FARM LEVEL IMPACTS OF POTENTIAL REGULATIONS ON GLYPHOSATE RESISTANT SUGARBEET IN WYOMING

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Sugarbeet are an important crop in Wyoming, especially in the Big Horn Basin and southeast portion of the state. In 2011, 859,000 tons of sugarbeet were produced in Wyoming (NASS, 2012). This value ranked eighth in the nation in 2011 for total production. The total production in the United States was 29 million tons in the same year (NASS, 2012).

The Roundup Ready technology made its way into the sugarbeet market in 2007 when Roundup Ready sugarbeet were introduced. Roundup Ready sugarbeet have since seen a 95 percent acceptance among producers nationally (Bartlett, 2011). Roundup Ready sugarbeet have a gene implanted in them to make them resistant to the herbicide Roundup (glyphosate). This glyphosate resistant (GR) technology allows producers to streamline their herbicide programs by allowing glyphosate application to a growing field of sugarbeet to control weeds without harming the crop and potentially reducing labor needs. However, the high adoption rate has led to another source of uncertainty for producers. There are concerns about potential environmental impacts of GR sugarbeet and effects on organic crops. These concerns may lead to regulation of the technology, which has the potential to impact sugarbeet producers nationwide.

Conventional and GR Sugarbeet Comparison

An economic evaluation was conducted to compare profitability of irrigated conventional and GR sugarbeet using historical price data. A Monte Carlo simulation created numerous potential combinations of profit estimates based on historical data and correlations across the various prices. A Monte Carlo simulation essentially creates extra years of data using a random draw from the established data. Our analysis generated 10,000 observations of prices based on historical data and allowed comparing systems across a wide range of potential economic outcomes. Using these data, average profitability of the alternative systems (conventional and GR) were conducted on a per-acre basis. Given the wide range of production practices across the state, the analysis included two conventional systems, a low-cost approach and a high-cost approach. Both conventional systems

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have an estimated 24 ton/acre yield. The main difference between the two conventional systems is that the high-cost approach includes more tillage and a more expensive herbicide program. It was assumed that GR sugarbeet had a 2 ton/acre yield increase over conventional sugarbeet. Past publications have set the yield increase for GR sugarbeet anywhere from 5 to 15 percent (Kniss et al., 2004, Kniss, 2010). A $75/acre technology fee for GR sugarbeet was assumed for this analysis. Considering all of this information, it was found that GR sugarbeet were on average $95.65/acre more profitable than their low-cost conventional counterparts, and $223.73/acre more profitable than the high-cost system. Considering the 2 ton/acre yield increase, at no time during the analysis were conventional sugarbeet more profitable than GR sugarbeet. However, the analysis also was estimated with no yield increase for GR sugarbeet. The resulting estimates without the additional yield indicate that the low-cost conventional sugarbeet were on average $20.91/acre more profitable, mainly due to the fact the producer would still have paid the technology fee for GR sugarbeet. A 0.33 ton/acre increase from GR sugarbeet is needed for GR sugarbeet to breakeven with their low-cost conventional counterparts.

Table 1. Profit distribution results of glyphosate resistant and conventional sugarbeet

	High Cost Conventional, 24 Ton/Ac.	**Low Cost Conventional, 24 Ton/Ac.**	**Roundup Ready, 24 Ton/Ac.**	**Roundup Ready, 26 Ton/Ac.**
Min	$ (348.14)	$ (215.09)	$ (236.00)	$ (153.65)
Max	$ 2,891.38	$ 3,019.49	$ 2,998.58	$ 3,315.54
Mean	$ 590.14[D]	$ 718.22[B]	$ 697.31[C]	$ 813.87[A]

Note: Superscript letters denote significant difference in the means at the 0.05 level

