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Assessment of Non-Thermal Bluegrass Seed Production

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Summary

Data from Washington Agricultural Statistics Services shows that total bluegrass seed acreage is influenced by bluegrass seed price and the price of wheat, a competitive crop. Since 1996, a greater percentage of seed acreage has shifted to the Columbia Basin where bluegrass seed fits into a short rotation with other high value crops, and production methods are not as hindered by the no-burn ban.

Seven yield and stand life scenarios were examined to determine an annual equivalent cost associated with not being able to burn bluegrass residue. Four researchers, three seed company representatives and 12 producers were interviewed to validate published cost estimates used in this study.

Data regarding yields and stand life trends experienced by bluegrass seed producers under no-burn production scenarios were also obtained. Annualized differences between the burn and no-burn alternatives varied from $22.58 to $166.06 per acre depending upon the scenario examined. The market for bluegrass residue plays a major factor in the profitability of raising bluegrass seed under a no-burn alternative. The market for bluegrass residue during the past two years has come from a demand for livestock feed, particularly in Montana. Most producers were able to sell their residue this past year for $30 to $40 per ton. This market is dependent upon the drought continuing in Montana and would probably be exhausted if bluegrass residue in northern Idaho was also made available.

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Introduction

The purpose of this report is to identify and assess potential economic differences between thermal and non-thermal production of bluegrass seed in northern Idaho. This study was not intended to provide a complete assessment of the economics of bluegrass burning in Idaho, and as such, relied upon data used in similar studies in Washington. Validation of the data used in the Washington studies was accomplished through personal conversations with researchers, industry representatives and producers involved with the production of bluegrass seed in Washington and Idaho. Most producers that were interviewed had previously grown bluegrass under a burn system but are currently growing bluegrass under a no-burn system. In all, four researchers, three seed company representatives and 12 producers were interviewed. Interviewees were asked about bluegrass seed production practices, yields, stand life and residue marketing.

Production and price data collected by the Washington Agricultural Statistics Service (WASS) were also obtained to examine changes in bluegrass seed production in Washington since open-field bluegrass burning was eliminated in Washington. Similar data was not available for Idaho.

Figure 1. Bluegrass Seed Harvested Acreage for the State of Washington and Spokane County.

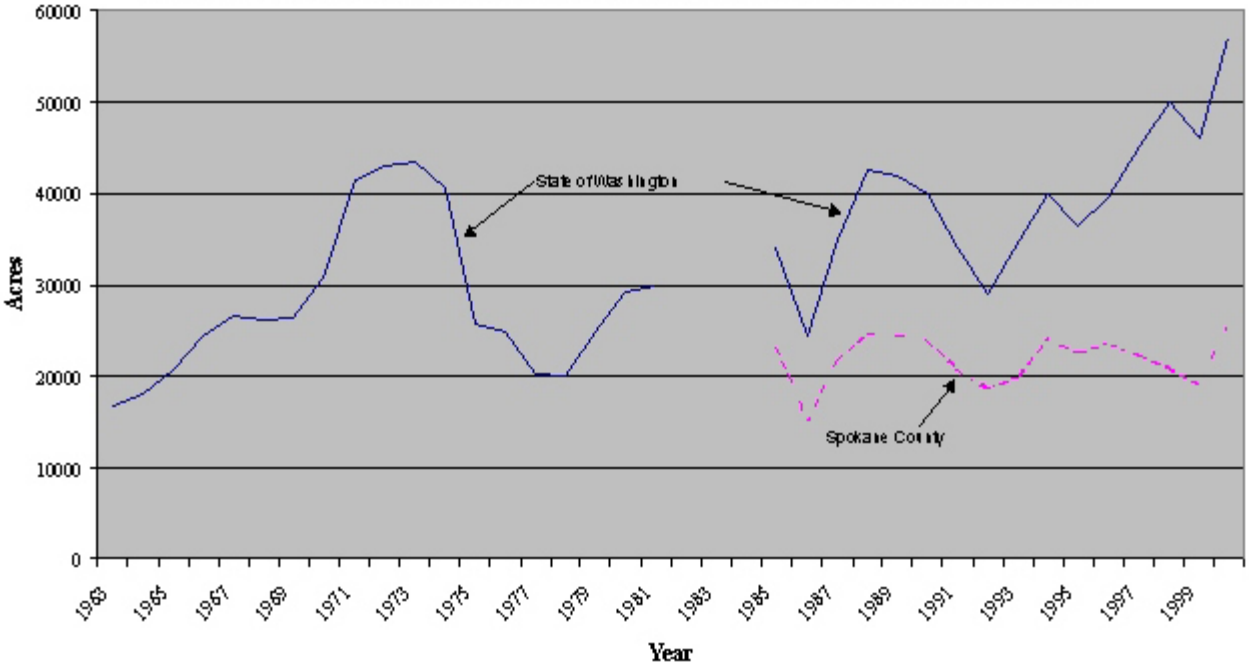
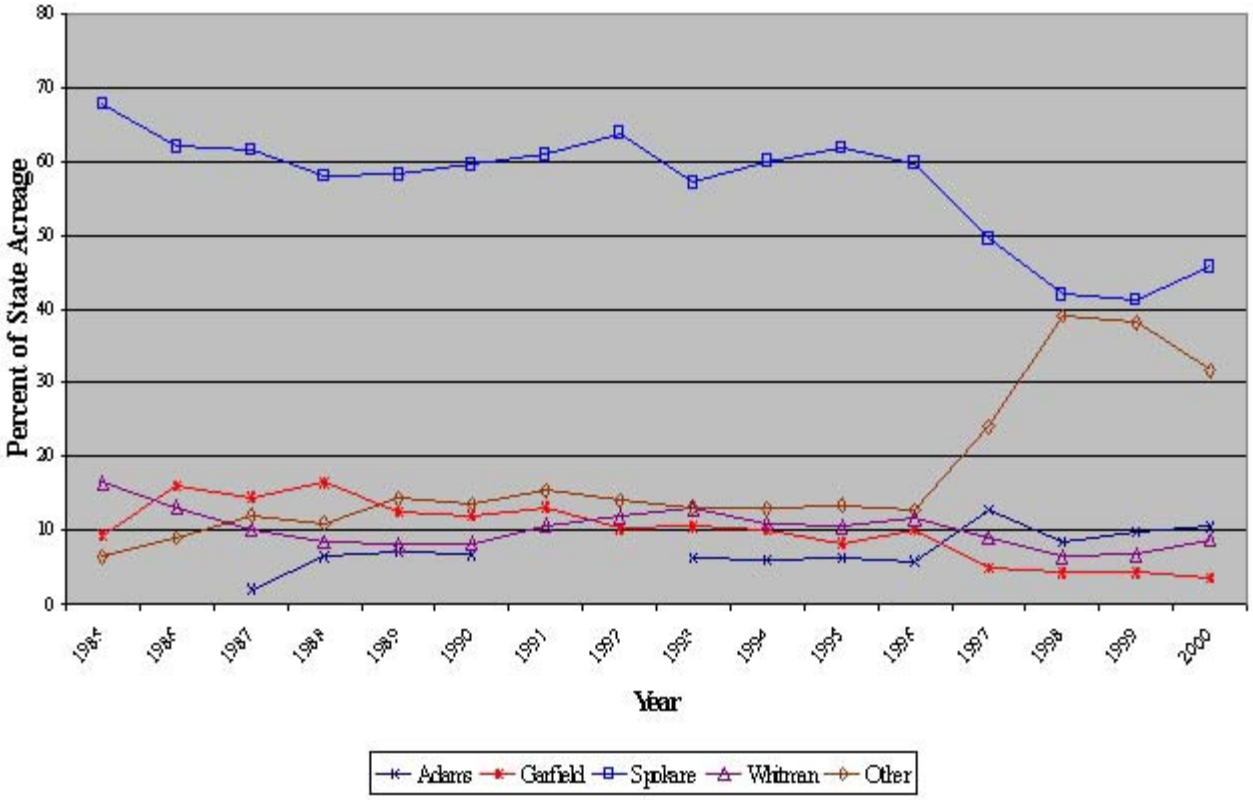


Figure 2. Percentage of Washington State Harvested Bluegrass Seed Acres.



