Harvest at Risk

Impacts of Roundup Ready Wheat in the Northern Great Plains

Executive Summary

By the end of 2002, a significant number of foreign buyers of hard red spring wheat grown in the Northern Great Plains had told the grain trade and farm organizations that the planting of Roundup Ready (RR) wheat would lead them to look elsewhere for grain that was not genetically engineered. In March 2004, a delegation from Japan delivered to wheat industry leaders in North Dakota a petition signed by 414 organizations urging the rejection of RR wheat (Reuters News Service 2004). Japan would turn to Canada and Australia for non-GE wheat if RR varieties were planted in the U.S., according to the delegation.

Fear of market rejection and lower prices mobilized many in the wheat industry first to raise questions, and then to openly oppose commercial release of Roundup Ready (RR) hard red spring wheat. The questions slowed the pace of regulatory reviews and delayed final approval. This gave scientists, farmers, and environmentalists more time to develop, compile and analyze information on the potential problems and consequences of commercial release of RR wheat. New information led to more questions and deeper concerns, and as a result, more and more individuals, and wheat industry organizations spoke out against the technology.

On May 10, 2004, the technology developer, Monsanto Company, suspended further efforts to gain government approval and market RR spring wheat. Carl Casale, a Monsanto executive vice president, stated that–

> *"As a result of our [R+D] portfolio review and dialogue with wheat industry leaders, we recognize the business opportunities with Roundup Ready spring wheat are less attractive relative to Monsanto's other commercial priorities."*
>
> (Monsanto Company 2004)

Some wheat industry leaders and organizations appear ready to make another push for approval of genetically engineered wheat. Sherman Reese, Vice President of the National Association of Wheat Growers, said at an industry meeting in February 2005 that –

> *"The hope and promise of biotechnology is so compelling…the faster we can do it, the better off we'll be."*
>
> (Gillam 2005)

An estimate by Iowa State University economist Dr. Robert Wisner that approval of RR wheat would trigger a loss of up to one-half of today's export sales and a 33% decline in average market prices clearly played a role in solidifying opposition in the wheat industry to approval of the technology under the current circumstances. It remains unlikely that the technology will be adopted until these projected impacts are substantially reduced.

If these circumstances change, however, and the industry reverses its united opposition to Roundup Ready wheat, Monsanto will almost certainly move quickly to push the technology through the remainder of the government approval process. As farmers across the Northern Great Plains plant the first crop of RR spring wheat, a high-stakes experiment will unfold. Will farmers who grow RR wheat be rewarded with lower operating costs, or higher yields? What are the potential costs of adoption? On balance, would farmers who adopt the technology benefit? What would be the impact on farmers who choose not to adopt the technology?

This report strives to describe the probable consequences of RR wheat adoption and to project economic impacts on growers and across the industry.

Potential Need

The popularity of Roundup Ready soybean, corn, and cotton varieties stems from three factors – simplicity, robustness, and effectiveness. RR weed management systems require little management attention and only basic proficiency in the operation of spray equipment.

It is a robust and forgiving system, in that over- or under-application of glyphosate (Roundup) herbicide will not spell disaster, nor will an equipment breakdown or bad weather that delays spray operations. It will work in conjunction with any tillage and planting system, and requires only the most basic spray equipment.

Because the herbicide mixing, loading, and application processes are simpler, it takes less time to cover a given field and all the fields managed by a farmer. As a result, RR technology helps producers cover more ground and expand farm size, while still achieving good weed control.

Roundup Ready wheat, if commercialized, would deliver the same sort of benefits to spring wheat growers, at roughly the same percentage increase in seed costs. To get a complete picture of the costs and benefits of RR wheat, it is important to look at whether RR wheat might solve other problems faced by wheat farmers, or perhaps set the stage for some new ones to emerge or existing problems to worsen.

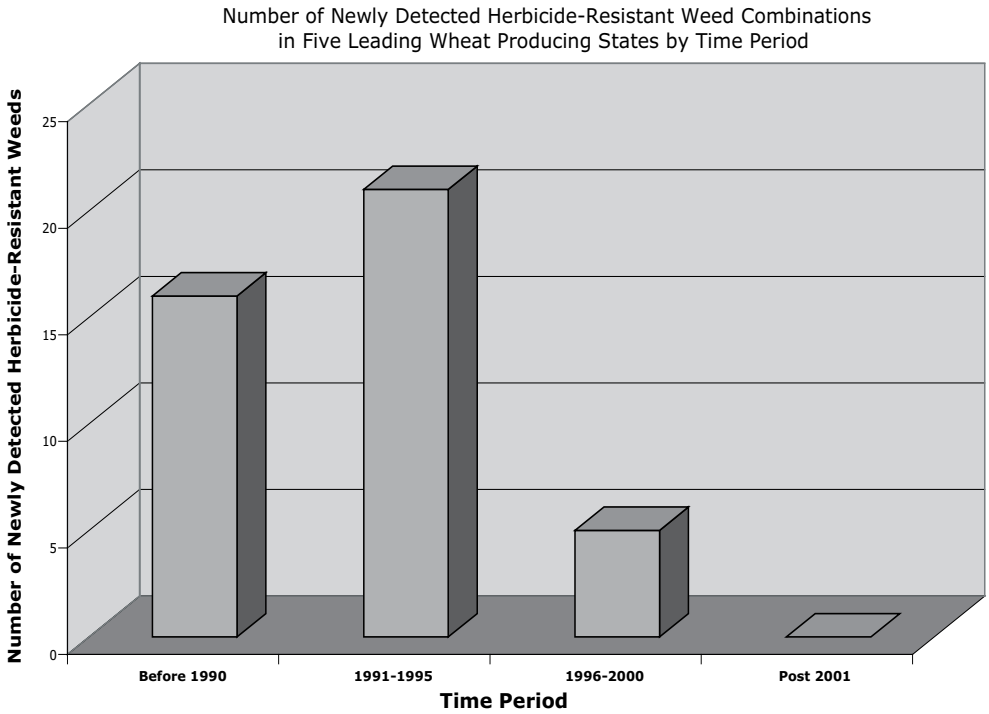
There is no evidence that wheat herbicide efficacy is slipping in the Northern Great Plains. A detailed examination of the herbicides applied over the last decade supports the conclusion that growers have largely stuck with products that both work and are priced competitively. Over most of the last 10 years, between 83% and 93% of wheat acres have been treated with the top two products – MCPA and 2,4-D.

