220	$145
2004	$-48	$-62	$-41	$-161
Nominal three-year total returns to variable costs ($/acre)				
2002–2004	$592[1]	$615[1]	$683[2]	$558[1]
Net present value of three-year total returns to variable costs ($/acre)				
2002–2004	$564[1]	$587[1]	$650[2]	$538[1]

Notes: Average county prices received for grass seed in 2002, 2003, and 2004 were used: $0.77/lb, $0.75/lb, and $0.79/lb, respectively. Row values followed by the same superscript are not statistically significant from one another at the 0.05 level.

Net Present Value Analysis

In tables 4 and 5, the results of the NPV analysis for the four-year and six-year production scenarios are presented. In all of the forecasted scenarios, bale/propane early again resulted in the highest NPV for returns to variable costs each time. Conversely, bale/propane late resulted in the lowest NPV for returns to variable costs all across all categories.

The results of this analysis indicate that thermal versus nonthermal techniques alone are not affecting the NPV of returns to variable costs. Differences in return to variable costs are mainly accounted for by significant differences in year one yields and significant differences in the timing and amount of variable costs. It also appears that the timing of propane application has a significant impact on the economics of grass seed production.

Table 4. Net present value of returns to variable costs for four-year production scenarios with high and low output prices for Kentucky bluegrass residue management techniques.

	Net present value of returns to variable costs ($/acre)			
	Nonthermal		Thermal	
Four-year production scenarios	Bale	Bale/flail	Bale/propane early	Bale/propane late
Declining yields, low output price	$153	$157	$176	$-3
Constant yields, low output price	$283	$287	$346	$140
Declining yields, High output price	$402	$414	$477	$299
Constant yields, high output price	$576	$589	$674	$466

Notes: Discount rate of 4% was used. High output price = $0.79/lb from 2004; low output price = $0.68/lb from 2005 as reported from county average prices. Constant yields calculated at 2004 yield levels; declining yields calculated at an extrapolated decline from previous years.

Table 5. Net present value of returns to variable costs for six-year production scenarios with high and low output prices for Kentucky bluegrass residue management techniques.

	Net present value of returns to variable costs ($/acre)	
Six-year forecasted scenarios	Bale/propane early	Bale/propane late
Declining yields, low output price	$-483	$-762
Constant yields, low output price	$185	$-198
Declining yields, high output price	$-168	$-447
Constant yields, high output price	$632	$207

Notes: Discount rate of 4% was used. High output price = $0.79/lb from 2004; low output price = $0.68/lb from 2005 as reported from county average prices. Constant yields calculated at 2004 yield levels; declining yields calculated at an extrapolated decline from previous years.

These results could be sensitive to fuel and propane prices and affecting the ranking of the returns to variable costs by residue management technique. The analysis was based upon 2002–2004 production year input costs of $1.60/gal of fuel and $1.08/gal of propane (Amerigas). However, increases in fuel and propane costs have been sustained over the past two years. Alternative scenarios were examined assuming $1.50/gal, $2.00/gal, and $2.50/gal price for propane and a $10.00/acre across the board (not a per-gallon increase) increase in fuel costs. Table 6 illustrates the sensitivity of the on-farm results to alterative fuel prices by reporting results under alternative fuel pricing scenarios. Under the first two alternative fuel scenarios, bale/propane early maintains its position with highest returns to variable costs and bale/propane late once again exhibiting the lowest returns. However, once propane reaches the highest price of $2.50/gal, the nonthermal bale/flail alternative has higher returns to variable costs.

An overall summary with each of the sensitivity scenario rankings is presented in table 7. Bale/propane late results in the highest return across all categories except the final propane price scenario.

Table 6. Net present value of returns to variable costs resulting from alternative fuel and propane price scenarios to three-year on-farm study.