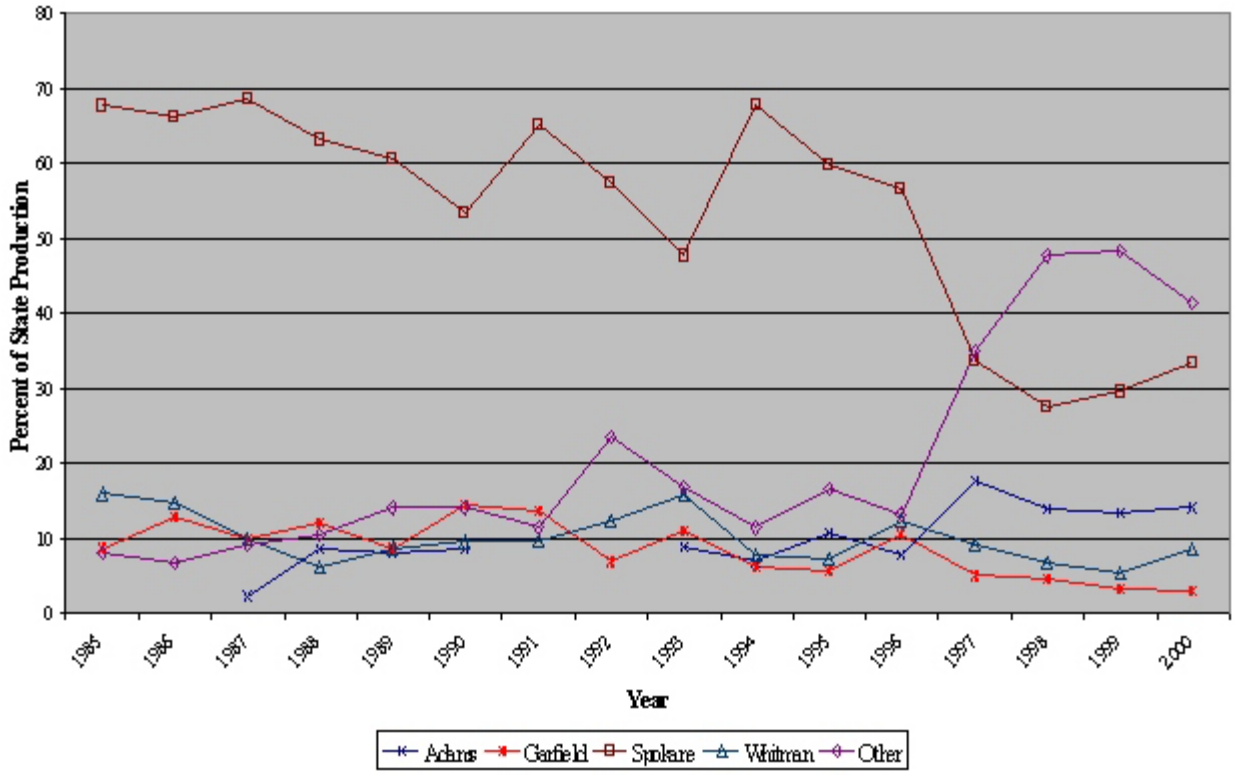
Trends in Bluegrass Seed Production in Washington

Yearly production and price data have been collected for the state of Washington since 1963, with a lapse in data collection from 1982-1984. Harvested acreage has been cyclical, but has steadily increased over the past four decades (Figure 1). This upward trend in bluegrass production has continued despite the burning ban that began in 1996.[1] If the elimination of burning was economically detrimental to farmers, one would reasonablely expect to see a decrease in bluegrass acreage.

Data for the major producing counties in Washington has been continuously collected since 1985. Spokane County has led Washington in the number of acres of bluegrass seed harvested since county statistics have been reported. The rate of increase in harvested bluegrass seed acreage that has occurred statewide over the past decade, though, has not occurred in Spokane

[1]In 1996, the Washington State Department of Ecology (DOE) restricted burning to two-thirds of each producer's total grass seed acreage. Only one-third of the production acreage in Washington was allowed to be burned in 1997, and burning was eliminated in 1998.

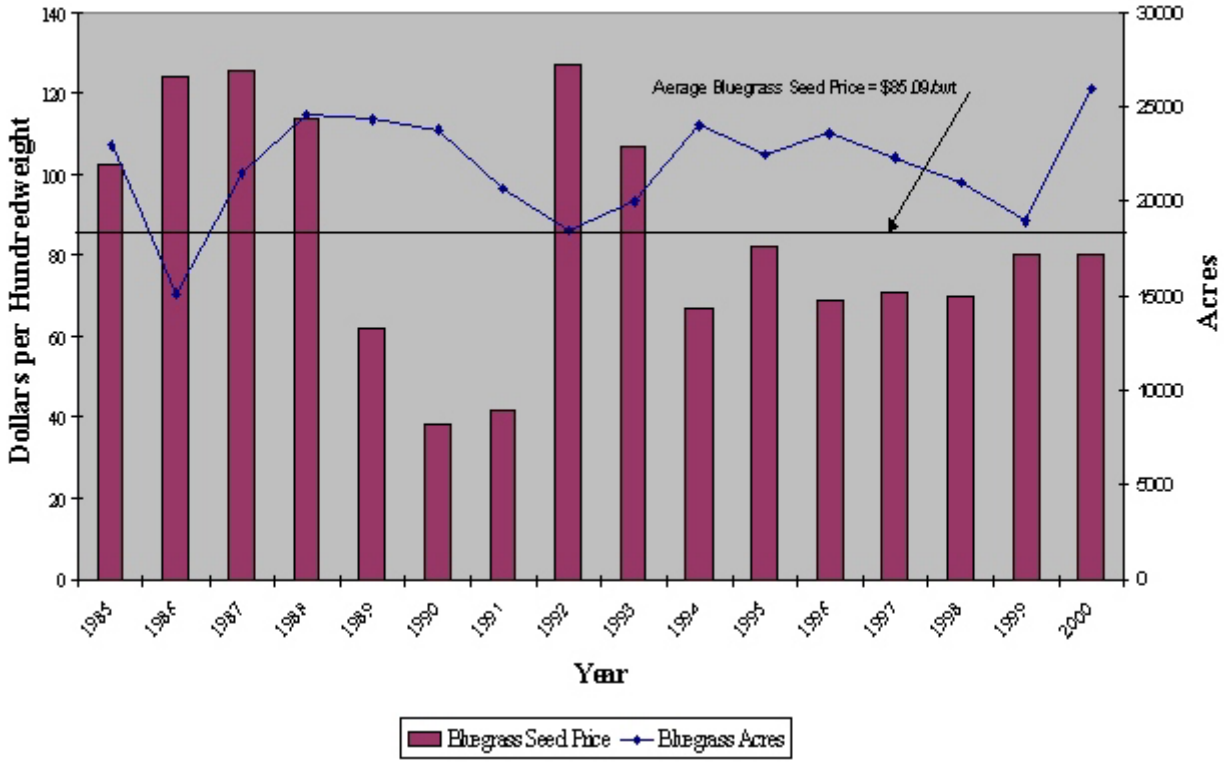
Figure 3. Percentage of Washington State Bluegrass Seed Production.