Whole-farm Model

The second part of this analysis included a whole-farm analysis. The whole-farm model was designed to allow an in-depth examination of sugarbeet production in a farm setting. The motivation behind the whole-farm model is to determine optimal crop mixes aimed at maximizing profit based on varying input prices and output prices. This model also utilized a Monte Carlo simulation designed to evaluate the potential to grow more or less acres of crops on the farm if the profitability of a crop such as sugarbeet changes relative to the other crops in the rotation. The model determines optimal cropping decisions for each random draw of prices within set crop rotation constraints. Crops used in the whole-farm model were the low-cost conventional and/or GR sugarbeet (with the assumed 2 ton/acre yield increase), corn, wheat, dry beans, and alfalfa. Several scenarios are analyzed, mostly based around GR and conventional sugarbeet acreage. This was done to examine profitability under scenarios where GR sugarbeet restrictions may occur.

The case farm was modeled around a typical irrigated farm in southeast Wyoming. There are 303 acres of available cropland on the model farm. Profitability of the farm, based on optimal acres of each crop, is determined as crop output prices, fuel price, and multiple fertilizer prices vary. Historical prices from the National Agricultural Statistics Service (NASS) and the Economic Research Service (ERS) were used to create the price data needed for the Monte Carlo simulation.

Table 2 shows the various scenarios analyzed. Due to rotational constraints, sugarbeet can only be produced once in three years. Corn on the other hand is constrained to one-half of the total acres, discouraging back-to-back corn cropping.

In scenarios A, B, and C, sugarbeet had to be grown on exactly one-third of the acres on the farm (101 acres), which simulates a scenario where a producer holds sugarbeet contracts equal to the maximum production allowed based on agronomic recommendations. In scenario A, the model could choose between conventional sugarbeet or GR sugarbeet, whereas scenario B forced the farm to grow only GR sugarbeet, and scenario C only allowed conventional sugarbeet. The model also was set so that dry bean acres must be the same as sugarbeet acres produced for rotational purposes.

Scenarios D, E, and F are similar to the first three except that the producer is allowed to produce less than one-third of the total farm acreage to sugarbeet. This allows for greater acres of other crops to be grown in place of sugarbeet if that were more profitable a given set of prices in a year. This would simulate a situation where a producer could adjust the amount of acres of sugarbeet that could be grown in any given year (for example, in the absence of sugarbeet contracts). As in scenarios A, B, and C, corn cannot be grown on more than half of the total acres, and dry beans must be the same number of acres as sugarbeet for rotation purposes. In scenario D, the producer can choose between conventional and GR sugarbeet, scenario E must be GR sugarbeet, and scenario F must be conventional sugarbeet.

Scenario G simulates a situation where no conventional or GR sugarbeet are available to the producer. This might be a case where GR sugarbeet are regulated and not enough conventional beet seedstock exists. The producer must choose from other crops, but corn cannot be more than two-thirds of the total acreage. While this practice would be discouraged in the long-run, it is expected that if sugarbeet seed was unavailable, producers would likely substitute toward corn until sugarbeet seed could be sourced. This scenario has the highest potential profit but also the greatest risk.

Table 2. Acreage constraints as a fraction of total acreage by scenario

<table>
<tr><th>Scenario</th><th>A</th><th>B</th><th>C</th><th>D</th><th>E</th><th>F</th><th>G</th></tr>
<tr><td colspan="8">Acreage constraints:</td></tr>
<tr><td>CSB</td><td rowspan="2">1/3</td><td>-</td><td>1/3</td><td rowspan="2">≤ 1/3</td><td>-</td><td>≤ 1/3</td><td>-</td></tr>
<tr><td>GRSB</td><td>1/3</td><td>-</td><td>≤ 1/3</td><td>-</td><td>-</td></tr>
<tr><td>C</td><td>≤ 1/2</td><td>≤ 1/2</td><td>≤ 1/2</td><td>≤ 1/2</td><td>≤ 1/2</td><td>≤ 1/2</td><td>≤ 2/3</td></tr>
<tr><td>DB</td><td>= GRSB or CSB</td><td>= GRSB</td><td>= CSB</td><td>= GRSB or CSB</td><td>= GRSB</td><td>= CSB</td><td>-</td></tr>
</table>

