

# **ROUNDUP READY VERSUS CONVENTIONAL COTTON VARIETIES: CASE STUDIES FROM THE SOUTHERN HIGH PLAINS REGION OF TEXAS**

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## **Abstract**

This paper compares the profitability and cost of production of irrigated Roundup Ready<sup>®</sup> cotton varieties and conventional cotton varieties grown under crop share rental agreements in the Texas High Plains Region for 1998. The Standardized Performance Analysis (SPA) program was used to analyze 25 sub-enterprises for each variety type from six producers selected from the regional SPA database for 1998. The results indicate that the Roundup Ready<sup>®</sup> cotton varieties were more profitable with returns to operator labor, management and risk 23% greater than conventional cotton varieties. Costs for weed control and seed for Roundup Ready<sup>®</sup> cotton varieties were \$11.79/acre greater than conventional varieties. The increased profitability for the Roundup Ready<sup>®</sup> cotton resulted from higher lint yields.

## **Introduction**

The introduction of Monsanto's Roundup Ready<sup>®</sup> cotton has provided Texas High Plains producers with a new approach for enhancing production efficiency and protecting against yield loss. Roundup Ready<sup>®</sup> cotton varieties, which became commercially available in 1997, allow for over-the-top Roundup<sup>®</sup> Ultra herbicide applications. This ability gives producers an additional tool to use against problem weed infestations and may also be beneficial in conservation and reduced tillage production systems.

Weed control is a significant production expense for many farmers. The early method of controlling weeds was physical hoe labor. Although this method is still used, the development of effective pre-emergence and post-emergence herbicides has provided producers with a more cost-effective system for weed control. Pre-emergence herbicides provide farmers with effective control of many annual weeds. However, they have limited effectiveness against perennial weeds such as silverleaf nightshade, woollyleaf bursage, and field bindweed (Everitt et al., 1999). These weeds are becoming an increasing nuisance for Texas High Plains farmers as they infest more acreage each year.

Monsanto's Roundup<sup>®</sup> Ultra is a widely used broad-spectrum herbicide that is highly successful in killing many annual weeds, as well as many perennial weeds that pre-emergence herbicides fail to control. In the past, farmers could only use Roundup<sup>®</sup> Ultra as a pre-plant weed control treatment. Through the application of biotechnology, farmers now have the option to use Roundup<sup>®</sup> Ultra in controlling some of their perennial weeds in-season (Everitt et al., 1999).

The development of Roundup Ready<sup>®</sup> cotton varieties began in the early 1980s with the purpose of providing farmers a new method for enhancing production efficiency and protecting against yield loss. The result was the development of cotton varieties containing a gene significantly more tolerant to Roundup<sup>®</sup> Ultra than conventional varieties. This technology allows farmers to spray the herbicide over-the-top of their cotton up to the four-leaf stage. Roundup Ready<sup>®</sup> field trials began in 1991, with commercialized distribution in 1997 through the Delta and Pine Land Company. In the first year of commercial use, Roundup Ready<sup>®</sup> cotton was planted on over

800,000 acres (Heering et al., 1998). Out of approximately 1,700 growers that were surveyed during that first year, 90% were found to be either satisfied or very satisfied with the product's results. Roundup Ready<sup>®</sup> cotton has continued to grow in popularity, reaching over 5 million planted acres in 1998 (Heering et al., 1998).

Benefits of Roundup Ready<sup>®</sup> cotton may include increased yield and fiber quality since farmers are able to control weeds that were not previously controlled through hoe labor or pre-emergence herbicides. This technology may also reduce weed control cost by decreasing the amount of hoe labor required. Another potential benefit of Roundup Ready<sup>®</sup> cotton is that it should allow for more effective use of conservation tillage systems. Conservation is becoming a significant farming practice and conservation tillage production systems using a wheat or rye cover crop have gained acceptance on the Texas High Plains. However, achieving effective weed control using conservation tillage can be more difficult than in conventional tillage systems (Keeling and Dotray, 1997). Roundup Ready<sup>®</sup> cotton has helped eliminate this problem by decreasing the number of trips through the field and increasing the level of weed control.