County (Figure 1).

The cyclical nature of harvested acreage, along with the recent increase in harvested acreage despite the elimination of burning, is somewhat intriguing but can perhaps be accounted for by three phenomenon. First, the increase in bluegrass acreage has occurred in areas where production is not greatly hindered by the no-burn ban. Historically, Spokane County has had the largest percentage of bluegrass seed acreage in Washington (Figure 2). In 1996, Spokane county accounted for 60% of the state's bluegrass seed acreage. This percentage hit a low of 41% in 1999 before rebounding to 46% in 2000. The percent of harvested bluegrass acreage in "other" counties was at 13% in 1996 and increased to 39% in 1998 before declining to 32% in 2000. This increase in bluegrass seed acreage has occurred in the productive irrigated farm region around the Columbia Basin. In most of these "other" counties, bluegrass seed production fits into a regular crop rotation with high dollar crops, such as sweet corn and potatoes, and is only grown for a couple of years before it "rotates out". By only keeping the bluegrass stand in for two years, yields are maintained without burning. In the Columbia Basin bluegrass can also be established in late summer after another crop has been harvested and be ready to be harvested the following summer; thus forgoing a non-revenue establishment year. The impact of this higher-yielding bluegrass production can be seen in Figure 3. Spokane county has historically produced

Figure 4. Bluegrass Seed Price and Acres of Bluegrass Harvested, Spokane Co.

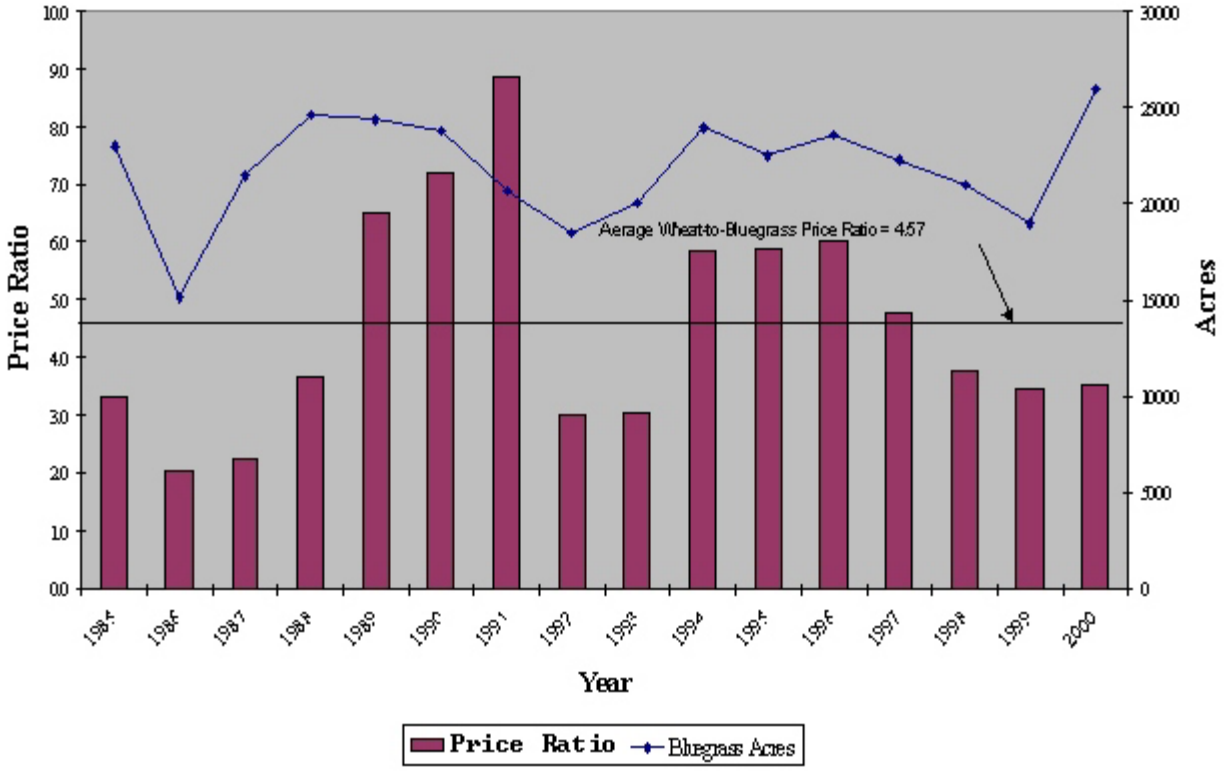


50% to 70% of the bluegrass seed in Washington. That percentage has declined since 1996 to around 30%, with "other" counties increasing their share from below 15% to over 40%.

Production of proprietary seed has increased in these "other" counties because of the high quality as well as the high and stable yields. In all, an increased cost advantage can be attributed to bluegrass production in these counties compared to Spokane County since the no-burn policy was implemented.

Second, even if bluegrass production is not as profitable without burning, supply and demand factors also influence the decision to increase or decrease the number of acres harvested. For most acreage in Washington, there is more than a one-year lag between when a producer decides to raise bluegrass and when production occurs. Bluegrass is typically planted in the spring, with the first harvest occurring during early summer the year after the crop is planted. The relationship between bluegrass seed price and acreage harvested can be seen in Figure 4 where seed price is plotted against harvested acreage for Spokane County. When the bluegrass seed price is relatively high, harvested acreage is typically low. Higher prices, though, precede an increase in bluegrass acreage that occurs a year or two later. The increased acreage increases supply, which depresses seed prices. Farmers respond by taking acreage out of production, and

Figure 5. Wheat Price-to-Bluegrass Seed Price and Acres of Bluegrass Harvested, Spokane Co.