	Net present value of returns to variable costs ($/acre)			
	Nonthermal		Thermal	
Alternative propane price scenarios	Bale	Bale/flail	Bale/propane early	Bale/propane late
$1.50/gal propane	$537	$562	$602	$468
$2.0/gal propane	$537	$562	$574	$413
$2.50/gal propane	$537	$562	$546	$357

Note: Alternative scenarios also included an adjustment for fuel prices of $10/acre.

Table 7. Ranking of returns to variable costs for Kentucky bluegrass residue management technique scenarios.

	Three-year on-farm		NPV of four-year scenarios*				NPV of six-year scenarios*				Alternative fuel scenarios		
	Nominal	NPV	Decl, low	Decl, high	Con, low	Con, high	Decl, low	Decl, high	Con, low	Con, high	1.50/ gal	2.00/ gal	2.50/ gal
Nonthermal													
Bale	3rd	3rd	3rd	3rd	3rd	3rd	n/a	n/a	n/a	n/a	3rd	3rd	3rd
Bale/flail	2nd	2nd	2nd	2nd	2nd	2nd	n/a	n/a	n/a	n/a	2nd	2nd	1st
Thermal													
Bale/propane early	1st	1st	1st	1st	1st	1st	1st	1st	1st	1st	1st	1st	2nd
Bale/propane late	4th	4th	4th	4th	4th	4th	2nd	2nd	2nd	2nd	4th	4th	4th

Notes: NPV = net present value. Decl, low = declining yields, low output price; Decl, high = Declining yields, high output price; Con, low = constant yields, low output price; Con, high = constant yields, high output price.
* High output price = $0.79/lb from 2004; low output price = $0.68/lb from 2005 as reported from county average prices. Constant yields calculated at 2004 yield levels; declining yields calculated at an extrapolated decline from previous years.

Conclusions and Implications

The grass seed industry in the GRV has long been of importance to the economic health of the area and to the surrounding communities that provide the infrastructure to this industry. The grass seed industry also plays a vital role in the environment: positively by reducing soil erosion and negatively by producing air pollution under open field burning techniques. This analysis focused on the economic implications of the agronomic results from the on-farm study of four different thermal and nonthermal residue management techniques.

Initial agronomic results indicate that propane flaming helps to maintain seed yields above mechanical-only residue management techniques. However, the final agronomic results indicate that these residue management treatments resulted in declining seed yields and increasing weed infestations over the three years of the study.

Economically, there were some significant differences in returns to variable costs in the three-year on farm research data between thermal and nonthermal techniques and within thermal techniques. These results were sensitive to various production and price scenarios as significant differences were observed under more scenarios. However, under all forecasted production scenarios, bale/propane early had the highest NPV of returns to variable costs and bale/propane late had the lowest NPV of returns to variable costs. The mechanical options consistently ranked in between the two thermal options.

The results of options with baling may become more economically competitive with the early propane technique if a strong local market for straw develops. Oregon's top export commodity requiring a phytosanitary certificate is grass straw; over 90% of all certificates issued by the Oregon Department of Agriculture are for straw (Young 2007). Exports were valued in 2006 at $62.2 million (ODA 2007). Over 1.2 billion pounds of compacted grass straw was sent to the three major Asian markets of Japan, Korea, and Taiwan in the 2006–2007 market year, down slightly from the previous year (Young 2007). Exports of grass straw are slipping some, and recent studies have noted that shipping costs and buyer preferences for rice straw may reduce the demand for grass straw in the Northwest (Steiner et al. 2006). However, recent shortages of hay in eastern Washington and Oregon and parts of western Idaho and Montana due to drought and fires have improved the grass straw market locally. Recent prices for baled Kentucky bluegrass residue in the GRV have averaged $30–$40/ton, with a high of $80/ton in 2007 and slightly lower prices for baled fescue residue. This additional revenue is currently going to custom balers rather than GRV producers who have avoided the baling activity and historically treated the straw as a valueless byproduct. The capture of this income by the grass seed producer may add significantly to the economic viability of the mechanical-only management alternatives. Finally, another potential source of income and use of mechanically recovered grass straw is the conversion of woody biomass such as grass straw to biofuel. Initial research is focusing on conversion of annual ryegrass straw, which has little nutritional value as animal feed compared to bluegrass straw. Current research suggests that grass straw may need to be combined with other woody biomass to create the energy necessary for conversion; the Oregon Department of Agriculture is assisting other state researchers in the completion of a feasibility study (ODA 2008).