While Roundup Ready<sup>®</sup> cotton has many advantages over conventional varieties, several drawbacks also exist. Allowing producers the ability to spray Roundup<sup>®</sup> Ultra up to the four-leaf stage may increase the possibility of product misuse. For example, many farmers may continue to spray the herbicide beyond label specifications for additional weed control. Several studies have shown that cotton yield can be negatively impacted when Roundup<sup>®</sup> Ultra is applied beyond the labeling recommendations (Webb et al., 1999). Additionally, although the product offers potential decreases in hoe labor and chemical costs, it has a significantly higher seed price,

with a \$21/bag technology fee and a \$3/bag seed premium. This leads to a situation where the adoption of Roundup Ready<sup>®</sup> varieties will only be profitable if the marginal decreases in chemical and hoe labor costs and/or the marginal increase in production are greater than the marginal increase in seed cost.

### **Problem Statement**

Producers in the Texas High Plains planted approximately 1.4 million acres of Roundup Ready<sup>®</sup> cotton in 1998 (Campbell, 1999). Considerable research has been conducted in this region on the quality of Roundup Ready<sup>®</sup> cotton bolls, lint, and yields. Studies have also been conducted on the effects of Roundup<sup>®</sup> Ultra applications after certain growth stages. However, there has been little research in the Texas High Plains concerning the profitability of Roundup Ready<sup>®</sup> cotton. There is a need for this type of information to compare the benefits of planting Roundup Ready<sup>®</sup> cotton varieties with the additional production costs.

### **Objectives**

The general objective of this study was to evaluate the financial benefits and costs of Roundup Ready<sup>®</sup> cotton compared to the benefits and costs of conventional cotton varieties. The specific objectives were to evaluate management practices for Roundup Ready<sup>®</sup> varieties compared to conventional cotton varieties, and to evaluate the additional costs and returns of using Roundup Ready<sup>®</sup> cotton varieties compared to conventional cotton varieties.

## **Methods and Procedures**

This study was conducted using the Standardized Performance Analysis – Multiple Enterprise (SPA-ME) computer program. The SPA-ME program allows for the performance of whole farm financial and economic analyses as well as enterprise and sub-enterprise analyses (Clark and Johnson, 1998). SPA utilizes production, financial, and marketing information obtained from producers to construct accrual adjusted financial statements. The financial information from the balance sheets and income statement is allocated to individual crop enterprises, which are then allocated to sub-enterprises representing a specific farm or field (Clark and Johnson, 1998). The ability to allocate cost and return information to separate enterprises allows the evaluation of conventional and Roundup Ready<sup>®</sup> cotton varieties on an individual farming operation.

SPA was used to perform integrated production and financial analysis on farming operations in the Texas High Plains Region for 1998. After evaluating the SPA database of approximately 15 producers, six were selected for this study. Participants were chosen from Crosby, Hale, and Lubbock counties based on their choice to plant both conventional and Roundup Ready<sup>®</sup> cotton varieties in the 1998 crop year. Twenty-five irrigated sub-enterprises for each cotton type were obtained from these producers, representing 2,768 acres of conventional cotton and 2,970 acres of Roundup Ready<sup>®</sup> cotton. Conventional cotton varieties planted included Atlas, Paymaster 145, and Paymaster HS 26. Roundup Ready<sup>®</sup> varieties included Paymaster Roundup Ready<sup>®</sup> 2200, Roundup Ready<sup>®</sup> Tejas, Paymaster Roundup Ready<sup>®</sup> 2145, and Paymaster Roundup Ready<sup>®</sup> 2326. All six producers applied pre-plant herbicide, and used approximately 2 quarts/acre of Roundup<sup>®</sup> Ultra herbicide on their Roundup Ready<sup>®</sup> cotton. Producers applied

more harvest aid chemicals on their Roundup Ready<sup>®</sup> varieties than on conventional varieties, especially on Paymaster Roundup Ready<sup>®</sup> 2145.

### **Results**

Tables 1 and 2 summarize production and income measures for conventional and Roundup Ready<sup>®</sup> cotton varieties on a per acre and per pound basis. Crop share yield for the conventional cotton varieties was 346 pounds/acre, based on a 75% crop share rental (461 pounds/acre total yield). Crop share yield for the Roundup Ready<sup>®</sup> cotton varieties was 416 pounds/acre (555 pounds/acre total yield). All observations were from cotton production under a 75% crop share rental agreement. The average cotton lint price was approximately \$0.58/pound for both variety types.