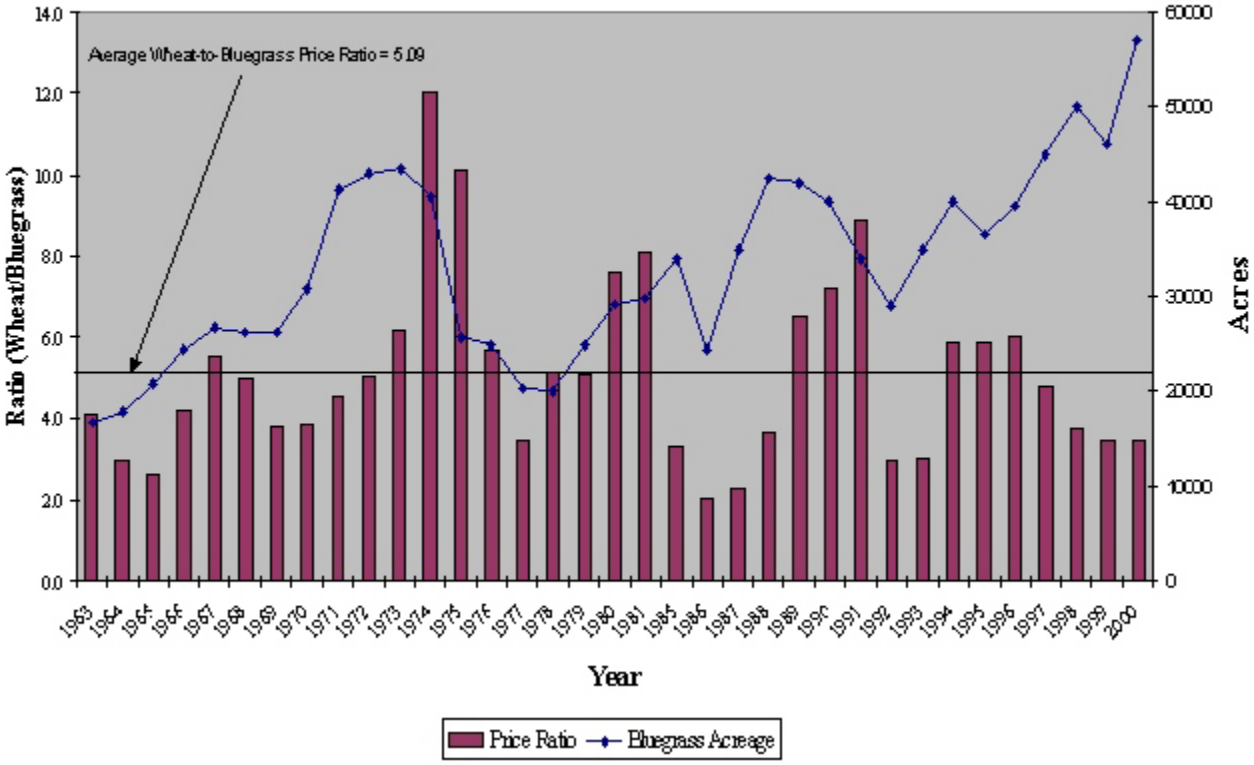


the cycle starts over again. This lagged relationship is also identifiable statistically, with a significant two-year lag between price and harvested acres for Spokane County (see Appendix Table A1).

The relationship between bluegrass price and harvested acreage is present when bluegrass seed acreage for the entire State of Washington is considered, but not as prominent as with Spokane County. A one-year lag rather than a two-year lag between price and production is more significant when total state bluegrass harvested acreage is considered (Appendix Table A2), perhaps because of the increased prominence of production in the irrigated Columbia Basin.

Third, while high bluegrass prices typically signal an increase in acreage, the profitability of alternative crops is also a factor. Several alternative cropping options may exit in the Columbia Basin and similar areas throughout Washington, but in Spokane County and most of eastern Washington, wheat is the major competition to bluegrass for farm acreage. Therefore, the relationship between wheat and bluegrass prices may be important. In Figure 5, the wheat-to-bluegrass seed prices ratio (i.e., wheat price per bushel ÷ bluegrass seed price per pound), is plotted against harvested bluegrass acreage for Spokane County. A high price ratio indicates that wheat prices are high relative to bluegrass seed prices. The below average ratio from 1998 to

Figure 6. Wheat Price-to-Bluegrass Seed Price and Acres of Bluegrass Harvested, Washington.

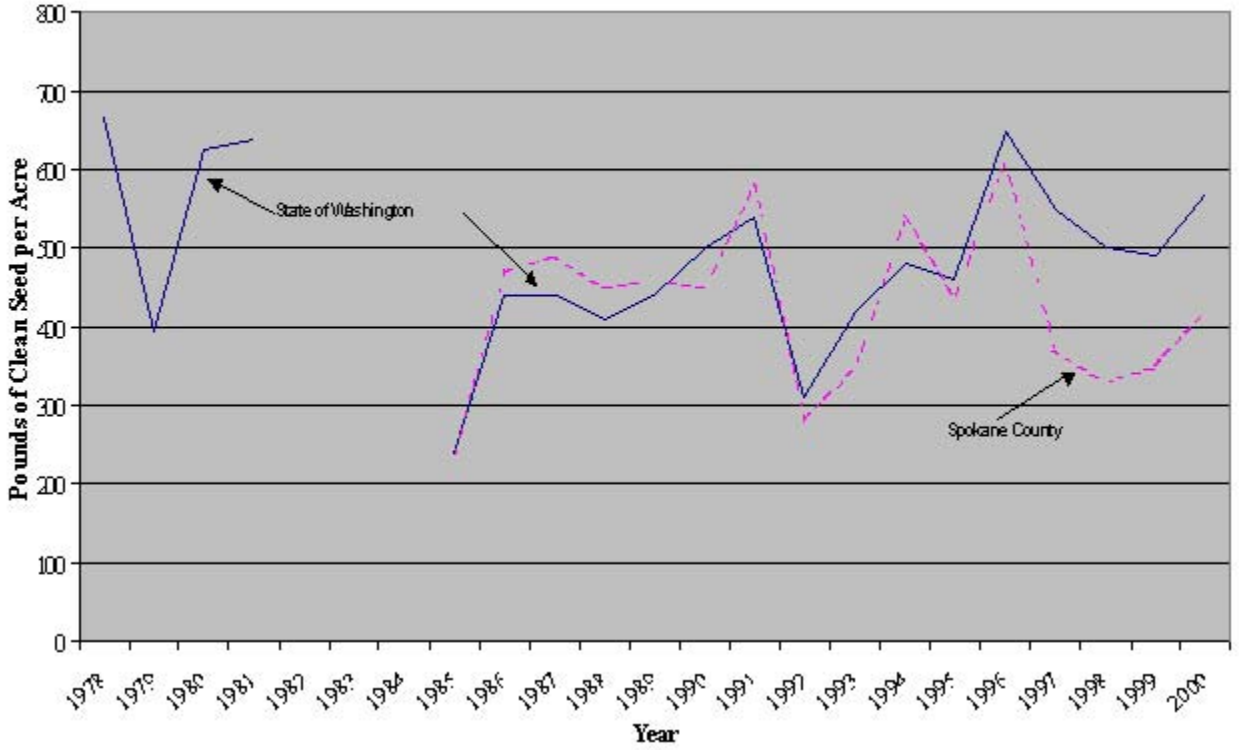


2000 may have been a significant contributor to the increase in bluegrass acreage harvested in 2000. From a statistical standpoint, the wheat-to-bluegrass price ratio was also more significant in explaining harvested acreage in Spokane County than was the bluegrass price alone (Appendix Table A1). A two-year lagged wheat-to-price ratio explained 47% of the variability in Spokane County harvested bluegrass acreage.

The relationship between wheat and bluegrass seed prices and the acres of bluegrass seeded can also be seen on a statewide basis (Figure 6). The same relationship that occurred in Spokane County visually appears to hold until the mid-1990s. A two-year lagged relationship between the price ratio and harvested acreage is statistically significant for bluegrass production in the entire state when only data prior to 1996 is included, but is not statistically significant when data after 1995 is included (Appendix Table A2). This relationship further substantiates the significance of the movement of bluegrass seed production to the Columbia Basin where bluegrass fits into a short rotation with other crops, and thus, is not as impacted by the inability to burn stubble.