Note: CSB means Conventional Sugarbeet, GRSB means GR Sugarbeet, C means Corn, and DB means Dry Beans

Results and Conclusions

Profitability by scenario as estimated by the whole-farm Monte Carlo simulation is shown in Table 3. Farming systems with sugarbeet are 5 percent more profitable than those without. Findings suggest that producers should be willing to pay on average about $73.40/acre for a sugarbeet contract, although these prices are set by the sugarbeet co-ops. If, however, a ban on GR sugarbeet occurs and producers grow conventional sugarbeet, profits would be 4.7 percent lower.

Our analysis suggests sugarbeet are a relatively less risky crop than other crop choices based on the coefficients of variation (CV), which is a measure of variability within a distribution (the larger the CV, the more widespread the distribution is, implying less certainty regarding annual profitability). Profitability has a wider range (as seen by the larger CV) in the scenarios with no sugarbeet, implying more risk. Based on the assumed increase in yield, it can be concluded that GR sugarbeet should be produced as long as they are available. As expected, scenarios D and E (the scenarios with the least restriction on crop acreage, yet still allowed GR sugarbeet) had the highest average profit with a similar CV as scenarios A and B.

While sugarbeet acreage in a crop rotation can reduce variability in profit, relying more heavily on corn in a crop rotation has the ability to potentially increase annual profitability but also increase variability in farm profits across years. This is due to the high potential profit from corn but also the potential of much lower per-acre profits. Excluding sugarbeet from production results in the potential to obtain a higher maximum profit; however, the risk involved increases significantly. Table 4 displays the range of potential profits for all of the crops used in this analysis.

Overall, our results suggest a ban of GR sugarbeet will have a negative impact on profitability for Wyoming sugarbeet producers. Average profitability would decrease while risk for an operation would increase. The loss of GR sugarbeet can create more risk for an operation due mainly to the lower productivity of conventional beets. Dry beans are the most profitable crop on average after conventional and GR sugarbeet. Corn is a relatively risky crop compared to the other options, although it has the highest maximum potential profit. These results suggest that the ability to adjust crop acreages can help reduce the negative impacts on profits compared to the per-acre analysis reported previously.

Table 3. Distributions of profitability by scenario in whole-farm model

Scenario	Max	Min	Average	95% CI +/-	SD	CV
A	$549,800.00	$35,889.06	$165,199.94[B]	$891.20	$45,470.15	0.28
B	$549,800.00	$35,889.06	$165,199.94[B]	$891.20	$45,470.15	0.28
C	$542,600.00	$30,033.30	$156,797.69[D]	$866.77	$44,223.78	0.28
D	$754,400.00	$47,620.47	$169,150.57[A]	$941.14	$48,018.11	0.28
E	$754,400.00	$47,620.47	$169,150.57[A]	$941.14	$48,018.11	0.28
F	$749,100.00	$45,461.15	$161,620.96[C]	$923.84	$47,135.56	0.29
G	$1,083,000.00	$27,998.69	$157,106.25[D]	$1,448.62	$73,910.56	0.47

Note: Superscript letters denote significance in the means at the 0.05 level

Table 4. Profitability distributions of all crops used in whole-farm model on a per-acre basis

	CSB	GRSB	C	W	DB	A
Max	$1,927.83	$2,128.86	$4,516.18	$1,336.37	$3,572.64	$741.58
Min	-$42.73	-$9.38	-$550.70	-$84.21	-$278.01	-$94.28
Average	$726.48	$809.66	$262.47	$188.18	$409.45	$273.66
95% CI +/-	$4.93	$5.34	$6.08	$3.22	$5.32	$1.97

Note: CSB means Conventional Sugarbeet, GRSB means GR Sugarbeet, C means Corn, W means Wheat, DB means Dry Beans, and A means Alfalfa

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