Fluctuations in the fuel market will also have a pivotal effect on the economically optimal choice between thermal and nonthermal residue management techniques. Understanding which choice is the most economically appealing option to producers can provide insight into future of grass seed production as well as environmental quality issues. This information can also assist farmers, policy makers, and public interest groups making decisions regarding grass seed field burning and its impact on natural resource quality and farm economic viability.

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Appendix: Example Grass Seed Residue Management Budgets

Nonthermal: Bale Only

Bluegrass Seed Production Enterprise Budget - Grande Ronde Valley Economic Costs and Returns ($/acre) for Baling Crop Residue (No Burning)					
GROSS REVENUE[1]		Quantity (per acre)	Unit	$/Unit	Total
	Bluegrass Seed	1087.00	pounds	0.85	923.95
	Bluegrass Straw (for custom baling)	1.50	tons	10.00	15.00
Total Gross Revenue					**938.95**
VARIABLE COSTS BY TYPE		Quantity	Unit	$/Unit	Total
PRE-HARVEST (January 1- June 30)					
	Fertilizer and custom application				
	Spring Fertilizerr: 80-0-0-0	0.12	tons	350.92	42.11
	Custom Application (1 Applications Total)	3.00	acre	3.50	10.50
	Herbicide and custom application				
	Bromoxynil (Buctril)	1.50	pts	8.99	13.49
	Tribenuron methyl (Express)	0.30	oz	18.63	5.59
	Primisulfuron methyl (Beacon)	0.76	oz	33.59	25.53
	Surfactant	0.10	quart	4.37	0.44
	Custom Application	1.00	acre	5.00	5.00
	Spot Spray - Curtail/Round-Up/Stinger	1.00	acre	6.00	6.00
	Insecticides and Fungicides				
	Tilt (propiconazole) (2 Applications)	4.00	oz/appl	2.89	23.09
	Surfactant	0.10	quart/appl	4.37	0.87
	Custom Application (2 Applications)	2.00	acre	5.00	10.00
	Certification	1.00	acre	3.00	3.00
	Irrigation (2 Applications)				
	Irrigation Labor	1.00	hr/ac/appl	7.00	14.00
	Irrigation Electricity	1.00	acre/appl	3.45	6.90
	Irrigation Repair and Maintenance	1.00	acre/appl	2.50	5.00
	Farm Truck				
	Fuel	1.00	acre	1.50	1.50
	Repair and Maintenance	1.00	acre	0.58	0.58
	Operator Labor	1.00	acre	0.17	0.17
	Owner Labor	0.50	hours	12.00	6.00