An examination of historical bluegrass seed yields shows the divergence of the state average yield and the Spokane County average yield after 1996 (Figure 7). The same general curvature in the two yield curves still exists after 1996, which is perhaps created by environmental conditions and overall stand life. The new difference in the level of yields between the two is probably a

Figure 7. Bluegrass Seed Yield for Washington State and Spokane County.



combination of higher yields being obtained in the Columbia Basin and the impact of not burning bluegrass stubble in Spokane County.

Cost and Return Analysis

Three major factors proposed to impact the profitability difference between thermal and non-thermal bluegrass are stand life, clean seed yield and cost of production. This section will address these and other issues using data collected from interviews and the literature. A budgeting analysis will then evaluate possible economic differences of bluegrass seed production under burn and no-burn alternatives for the production environment of northern Idaho.

Yield and Stand Life

Post-harvest residue in bluegrass seed production must be removed to sustain yield and stand life. This has traditionally been accomplished by burning the residue shortly after harvest. Benefits attributed to burning include removal of the crop residue and organic matter accumulation, exposure of considerable soil surface, thinning of the bluegrass stand, providing enhanced light to the grass crowns and tillers, physiologically "shocking" the plant by the high

temperature exposure, suppression of disease and control of other plants. Burning, though, is not an exact science and an improper burn can lead to suppressed yields the following year. Several non-thermal residue removal alternatives have been proposed. Some of the more popular methods include baling the residue with no subsequent residue management, and baling followed by flailing, raking, and/or harrowing. While the ability of non-thermal residue management techniques to suppress disease and control other plants has been questioned, economic comparisons between alternative techniques have focused on clean seed yield and stand life.

Bluegrass seed production in northern Idaho and eastern Washington requires an establishment year where no production is obtained. Costs of establishment must then be prorated over the stand life of the plant. Environmental conditions are sometimes such that a bluegrass stand will not establish in the first year. This requires a complete re-establishment, or at minimum, the drilling of additional seed the following year. A 15% probability (1.5 years in 10) of stand failure was estimated by visiting with producers and from the experience of researchers interviewed for this study. The danger of an establishment failure and the cost of establishment impels many producers to maintain their stand for as many years as possible.

Using input from a panel of farmers, Hinman and Schreiber assumed a seven year stand life (production period) for bluegrass grown under a burn alternative. Producers interviewed for this study felt most farmers kept their bluegrass stands in for seven to 10 years when allowed to burn. Some producers knew of others who kept stands in for up to 20 years before re-establishing them. Most of these longer term stands were located on fields that were very prone to erosion. Many producers felt that after seven years, yields became more variable and that it was economically prudent to re-establish every seven to 10 years. Canode and Law (1977) credited burning for extending the economic life of bluegrass stands for over 15 years.

Under a burn alternative, Hinman and Schreiber assumed yields of 650, 750, 750, 750, 650, 650 and 650 pounds, respectively, in years one through seven after the establishment year (Table 1). These average yields are statistically higher that those reported by WASS. Yields presented in Hinman and Schreiber were based on information gathered from a panel of farmers that were producing bluegrass seed in the geographical area being studied. This method of collecting cost and return data is commonly used by agricultural economists. Farmers asked to participate on these data collection panels usually possess above average management skills and typically use progressive farming techniques. As such, the yields experienced by these farmers may be higher than average, but also typically require more intensive inputs (including management) to produce those higher yields. Many of the producers interviewed for this study confirmed the yield ranges used by Hinman and Schreiber for the burn alternative. The difference was that producers interviewed for this study did not feel these yields could be maintained each year. Because of environmental conditions and the quality of the burn obtained the previous fall, dryland bluegrass seed yields can be somewhat variable (Figure 7).

Besides the fact that producers in Hinman and Schreiber's study were perhaps better

managers than average, averages reported by farmers are often higher than average reported by WASS. WASS obtains total production and divides that by total harvested acres. Producers often maintain older stands of bluegrass on fields that are quite erosive because that is the best option they have both economically and environmentally. When asking producers about their average yields, they often don't figure these fields into their averages since they don't view these fields as their "productive acreage". Bluegrass yields are also environmentally sensitive and an extremely low yield can be obtained because of moisture limitations or a bad residue burn. Many times, these yields aren't figured into a "typical yield year" reported by farmers, but when averaged across all producers in a given yield, they can reduce average yields in a county substantially.

Producers do obtain yields that average within the range reported by Hinman and Schreiber, but as previously mentioned, they are more variable. Historical yields from actual cleaning receipts are shown in Table 1, under Producer A, for six years of production (1996-2001) obtained from a producer that farmed from 600 to 1,000 acres of dryland bluegrass over this time period. He was able to average 736 lbs/acre with a range of 494 to 924 lbs/acre. Also located in Table 1 (Producer B–burn) are yields (1996-2000) from a dryland field established in 1995 that averaged 725 lbs/acre, as well as data from1999 to 2001 (Producer D–burn) for a dryland field established in 1998 that averaged 748 lbs/acre. As seen by these statistics, individual producer dryland bluegrass seed yields can average over 700 lbs/acre in northern Idaho as suggested by Hinman and Schreiber. Yields do vary from producer to producer and from field to field depending upon the number of years the stand has been in, the quality of the burn, the production practices of the producer and environmental conditions. For example, comparative statistics for 1999 compiled by a seed company for a Ken Blue variety from 40 fields in Idaho showed the average yield was 518 lbs/acre with a high of 1,137 lbs/acre and a low of 100 lbs/acre. For an Alene variety from 27 fields in northern Idaho, the average yield was 479 lbs/acre, with a range of 137 to 932 lbs/acre.

Most research regarding non-thermal production of bluegrass seed has been short-term in nature and, therefore, has not been able to adequately address stand life. Most studies were conducted for a maximum of three years. Chastain et al. examined bluegrass production in the Grande Ronde Valley in Oregon under one burn alternative and four non-thermal production alternatives from 1993 to 1995 (Table 1, under Chastain et al.). Bluegrass seed yield on several of the non-thermal production trials rivaled or surpassed those under the burn trial. Chastain et al. state (p. 1984), "Our work clearly shows that under conditions in the Grande Ronde Valley, seed yield and seed quality can be maintained in Kentucky bluegrass without burning if growers use management techniques...that remove most of the straw and reduce stubble height." They stated that studies by Murray and Swensen, along with Coats et al., also showed the potential for non-thermal production of Kentucky bluegrass seed.

Crowe also conducted several three-year trials on various residue management strategies in central Oregon from 1991 to 1996. Because yield graphs and not statistics were presented in their paper, it was difficult to tell what the actual yields were for each post-harvesting alternative.

They summarized their study as (p. 63), "Our yield data indicate that, in central Oregon, mechanical means of residue management resulted in generally lowered yields compared to OFB [open field burning]. This, combined with the fact that OFB is less expensive than all the mechanical means of residue removal evaluated, suggests that no alternative treatment utilized to date would be acceptable in central Oregon as long as OFB is an available tool."

Lamb conducted post-harvest residue management trials on the Rathdrum Prairie in Northern Idaho during 1996 and 1997 on a stand that was established in 1994. Several varieties were examined under different fertilizer and production treatments. When averaged across cultivars and nitrogen applications, the burn treatment outperformed the crewcut/vacuum and bale/rake production treatments each year (Table 1, under Lamb). Lamb, however, did find that yields from three of the six cultivars, while numerically averaging higher yields under the burn alternative, were not statistically different between the three production alternatives.