Income measures shown in Table 1 indicated that Roundup Ready<sup>®</sup> cotton had \$33/acre higher gross accrual revenue compared to conventional cotton. This situation was due primarily from greater enterprise primary product revenue of \$239.55/acre compared to \$203.63/acre for conventional cotton. Crop insurance proceeds were higher for Roundup Ready<sup>®</sup> cotton, possibly because farmers insured these varieties for more due to the higher costs associated with the Roundup Ready<sup>®</sup> system. It should also be noted that conventional cotton had higher government payments than Roundup Ready<sup>®</sup>, and that the two varieties shared similar other income values of \$39.16/acre and \$43.27/acre, respectively. There is no apparent reason for the higher level of government payments for the Roundup Ready<sup>®</sup> cotton other than the random selection of the farms planted to Roundup Ready<sup>®</sup> varieties within each farming operation.

The Roundup Ready<sup>®</sup> varieties showed higher operating costs as shown in Table 1. Roundup Ready<sup>®</sup> cotton had a total operating cost of \$213.59/acre compared to \$193.36/acre for conventional cotton. Chemicals, irrigation, seed, and hoe labor represented the most significant difference in operating costs between varieties. Roundup Ready<sup>®</sup> cotton's total chemical cost was \$35.42/acre compared to \$22.45/acre for conventional cotton. The higher chemical cost was due primarily from greater herbicide and harvest aid expenditures. Roundup Ready<sup>®</sup> varieties allow the spraying of Roundup<sup>®</sup> Ultra herbicide over-the-top of cotton up to the fourth leaf stage, which may have contributed to the greater herbicide cost of \$22.07/acre for Roundup Ready<sup>®</sup> compared to \$14.78/acre for conventional varieties. Roundup Ready<sup>®</sup> cotton also had greater harvest aid costs of \$6.29/acre compared to \$1.63/acre on conventional cotton, and greater irrigation expenses of \$47.71/acre compared to \$40.93/acre on conventional cotton. This may have been due to variety differences and different production practices. Roundup Ready's<sup>®</sup> higher seed cost of \$15.92/acre compared to \$9.72/acre for conventional cotton was due to a \$21/bag technology fee and \$3/bag seed premium.

Although Roundup Ready<sup>®</sup> cotton had higher seed, irrigation, and chemical costs than conventional varieties, hoe labor cost of \$1.81/acre was less than the hoe labor expense of \$3.51/acre for the conventional cotton. This situation may have resulted from the fact that producers were able to apply Roundup<sup>®</sup> Ultra through the fourth leaf stage on Roundup Ready<sup>®</sup> varieties; therefore, hoe labor may not have been used until later in the season. The expenses associated with insurance, supplies, and machinery leases were similar between conventional and Roundup Ready<sup>®</sup> cotton. Depreciation and interest expenses were also similar for both cotton types.

The unit cost of production was \$167.00/acre and \$144.70/acre for Roundup Ready<sup>®</sup> and conventional cotton, respectively. Unit cost of production is calculated by adjusting total cost of production by non-primary product revenue. The breakeven price is the unit cost of production divided by the yield and was \$0.40/pound for Roundup Ready<sup>®</sup> cotton, compared to \$0.42/pound for conventional cotton (Table 2). These results indicate that even with higher operating cost, Roundup Ready<sup>®</sup> cotton had a lower breakeven cost per pound due to a higher per acre yield.

### **Summary and Conclusions**

Overall, Roundup Ready<sup>®</sup> cotton was found to be more profitable than conventional cotton, as indicated by a net income (returns to operator labor, management and risk) of \$72.55/acre compared to \$58.93/acre for conventional cotton. Although Roundup Ready<sup>®</sup> cotton had operating expenditures that were \$20.23/acre higher than conventional cotton, these expenses were sufficiently offset by primary product revenue that was \$35.92/acre greater. Weed control cost (herbicide plus hoe labor) was \$23.88/acre for the Roundup Ready<sup>®</sup> cotton versus \$18.33/acre for conventional varieties. When the additional seed cost of the Roundup Ready<sup>®</sup> varieties is combined with weed control cost, the Roundup Ready<sup>®</sup> varieties had an additional \$11.79/acre in operating cost for these inputs. Therefore, an increased yield response for the Roundup Ready<sup>®</sup> varieties was necessary to provide the increased profitability shown. A limitation of this study was the availability of only one year's data. While Roundup Ready<sup>®</sup> varieties were more profitable in 1998, additional years of data and analysis are needed.