	Rogueing Crew (4 person crew @ 1 hour per acre)	4.00	hours	7.15	28.60
Total Pre-Harvest Costs Per Acre					208.37
HARVEST (July 1 - August 15)					
	Swathing - (Self-Propelled - 14 ft)				
	Gasoline, Fuel, Oil, and Filter	1.00	acre	1.83	1.83
	Repair and Maintenance	1.00	acre	2.65	2.65
	Operator Labor	1.00	acre	1.84	1.84
	Combining - (14ft header)				
	Gasoline, Fuel, Oil, and Filter	1.00	acre	5.82	5.82
	Repair and Maintenance	1.00	acre	3.17	3.17
	Operator Labor	1.00	acre	3.51	3.51
	Grain Truck				
	Seed Hauling	0.00	loads/acre	4.00	0.00
	Repair and Maintenance	1.00	acre	1.23	1.23
	Operator Labor	0.25	hrs/acre	11.00	2.75
	Seed Handling				
	Seed Cleaning	10.87	cwt	7.00	76.09
	Seed Bags and Tags	14	bags	0.48	6.52
	Seed sampling	10.87	cwt	0.23	2.50
	Seed Testing	1.00	acre	2	2.00
	Owner Labor	0.25	hours	12.00	3.00
	Farm Truck				
	Fuel	1.00	acre	1.50	1.50
	Repair and Maintenance	1.00	acre	0.58	0.58
	Operator Labor	1.00	acre	0.17	0.17
Total Harvest Costs Per Acre					115.16
RESIDUE MANAGEMENT (August 16 - September 30)					
	Farm Truck				
	Fuel	1.00	acre	1.50	1.50
	Repair and Maintenance	1.00	acre	0.58	0.58
	Operator Labor	1.00	acre	0.17	0.17
	Owner Labor	0.25	hours	12.00	3.00
Total Residue Management Costs Per Acre					5.25
POST-RESIDUE MANAGEMENT (October 1 - December 31)					
	Fertilizer				
	Fall Fertilizer: 100-40-20-15	0.20	tons	250.00	50.00
	Custom Application	1.00	acre	3.50	3.50
	Herbicide and custom application				
	Pendimethalin (Prowl 3.3 EC)	0.25	gallon	22.72	5.68
	Custom Application (1 Application)	1.00	acre	5.00	5.00
	Insecticides and Fungicides				
	Lorsban (chlorpyrifos)	0.25	gallon	41.18	10.30
	Custom Application (1 Applications)	1.00	acre	5.00	5.00
	Irrigation (1application)				
	Irrigation Labor	1.00	hr/ac/appl	7.00	7.00
	Irrigation Electricity	1.00	acre/appl	3.45	3.45
	Irrigation Repair and Maintenance	1.00	acre/appl	2.50	2.50
	Farm Truck				
	Fuel	1.00	acre	1.50	1.50
	Repair and Maintenance	1.00	acre	0.58	0.58
	Operator Labor	1.00	acre	0.17	0.17
	Owner Labor	0.25	hours	12.00	3.00
Total Post-Residue Costs Per Acre					97.68
		Total Cash Operating (Variable) Costs			426.46
		GROSS RETURNS ABOVE VARIABLE COSTS			512.49