The trials conducted by Chastain et al., Crowe et al. and Lamb were conducted under irrigated conditions. The transferability of these studies to dryland conditions, to a different area in the case of the Oregon studies, and beyond their two-year to three-year trial period is uncertain. Dryland trials will be conducted by the University of Idaho beginning in 2002, but it will be a few years before data will be available.

Hinman and Schreiber assumed a four-year stand life for bluegrass grown under a no-burn alternative with yields equaling the burn alternative in production years one and two. Yields were assumed to drop to 400 pounds of clean seed in year three and 350 pounds of clean seed in year four. Producers interviewed for this study stated their stand life when not burning was only three to four years. Some producers felt that production from a four-year stand may not be economically viable. Most said their yields from a three-year stand were only 45% to 60% of those obtained when burning. One producer stated he will be trying to get production from a five-year stand this summer, but wasn't sure if the yields will make it profitable. He stated he lives about as far west as dryland bluegrass production can occur and that the dryer climate assists him in extending his stand life. He stated that the climate in northern Idaho would make it more difficult to realize the longer stand life without burning.

Two producers that were interviewed farmed on the Idaho/Washington boarder and had bluegrass fields in each state. Producer C (Table 1) established two fields in Washington and one in Idaho in 1995. Neither of the Washington fields were burned while the Idaho field was burned. Through the first three production years, the two Washington fields averaged just over 400 lbs/acre and the Idaho field averaged 745 lbs/acre. One of the Washington fields was then taken out of production. Over the following two years, the other Washington field yielded 159 and 134 lbs/acre while the Idaho field averaged 680 and 760 lbs/acre, respectively. Producer D (Table 1) established a field in 1998 that straddled the Washington/Idaho boarder. The total field was treated the same except the residue on the Washington side was baled and mowed while the residue on the Idaho side was burned. The Washington side averaged approximately 173 lbs/acre less than the burned field over a three year period with yields trending downward. Another

producer had a field in bluegrass production during the no-burn phase-in. The field was burned in 1995 and the 1996 production was 1,117 lbs/acre; was not burned in 1996 and the 1997 production was 333 lbs/acre; was burned in 1997 and the 1998 production was 727 lbs/acre; was not burned in 1998 or 1999 and the resulting production was 489 and 317 lbs/acre, respectively.

A main consideration of the data just presented is that the fertilizer and chemical treatments of the burn and no-burn fields was the same in most cases. One interviewee that works with producers stated that comparable yields between the burn and no-burn production methods could be maintained for two or three years but that it required an increase in inputs, both fertilizer and chemicals, along with the post-harvest residue treatment. He also stated that after three production years the no-burn fields would have to be re-established or yields would plummet. He stated that producers that had fields in bluegrass production when the no-burn ban was instituted were not able to maintain yields but experienced a 20% decrease in seed yield per year when they could no longer burn. For producers to obtain yields comparable to those received from burning required a new bluegrass stand.

Comparative statistics for 1999 compiled by a seed company for a Ken Blue variety from 40 fields in Idaho showed the average yield was 518 lbs/acre with a high of 1,137 lbs/acre and a low of 100 lbs/acre. Yields for the same variety from 22 fields in Washington that were not burned averaged 266 lbs/acre with a range of 92 to 745 lbs/acre. For an Alene variety from 27 fields in northern Idaho, the average yield was 479 lbs/acre, with a range of 137 to 932 lbs/acre. Yields for the same variety from 11 fields in Washington averaged 336 lbs/acre with a range of 101 to 574 lbs/acre. During this same year, Spokane County average yields as reported by WASS were 350 pounds–close to the average reported for Washington fields in this last comparison.

Bluegrass Seed Prices

A 5-year (1996 to 2000) average of bluegrass seed ($0.74/lb) was obtained from Washington Agricultural Statistics and used to value bluegrass production in this study.

Residue Marketing

For the most part, producers were able to sell their baled bluegrass residue this past year for $30 to $40 per ton. Most of the residue was sold into Montana to livestock ranchers. One producer stated he was not able to sell any residue his first year of no-burn, his second year he covered two-thirds of his associated costs, and this past year he sold everything. Another producer said he started a bale-and-burn production system around 15 years ago because of being located close to Spokane. He stated that he typically had a market for bluegrass residue when alfalfa prices were high; otherwise, he was not able to sell the residue. In years when he was not able to sell the residue he was able to obtain a permit to burn the bales.

If burning was stopped in Kootenai and Benewah counties, it is doubtful that a market would be available, especially in the short run, for all the residue. The current residue market appears to be created by the extended drought situation in Montana and could rapidly disappear when they get adequate moisture.[2] Individuals I spoke with that are associated with the Benewah County Strawboard Plant stated they don't have excess capacity, especially with current strawboard prices. Producers selling to a strawboard plant would also need to build storage facilities to protect their residue until it was delivered.

For this analysis, three residue prices, $0/ton, $20/ton and $40/ton, were examined for each production scenario.

Costs of Production

Production costs are based on those presented by Hinman and Schreiber for Spokane County with a few exceptions (Appendix, Tables A3 and A4). The Hinman and Schreiber report was designed to present break-even prices for bluegrass seed under a burn and no-burn alternative. To determine this break-even price, they accounted for all costs, including a lease charge for land. The lease charge was based on a share arrangement between the lessee and lessor. For the analysis done in this report, the land charge was dropped under the assumption that the land cost would be the same in the no-burn as in the burn scenario and would "cancel out" when the two scenarios were compared.[3] The assumption of "cancelling out" also could have been made for many of the inputs that are consistent between the two production alternatives, but all other costs were left in the analysis to show the complete production process. These "common" costs do cancel each other out in the final comparison. Net income reported in this report will be a return to land, management and risk.

Method of Comparing Alternatives

A net present value (NPV) analysis was used in this report to compare the burn and no-burn alternatives. Net returns were determined for each year in the investment period. All returns were then discounted to the beginning of the investment period and summed to obtain the NPV.

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[2] Bluegrass straw is an inadequate feed source for livestock and needs to be supplemented. Researchers at UI and WSU are currently working on methods to treat bluegrass straw to make it more acceptable as a livestock feed. It is uncertain at this point if the treatment methods will be economically viable.

[3] This assumption will hold as long as bluegrass production is the highest and best use of the land. If the land goes out of bluegrass production because of a "no-burn" ruling, land prices could increase if more profitable crops occupied the bluegrass acreage and could decrease if less profitable crops replaced bluegrass.

Budgeted costs were accumulated throughout the year, with harvesting taking place in July. For this analysis the assumption was made that all costs and returns occurred mid-year and were thus discounted accordingly to bring all returns to January 1 of the establishment year (e.g., the establishment cost of $213.19 was discounted 0.5 years and net returns from the first year of production were discounted 1.5 years, etc.). The assumed investment period included the establishment year and each subsequent production year. Because the investment periods between the burn and no-burn periods were of different lengths due to differences in productive stand life, an annuity equivalent was developed from the NPV's. This gave a annual equivalent value (discounted "average" yearly net return) that could be expected over the life of the investment (including the establishment year) that is directly comparable between the two alternative production systems. The difference between this annual equivalent can then be used to determine a "buy-out" value (if the buy-out was for multiple years, the annuity value would need to be discounted for years 2 and beyond to obtain a present value buy-out amount).