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**Table 1. Total Enterprise Crop SPA Measures**

	\$/Acre*	
	Conventional	Roundup Ready
<b>Production</b>		
Total Enterprises	25	25
Total Acres	2,768	2,970
Total Production (Pounds)	461	555
Crop Share Production (Pounds)**	346	416
<b>Gross Revenue</b>		
Enterprise Primary Product	203.63	239.55
Government Payments	52.99	41.86
Crop Insurance	0.17	4.26
Other Income***	39.16	43.27
<b>Gross Accrual Revenue</b>	<b>295.95</b>	<b>328.94</b>
<b>Select Cost Items</b>		
Total Chemicals		
-Herbicide	14.78	22.07
-Insecticide	3.26	4.67
-Harvest Aids	1.63	6.29
-Other Chemicals	2.78	2.39
Fertilizer and Lime	14.41	14.08
Gasoline, Fuel, and Oil	10.09	11.10
Irrigation	40.93	47.71
Seed Cost	9.72	15.92
Repair Cost	18.82	16.96
Hired Labor and Management	26.45	25.65
Hoe Labor	3.51	1.81
Insurance	9.81	12.47
Leases (Mach and Equip)	14.79	14.18
Supplies	11.48	10.09
Other Expenses****	10.90	8.20
<b>Total Cash Operating Costs</b>	<b>193.36</b>	<b>213.59</b>
Depreciation Expense	29.51	27.64
Interest Expense	14.15	15.16
<b>Total Overhead Cost</b>	<b>43.66</b>	<b>42.80</b>
<b>Total Cost</b>	<b>237.02</b>	<b>256.39</b>
<b>Net Income</b>	<b>58.93</b>	<b>72.55</b>
<b>Unit Cost of Production</b>	<b>144.70</b>	<b>167.00</b>

\*Total production and financial values were calculated using weighted averages based on number of acres.

\*\*Crop share production was based on a 75% crop share lease agreement.

\*\*\*Other income includes co-op distributions, custom hire earnings, and miscellaneous income.

\*\*\*\*Other expenses include custom hire, insurance, rents, supplies, and miscellaneous expenses.

**Table 2. Total Enterprise Crop SPA Measures**

	\$/Pound	
	Conventional	Roundup Ready
<b>Gross Revenue</b>		
Enterprise Primary Product	0.58	0.58
Government Payments	0.15	0.10
Crop Insurance	0.00	0.01
Other Income*	0.11	0.10
<b>Gross Accrual Revenue</b>	<b>0.86</b>	<b>0.79</b>
<b>Select Cost Items</b>		
Total Chemicals		
-Herbicide	0.04	0.05
-Insecticide	0.01	0.01
-Harvest Aids	0.00	0.02
-Other Chemicals	0.01	0.01
Fertilizer and Lime	0.04	0.03
Gasoline, Fuel, and Oil	0.03	0.03
Irrigation	0.12	0.11
Seed Cost	0.03	0.04
Repair Cost	0.05	0.04
Hired Labor and Management	0.08	0.06
Hoe Labor	0.01	0.01
Insurance	0.03	0.03
Leases (Mach and Equip)	0.04	0.03
Supplies	0.03	0.02
Other Expenses**	0.03	0.02
<b>Total Cash Operating Costs</b>	<b>0.56</b>	<b>0.51</b>
Depreciation Expense	0.09	0.07
Interest Expense	0.04	0.03
<b>Total Overhead Cost</b>	<b>0.13</b>	<b>0.10</b>
<b>Total Cost</b>	<b>0.69</b>	<b>0.62</b>
<b>Net Income</b>	<b>0.17</b>	<b>0.17</b>
<b>Cost of Production</b>	<b>0.42</b>	<b>0.40</b>

\*Other income includes co-op distributions, custom hire earnings, and miscellaneous income.

\*\*Other expenses include custom hire, insurance, rent, supplies, and miscellaneous expenses.