[1]Revenues in this budget were caculated using YR 1 (2002) yields from on-farm data and YR 1 (2002) average county prices received.

Nonthermal: Bale/Flail

Bluegrass Seed Production Enterprise Budget - Grande Ronde Valley Economic Costs and Returns ($/acre) for Bale and Flail/Mow of Crop Residue (No Burning)				
GROSS REVENUE[1]	Quantity (per acre)	Unit	$/Unit	Total
Bluegrass Seed	1236.00	pounds	0.85	1050.60
Bluegrass Straw (for custom baling)	1.50	tons	10.00	15.00
Total Gross Revenue				**1065.60**
VARIABLE COSTS BY TYPE	Quantity	Unit	$/Unit	Total
PRE-HARVEST (January 1- June 30)				
Fertilizer and custom application				
Spring Fertilizer: 80-0-0-0	0.12	tons	350.92	42.11
Custom Application (1 Applications Total)	3.00	acre	3.50	10.50
Herbicide and custom application				
Bromoxynil (Buctril)	1.50	pts	8.99	13.49
Tribenuron methyl (Express)	0.30	oz	18.63	5.59
Primisulfuron methyl (Beacon)	0.76	oz	33.59	25.53
Surfactant	0.10	quart	4.37	0.44
Custom Application	1.00	acre	5.00	5.00
Spot Spray - Curtail/Round-Up/Stinger	1.00	acre	6.00	6.00
Insecticides and Fungicides				
Tilt (propiconazole) (2 Applications)	4.00	oz/appl	2.89	23.09
Surfactant	0.10	quart/appl	4.37	0.87
Custom Application (2 Applications)	2.00	acre	5.00	10.00
Certification	1.00	acre	3.00	3.00
Irrigation (2 Applications)				
Irrigation Labor	1.00	hr/ac/appl	7.00	14.00
Irrigation Electricity	1.00	acre/appl	3.45	6.90
Irrigation Repair and Maintenance	1.00	acre/appl	2.50	5.00
Farm Truck				
Fuel	1.00	acre	1.50	1.50
Repair and Maintenance	1.00	acre	0.58	0.58
Operator Labor	1.00	acre	0.17	0.17
Owner Labor	0.50	hours	12.00	6.00
Rogueing Crew (4 person crew @ 1 hour per acre)	4.00	hours	7.15	28.60
Total Pre-Harvest Costs Per Acre				208.37
HARVEST (July 1 - August 15)				
Swathing - (Self-Propelled - 14 ft)				
Gasoline, Fuel, Oil, and Filter	1.00	acre	1.83	1.83
Repair and Maintenance	1.00	acre	2.65	2.65
Operator Labor	1.00	acre	1.84	1.84
Combining - (14ft header)				
Gasoline, Fuel, Oil, and Filter	1.00	acre	5.82	5.82
Repair and Maintenance	1.00	acre	3.17	3.17
Operator Labor	1.00	acre	3.51	3.51
Grain Truck				
Seed Hauling	0.25	loads/acre	4.00	0.99
Repair and Maintenance	1.00	acre	1.23	1.23
Operator Labor	0.25	hrs/acre	11.00	2.75
Seed Handling				
Seed Cleaning	12.36	cwt	7.00	86.52
Seed Bags and Tags	15	bags	0.48	7.42
Seed sampling	12.36	cwt	0.23	2.84
Seed Testing	1.00	acre	2	2.00
Owner Labor	0.25	hours	12.00	3.00
Farm Truck				
Fuel	1.00	acre	1.50	1.50
Repair and Maintenance	1.00	acre	0.58	0.58
Operator Labor	1.00	acre	0.17	0.17
Total Harvest Costs Per Acre				127.82
RESIDUE MANAGEMENT (August 16 - September 30)				
Flail (Mow w/100hp tractor with rotary mower)				
Fuel, Oil, Filter	1.00	acre	0.43	0.43
Repairs	1.00	acre	0.67	0.67
Labor	1.00	acre	0.88	0.88
Farm Truck				
Fuel	1.00	acre	1.50	1.50
Repair and Maintenance	1.00	acre	0.58	0.58
Operator Labor	1.00	acre	0.17	0.17
Owner Labor	0.25	hours	12.00	3.00
Total Residue Management Costs Per Acre				7.23
POST-RESIDUE MANAGEMENT (October 1 - December 31)				
Fertilizer				
Fall Fertilizer: 100-40-20-15	0.20	tons	250.00	50.00
Custom Application	1.00	acre	3.50	3.50
Herbicide and custom application				
Pendimethalin (Prowl 3.3 EC)	0.25	gallon	22.72	5.68
Custom Application (1 Application)	1.00	acre	5.00	5.00
Insecticides and Fungicides				
Lorsban (chlorpyrifos)	0.25	gallon	41.18	10.30
Custom Application (1 Applications)	1.00	acre	5.00	5.00
Irrigation (1application)				
Irrigation Labor	1.00	hr/ac/appl	7.00	7.00
Irrigation Electricity	1.00	acre/appl	3.45	3.45
Irrigation Repair and Maintenance	1.00	acre/appl	2.50	2.50
Farm Truck				
Fuel	1.00	acre	1.50	1.50
Repair and Maintenance	1.00	acre	0.58	0.58
Operator Labor	1.00	acre	0.17	0.17
Owner Labor	0.25	hours	12.00	3.00
Total Post-Residue Management Costs Per Acre				97.68
	Total Cash Operating (Variable) Costs			441.09
	GROSS RETURNS ABOVE VARIABLE COSTS			624.51

[1]Revenues in this budget were caculated using YR 1 (2002) yields from on-farm data and YR 1 (2002) average county prices received.