Another controversial point on many studies like this is determining an appropriate discount rate. A 10 percent discount rate is probably too high to discount the flows over time to obtain a NPV or annuity equivalent. The costs and returns used by Hinman and Schreiber were not adjusted for inflation or risk and therefore should be discounted by a real discount rate as opposed to a nominal discount rate. A discount rate of 2% to 6% is often used in such studies. A 4% rate for discounting cash flows was used in this study, with the 10% short-term interest rate used by Hinman and Schreiber maintained to determine operating interest for each production period.

Production Scenarios

Seven production scenarios were examined (Table 2). Each scenario varied by bluegrass seed yield and/or stand life. A seven-year stand life was assumed for the burn options. A two-year to four-year stand life was assumed for the no-burn options.

Scenario 1 uses the burn and no-burn yields and stand lives assumed by Hinman and Schreiber. Scenario 2 is the Hinman and Schreiber scenario, but with a two-year stand life for the no-burn alternative because the last two years of their four-year no-burn production life were not economically viable. Scenario 3, 4 and 5 use the same yield scenarios for the burn option. These yields are modified from Hinman and Schreiber by taking into account many producer's feelings that yields were more variable and would taper off before re-establishment. The no-burn yields in Scenario 3 assumed that equal yields were obtained between the burn and no-burn alternatives for three years; after which, yields would drop enough to require the stand to be re-established. Scenarios 4 and 5 modify the no-burn yields by assuming they taper off somewhat in the third year. Scenario 6 uses average historical yields obtained in Spokane County. The no-burn yield (368 lbs/acre) is the four-year average from 1997 through 2000 after no-burn production started to be used on a wide basis. The burn yield (485 lbs/acre) is the four-year average from 1993 to 1996, the four years prior to the no-burn ruling.

Results

The net present value results (NPV) are presented in Table 3. Annualized differences between the burn and no-burn alternatives varied from $22.58 to $166.06 depending upon the scenario examined. The lowest amortized values occurred when fully comparable yields were obtained between burn and no-burn alternatives for three years, after which, the no-burn field was re-established (Scenario 3). The highest amortized values were obtained using the Hinman and Schreiber yields (Scenario 1).

It is apparent from the amortized value analysis that keeping a bluegrass stand for any extended time if and when yields start to rapidly decline may not be economically prudent. For example, in Scenario 1, no-burn yields dropped in years three and four, whereas in Scenario 2, the stand was only maintained for two years. By re-establishing the stand after the second year of production (i.e., Scenario 2) the amortized difference between the burn and no-burn options was decreased $30 to $40.

Given the historical yields used for Scenario 6, the NPV and amortized values of the no-burn alternative were negative regardless of the value of bluegrass residue. The burn alternative, while less profitable, was able to maintain a positive return with yields of 485 lbs/acre.

The value placed on the baled bluegrass residue that is removed from the no-burn fields is an important economic factor. The NPV of the no-burn alternative scenarios increased from approximately $55/acre to over $100/acre with each $20/ton increase in residue value.

Other Factors Not Accounted for in This Study

There are several other factors that could influence the results of this analysis that were not included due to time and/or the lack of data currently available. These include:

1. When the bluegrass stands were left in for seven to 10 years under burning, producers did not have problems with wild oats and other weeds for up to three years in their rotation crop because the seed bank had been expended and the weeds had been choked out by the bluegrass. Some producers claimed that without burning, they now have weed problems in their rotation crops.

2. This study has not accounted for the reduced revenue that will occur if producers have to rotate out of bluegrass and into a less profitable crop for one or two years before they can re-establish a new stand. This rotation would come more frequently under a no-burn production system.

3. Some producers say that environmental conditions have a greater impact on seed production under a no-burn production system and present them with a more uncertain income stream.

Also, yields under both production systems are quite variable and will not be as consistent as maintained in this study. A stochastic simulation model would be able to account for this characteristic but was not used in this analysis because of time and data constraints.

4. An optimal rotation was not obtained for each bluegrass stand life but is a factor when examining profitability of burn versus no-burn alternatives as seen by in Scenarios 1 and 2.

5. Establishment of a bluegrass stand is not automatic. There is an approximate 15% probability that a stand will not establish the first year depending upon environmental conditions. Thus, some producers would rather have variable yields from a stand that is over seven years old than try to re-establish the stand. Re-establishing the stand more often under a no-burn scenario leaves the producer open to more re-establishment problems.

Table 1. Comparison of Bluegrass Seed Yields (per acre) from Various Studies and Producers.

	Period						
	1	2	3	4	5	6	7
Hinman & Schrieber [burn]	650	750	750	750	650	650	650
Hinman and Schreiber [no burn]	650	750	400	350			
Chastain et al [Abbey, burn]	1224	749	959				
Chastain et al [Abbey, bale]	1100	490	968				
Chastain et al. [Abbey, rake]	1242	766	1200				
Chastain et al. [Bristol, burn]	674	434	615				
Chastain et al. [Bristol, bale]	600	356	667				
Chastain et al. [Bristol, rake]	642	452	623				
Lamb [burn]	756	547					
Lamb [rake]	650	424					
Producer A [burn]	797	494	846	783	924	570	
Producer B [burn]	924	324	831	711	834		
Producer C [burn]	809	292	1133	680	760	450	
Producer C [no burn 1]	508	413	317				
Producer C [no burn 2]	405	425	371	159	134		
Producer D [burn]	615	1104	526				
Producer D [no burn]	743	592	390				

Table 2. Bluegrass Seed Yield (per acre) Scenarios for the Economic Analysis.

	Production Period						
	1	2	3	4	5	6	7
Scenario 1 [burn]	650	750	750	750	650	650	650
Scenario 1 [no-burn]	650	750	400	350			
Scenario 2 [burn]	650	750	750	750	650	650	650
Scenario 2 [no-burn]	650	750					
Scenario 3 [burn]	650	750	750	650	650	500	400
Scenario 3 [no-burn]	650	750	750				
Scenario 4 [burn]	650	750	750	650	650	500	400
Scenario 4 [no-burn]	650	750	500				
Scenario 5 [burn]	650	750	750	650	650	500	400
Scenario 5 [no-burn]	650	750	400				
Scenario 6 [burn]	485	485	485	485	485	485	485
Scenario 6 [no-burn]	368	368	368				

Table 3. Per Acre Net Present Value, Amortized (Annual) Value, and Difference in Amortized Value Between the Burn and No-Burn Bluegrass Seed Production Scenarios at Different Values for Bluegrass Residue.