Thermal: Bale/Propane Early

Bluegrass Seed Production Enterprise Budget - Grande Ronde Valley

Economic Costs and Returns ($/acre) for Propane Burn Early

GROSS REVENUE[1]	Quantity (per acre)	Unit	$/Unit	Total
Bluegrass Seed	1256.00	pounds	0.85	1067.60
Total Gross Revenue				**1067.60**
VARIABLE COSTS BY TYPE	Quantity	Unit	$/Unit	Total
PRE-HARVEST (January 1- June 30)				
Fertilizer and custom application				
Spring Fertlizer: 80-0-0-0	0.12	tons	350.92	42.11
Custom Application (1 Applications Total)	3.00	acre	3.50	10.50
Herbicide and custom application				
Bromoxynil (Buctril)	1.50	pts	8.99	13.49
Tribenuron methyl (Express)	0.30	oz	18.63	5.59
Surfactant	0.10	quart	4.37	0.44
Custom Application	1.00	acre	5.00	5.00
Spot Spray				
Insecticides and Fungicides				
Tilt (propiconazole) (2 Applications)	4.00	oz/appl	2.89	23.09
Surfactant	0.10	quart/appl	4.37	0.87
Custom Application (2 Applications)	2.00	acre	5.00	10.00
Certification	1.00	acre	3.00	3.00
Irrigation (2 Applications)				
Irrigation Labor	1.00	hr/ac/appl	7.00	14.00
Irrigation Electricity	1.00	acre/appl	3.45	6.90
Irrigation Repair and Maintenance	1.00	acre/appl	2.50	5.00
Farm Truck				
Fuel	1.00	acre	1.50	1.50
Repair and Maintenance	1.00	acre	0.58	0.58
Operator Labor	1.00	acre	0.17	0.17
Owner Labor	0.50	hours	12.00	6.00
Rogueing Crew (4 person crew @ 1 hour per acre)	4.00	hours	7.15	28.60
Total Pre-Harvest Costs Per Acre				176.84
HARVEST (July 1 - August 15)				
Swathing - (Self-Propelled - 14 ft)				
Gasoline, Fuel, Oil, and Filter	1.00	acre	1.83	1.83
Repair and Maintenance	1.00	acre	2.65	2.65
Operator Labor	1.00	acre	1.84	1.84
Combining - (14ft header)				
Gasoline, Fuel, Oil, and Filter	1.00	acre	5.82	5.82
Repair and Maintenance	1.00	acre	3.17	3.17
Operator Labor	1.00	acre	3.51	3.51
Grain Truck				
Seed Hauling	0.25	loads/acre	4.00	1.00
Repair and Maintenance	1.00	acre	1.23	1.23
Operator Labor	0.25	hrs/acre	9.00	2.25
Seed Handling				
Seed Cleaning	12.56	cwt	7.00	87.92
Seed Bags and tags	16	bags	0.48	7.54
Seed sampling	12.56	cwt	0.23	2.89
Seed Testing	1.00	acre	2	2.00
Owner Labor	0.25	hours	12.00	3.00
Farm Truck				
Fuel	1.00	acre	1.50	1.50
Repair and Maintenance	1.00	acre	0.58	0.58
Operator Labor	1.00	acre	0.17	0.17
Total Harvest Costs Per Acre				128.90
RESIDUE MANAGEMENT (August 16 - September 30)				
Field Prep				
Rake	1.00	acre	3.17	3.17
Bale	1.00	acre	3.47	3.47
Burning (100 hp tractor with 30 ft burner)				
Burn Fee	1.00	acre	2.00	2.00
Propane Burner (30 ft) and operator labor	1.00	acre	8.64	8.64
Propane	20.00	gallons	1.08	21.60
2 Water Trucks	1.00	acre	3.10	3.10
Labor (3 people @ 0.125 hrs/acre)	0.38	hours	11.00	4.13
Farm Truck				
Fuel	1.00	acre	1.50	1.50
Repair and Maintenance	1.00	acre	0.58	0.58
Operator Labor	1.00	acre	0.17	0.17
Owner Labor	0.25	hours	12.00	3.00
Total Residue Management Costs Per Acre				51.36
POST-RESIDUE MANAGEMENT (October 1 - December 31)				
Fertilizer				
Fall Fertilizer: 100-40-20-15	0.20	tons	250.00	50.00
Custom Application	1.00	acre	3.50	3.50
Herbicide and custom application				
Pendimethalin (Prowl 3.3 EC)	0.75	gallon	22.72	17.04
Custom Application (1 Applications Total)	1.00	acre	5.00	5.00
Insecticides and Fungicides				
Lorsban (chlorpyrifos)	0.25	gallon	41.18	10.30
Custom Application (1 Applications)	1.00	acre	5.00	5.00
Irrigation (1 application)				
Irrigation Labor	1.00	hr/ac/appl	7.00	7.00
Irrigation Electricity	1.00	acre/appl	3.45	3.45
Irrigation Repair and Maintenance	1.00	acre/appl	2.50	2.50
Farm Truck				
Fuel	1.00	acre	1.50	1.50
Repair, Maintenance, License, and Insurance	1.00	acre	0.58	0.58
Operator Labor	1.00	acre	0.17	0.17
Owner Labor	0.25	hours	12.00	3.00
Total Post-Management Costs Per Acre				109.04
	Total Cash Operating (Variable) Costs			466.13
	GROSS RETURNS ABOVE VARIABLE COSTS			601.47

[1]Revenues in this budget were caculated using YR 1 (2002) yields from on-farm data and YR 1 (2002) average county prices received.

Bluegrass Seed Production Enterprise Budget - Grande Ronde Valley				
Economic Costs and Returns ($/acre) for Propane Burn Late (September) Option				
GROSS REVENUE[1]	Quantity (per acre)	Unit	$/Unit	Total
Bluegrass Seed	1416.00	pounds	0.85	1203.60
Total Gross Revenue				**1203.60**
VARIABLE COSTS BY TYPE	Quantity	Unit	$/Unit	Total
PRE-HARVEST (January 1- June 30)				
Fertilizer and custom application				
Spring Fertilizer: 80-0-0-0	0.12	tons	350.92	42.11
Custom Application (1 Applications Total)	3.00	acre	3.50	10.50
Herbicide and custom application				
Bromoxynil (Buctril)	1.50	pts	8.99	13.49
Tribenuron methyl (Express)	0.30	oz	18.63	5.59
Surfactant	0.10	quart	4.37	0.44
Custom Application	1.00	acre	5.00	5.00
Spot Spray				
Insecticides and Fungicides				
Tilt (propiconazole) (2 Applications)	4.00	oz/appl	2.89	23.09
Surfactant	0.10	quart/appl	4.37	0.87
Custom Application (2 Applications)	2.00	acre	5.00	10.00
Certification	1.00	acre	3.00	3.00
Irrigation (2 Applications)				
Irrigation Labor	1.00	hr/ac/appl	7.00	14.00
Irrigation Electricity	1.00	acre/appl	3.45	6.90
Irrigation Repair and Maintenance	1.00	acre/appl	2.50	5.00
Farm Truck				
Fuel	1.00	acre	1.50	1.50
Repair and Maintenance	1.00	acre	0.58	0.58
Operator Labor	1.00	acre	0.17	0.17
Owner Labor	0.50	hours	12.00	6.00
Rogueing Crew (4 person crew @ 1 hour per acre)	4.00	hours	7.15	28.60
Total Pre-Harvest Costs Per Acre				176.84
HARVEST (July 1 - August 15)				
Swathing - (Self-Propelled - 14 ft)				
Gasoline, Fuel, Oil, and Filter	1.00	acre	1.83	1.83
Repair and Maintenance	1.00	acre	2.65	2.65
Operator Labor	1.00	acre	1.84	1.84
Combining - (14ft header)				
Gasoline, Fuel, Oil, and Filter	1.00	acre	5.82	5.82
Repair and Maintenance	1.00	acre	3.17	3.17
Operator Labor	1.00	acre	3.51	3.51
Grain Truck				
Seed Hauling	0.28	loads/acre	4.00	1.13
Repair and Maintenance	1.00	acre	1.23	1.23
Operator Labor	0.25	hrs/acre	9.00	2.25
Seed Handling				