		Net Present Value		Amortized Value		
Scenario	Residue $/Ton	Burn	No-Burn	Burn	No-Burn	Difference in Amortized Values
1	0	1222.28	68.94	181.54	15.49	166.06
	20	“	175.73	“	39.47	142.07
	40	“	282.51	“	63.46	118.08
2	0	1222.28	142.89	181.54	51.49	130.05
	20	“	198.38	“	71.49	110.06
	40	“	253.86	“	91.48	90.06
3	0	998.92	293.32	148.37	80.81	67.56
	20	“	374.96	“	103.30	45.07
	40	“	456.59	“	125.79	22.58
4	0	998.92	167.02	148.37	46.01	102.36
	20	“	248.66	“	68.50	79.87
	40	“	330.29	“	90.99	57.38
5	0	998.92	116.50	148.37	32.10	116.27
	20	“	198.14	“	54.59	93.78
	40	“	279.77	“	77.07	71.29
6	0	510.46	(252.93)	75.82	(69.68)	145.50
	20	“	(171.29)	“	(47.19)	123.01
	40	“	(89.66)	“	(24.70)	100.52

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Appendix

Table A1. Ordinary Least Squares Analysis of the Ability of the Wheat-to-Bluegrass Price Ratio and Bluegrass Seed Price to Explain Changes in Bluegrass Seed Harvested Acreage in Spokane County, 1985-2000.[a]

	Wheat-to-Bluegrass Price Ratio (all lags)	Wheat-to-Bluegrass Price Ratio (best lag)	Bluegrass Seed Price (all lags)	Bluegrass Seed Price (best lag)
Intercept	28,011.00 (14.55)*	25,845.00 (21.78)*	16,373.00 (6.56)*	18,166.00 (12.45)*
1-year lag	-327.03 (-1.07)		2,089.42 (0.89)	
2-year lag	-566.33 (-0.81)	-755.00 (-3.26)*	3,632.88 (1.54)	4,792.72 (2.98)*
3-year lag	-275.18 (-0.96)		1,377.52 (0.62)	
R^2	0.59	0.47	0.51	0.43

[a] Value in parenthesis is the t-statistic.
* Implies statistically significant at $P < 0.10$.

Table A2. Ordinary Least Squares Analysis of the Ability of the Wheat-to-Bluegrass Price Ratio and Bluegrass Seed Price to Explain Changes in Bluegrass Seed Harvested Acreage in the State of Washington.[a,b]

	Wheat-to-Bluegrass Price Ratio 1963-2000 (best lag)	Wheat-to-Bluegrass Price Ratio 1963-1995 (best lag)	Bluegrass Seed Price 1963-2000 (all lags)	Bluegrass Seed Price 1963-2000 (best lag)
Intercept	40,403.00 (10.20)*	37,817.00 (11.50)	26,718.00 (6.20)*	27,397.00 (7.51)*
1-year lag			5,625.34 (0.82)	10,355.00 (2.00)*
2-year lag	-1,111.10 (-1.58)	-1,057.63 (-1.83)*	2,117.55 (0.25)	
3-year lag			4,916.93 (0.72)	
R^2	0.07	0.11	0.12	0.10

[a] Value in parenthesis is the t-statistic.
[b] Missing data from 1982-1984 were interpolated fitting a cubic spline curve to the nonmissing data (SAS).
* Implies statistically significant at $P < 0.10$.

Table A3. Per Acre Cost and Return Estimates for the No-Burn Alternative Assuming a $40.00/Ton Value on Bluegrass Residue.				
Lbs. of Yield (Field Run):	1000.00	1153.85	615.38	538.46
Lbs. of Clean Seed :	650	750	400	350
Transport Cost per Lb. of Field Run Seed:	$0.015	$0.015	$0.015	$0.015
Cleaning Cost per Lb. of Clean Seed:	$0.125	$0.125	$0.125	$0.125
Insurance Cost per Lb. of Clean Seed:	$0.010	$0.010	$0.010	$0.010
Price Received per Lb. of Clean Seed:	$0.740	$0.740	$0.740	$0.740
Tons of Residue:	1.50	1.50	1.50	1.50
Price of Residue:	$40.000	$40.000	$40.000	$40.000
Gross Revenue	$541.00	$615.00	$356.00	$319.00
Production Year -->	Year 1	Year 2	Year 3	Year 4
Spray	20.75	20.75	20.75	20.75
Spot Spray	5.13	5.13	5.13	5.13
Swath	18.23	21.27	21.27	21.27
Combine	40.22	40.22	40.22	40.22
Transport Seed	15.00	17.31	9.23	8.08
Clean & Bag Seed	81.25	93.75	50.00	43.75
Insurance	6.50	7.50	4.00	3.50
Rake, Bale, Stack	46.50	46.50	46.50	46.50
Chop Grass	10.34	10.34	10.34	
Spray	9.59	9.59	9.59	8.06
Harrow (2x)	5.27	5.27	5.27	
Fertilize	58.22	58.22	58.22	
Erosion Control	2.00			
Service Truck	2.17	2.17	2.17	2.17
Shop Tools	1.36	1.36	1.36	1.36
Machine Shed & Shop	5.96	5.96	5.96	5.96
4x4 Pickup	9.10	9.10	9.10	9.10
Operating Interest	9.08	9.05	8.59	2.57
Overhead	14.68	15.44	12.65	8.63
Total Cost	361.35	378.93	320.35	227.05
Net Revenue	$179.65	$236.07	$35.65	$91.95

Data summarized from Hinman and Schreiber.

Table A4. Per Acre Cost and Return Estimates for the Burn Alternative.							
Lbs. of Yield (Field Run):	1000.00	1153.85	1153.85	1153.85	1000.00	1000.00	1000.00
Lbs. of Clean Seed :	650	750	750	750	650	650	650
Transport Cost per Lb. of Field Run Seed:	$0.015	$0.015	$0.015	$0.015	$0.015	$0.015	$0.015
Cleaning Cost per Lb. of Clean Seed:	$0.125	$0.125	$0.125	$0.125	$0.125	$0.125	$0.125
Insurance Cost per Lb. of Clean Seed:	$0.010	$0.010	$0.010	$0.010	$0.010	$0.010	$0.010
Price Received per Lb. of Clean Seed:	$0.740	$0.740	$0.740	$0.740	$0.740	$0.740	$0.740
Tons of Residue:							
Price of Residue:							
Gross Returns	$481.00	$555.00	$555.00	$555.00	$481.00	$481.00	$481.00
Production Year -->	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Spray	20.75	10.37	10.37	10.37	10.37	10.37	10.37
Spot Spray	5.13	5.13	5.13	5.13	5.13	5.13	5.13
Swath	18.23	18.23	18.23	18.23	18.23	18.23	18.23
Combine/Spray 10%	41.59	41.59	41.59	41.59	41.59	41.59	38.79
Transport Seed	15.00	17.31	17.31	17.31	15.00	15.00	15.00
Clean & Bag Seed	81.25	93.75	93.75	93.75	81.25	81.25	81.25
Insurance	6.50	7.50	7.50	7.50	6.50	6.50	6.50
Fertilize	43.22	43.22	43.22	43.22	43.22	43.22	
Erosion Control	2.00						
Burn	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Spray Roundup							6.49
Service Truck	2.17	2.17	2.17	2.17	2.17	2.17	2.17
Shop Tools	1.36	1.36	1.36	1.36	1.36	1.36	1.36
Machine Shed & Shop	5.96	5.96	5.96	5.96	5.96	5.96	5.96
4x4 Pickup	9.10	9.10	9.10	9.10	9.10	9.10	9.10
Operating Interest	6.80	6.42	6.42	6.42	6.29	6.29	3.02
Overhead	11.25	11.40	11.40	11.40	10.60	10.60	8.54
Total Cost	280.31	283.51	283.51	283.51	266.77	266.77	221.91
Net Returns	$200.69	$271.49	$271.49	$271.49	$214.23	$214.23	$259.09

Data summarized from Hinman and Schreiber