Seed Cleaning	14.16	cwt	7.00	99.12
Seed Bags and Tags	18	bags	0.48	8.50
Seed sampling	14.16	cwt	0.23	3.26
Seed testing	1.00	acre	2	2.00
Owner Labor	0.25	hours	12.00	3.00
Farm Truck				
Fuel	1.00	acre	1.50	1.50
Repair and Maintenance	1.00	acre	0.58	0.58
Operator Labor	1.00	acre	0.17	0.17
Total Harvest Costs Per Acre				141.56
RESIDUE MANAGEMENT (August 16 - September 30)				
Field Prep				
Rake	1.00	acre	3.17	3.17
Bale	1.00	acre	3.47	3.47
Burning (100 hp tractor with 30 ft burner) - 2 times with a late burn				
Burn Fee - 2x	1.00	acre/appl	4.00	4.00
Propane Burner (30 ft) and operator labor - 2x	1.00	acre/appl	17.28	17.28
Propane - 2x	20.00	gallons/appl	1.08	43.20
2 Water Trucks - 2x	1.00	acre/appl	6.20	6.20
Labor (3 people @ 0.125 hrs/acre) - 2X	0.75	hours/acre	11.00	8.25
Farm Truck				
Fuel	1.00	acre	1.50	1.50
Repair and Maintenance	1.00	acre	0.58	0.58
Operator Labor	1.00	acre	0.17	0.17
Owner Labor	0.25	hours	12.00	3.00
Total Residue Management Costs Per Acre				90.82
POST-RESIDUE MANAGEMENT (October 1 - December 31)				
Fertilizer				
Fall Fertilizer: 100-40-20-15	0.20	tons	250.00	50.00
Custom Application	1.00	acre	3.50	3.50
Herbicide and custom application				
Pendimethalin (Prowl 3.3 EC)	0.75	gallon	22.72	17.04
Custom Application (1 Applications Total)	1.00	acre	5.00	5.00
Insecticides and Fungicides				
Lorsban (chlorpyrifos)	0.25	gallon	41.18	10.30
Custom Application (1 Applications)	1.00	acre	5.00	5.00
Irrigation (1application)				
Irrigation Labor	1.00	hr/ac/appl	7.00	7.00
Irrigation Electricity	1.00	acre/appl	3.45	3.45
Irrigation Repair and Maintenance	1.00	acre/appl	2.50	2.50
Farm Truck				
Fuel	1.00	acre	1.50	1.50
Repair, Maintenance, License, and Insurance	1.00	acre	0.58	0.58
Operator Labor	1.00	acre	0.17	0.17
Owner Labor	0.25	hours	12.00	3.00
Total Post-Management Costs Per Acre				109.04
	Total Cash Operating (Variable) Costs			518.25
	RETURNS ABOVE VARIABLE COSTS			685.35

[1]Revenues in this budget were caculated using YR 1 (2002) yields from on-farm data and YR 1 (2002) average county prices received.