In addition, herbicide alternatives abound. In 1992 and 1995, USDA reported the use of 13 herbicides on one percent or more of national hard red spring wheat acreage. By 2000, the number had risen to 18. Ten more herbicides were registered for use on wheat but were not used widely enough for USDA to include them in its survey results. Since 2000, several new products have entered the market. In addition, the 30-plus herbicide active ingredients now on the market are formulated into well over a dozen premixes containing two to four active ingredients.

The emergence of weed biotypes resistant to wheat herbicides emerged as a significant problem in the late 1980s and grew worse for about 10 years. Thirty-seven resistant weeds were documented by scientists from 1985 through 1994. The spread of resistance markedly slowed in the second half of the 1990s, a period during which only five new resistant biotypes were documented. Not a single additional resistant weed has emerged since, as evident in Figure 1.

The absence of any new cases of resistant weeds in the last five years is evidence that spring wheat growers are now doing a good job managing weed

Figure 1.



resistance. They have diversified their selection and use of herbicides. Equally important, herbicides bear only a portion of the weed management burden in spring wheat production. Crop rotations and tillage are integral weed management practices on the majority of the farms growing spring wheat.

The costs of weed control are not rising. Indeed, USDA data show that average herbicide costs have fallen modestly over the last several years, largely as a result of lower prices for many widely used products that have gone off patent. In addition, the low cost of many older but still effective herbicides caps the prices that herbicide manufacturers can charge for new chemistry.

Roundup Ready Crops and No-Till

Roundup Ready technology is highly compatible with no-till planting systems. Only about 9% of hard red spring wheat acres were planted using no-till in 1998 in the Northern Great Plains region (Ali 2002). Such systems are used with success throughout the region, and in years with limited moisture, no-till yields are often higher than in nearby fields that were tilled and planted with conventional equipment. Still, many farmers are hesitant to adopt no-till because it slows down the warming of the soil in the spring, can lead to uneven germination, and sacrifices yield in years with ample or more than ample rainfall. No-till fields are also more susceptible to certain pest problems.

Roundup Ready wheat technology will not significantly enhance the ease, efficacy, or profitability of no-till systems in the Northern Great Plains. One new disadvantage will also emerge. Once RR wheat is widely planted, volunteer RR wheat will be harder to control along roads, rights of way, and in public places, where glyphosate is often the herbicide of choice. Farmers planting Roundup Ready soybeans, corn, or canola will also have problems when RR wheat volunteers germinate. For these reasons, it is unlikely that the commercial release of RR wheat will greatly change the number of farmers utilizing no-till planting systems.

Monsanto and other promoters of RR wheat have claimed that a switch to RR technology and wider use of glyphosate will reduce the public health and environmental impacts of herbicide use in wheat production areas. This claim rests on the often-repeated assertion that glyphosate is relatively non-toxic compared to other herbicides, and quickly breaks down to benign chemicals. Recent research, however, has raised troubling questions about the safety of glyphosate and formulated Roundup herbicides. A study published in the June 2005 issue of *Environmental Health Perspectives*, a publication of the National Institute of Environmental Health Sciences, found that glyphosate is toxic to human placental cells at concentrations below those found with agricultural use (Richard et al., 2005). According to the French scientists who carried out the work –

> *"…glyphosate acts as a disruptor of mammalian cytochrome P450 aromatase activity from concentrations 100 times lower than recommended use in agriculture."*
>
> (Richard et al., 2005)

Moreover, formulated Roundup herbicides were nearly twice as toxic as glyphosate alone in one assay used by the French team. The authors speculate that formulated Roundup products are more toxic because the adjuvant and stabilizers in Roundup formulated herbicides alter the cellular uptake of glyphosate, enhance potency, or promote bioaccumulation.

Fortunately, herbicide use in spring wheat production virtually never results in residues in harvested wheat because most herbicides are applied early in the season, long before kernels of grain have started to form. If and as RR wheat is adopted, more mid-season glyphosate applications will be made, in some cases, after wheat kernels have formed. As a result, Roundup residues might start appearing in harvested wheat. Still, because of the environmental properties and low mammalian toxicity of glyphosate, it is premature to conclude that residues in wheat will emerge as a serious concern.

Because of the climate in the Northern Great Plains, herbicide runoff is not a common cause of serious damage in aquatic ecosystems. Acute risks to applicators and other non-target organisms are also modest, based on contemporary herbicide use patterns.

Given that ample herbicide alternatives are available, weed management costs are stable or falling, and resistance is in check, there is no compelling need driving the commercial adoption of RR wheat in the Northern Great Plains region, beyond Monsanto's understandable desire to recover its development costs.

Potential Impacts

Nine areas of mostly negative consequences would likely to follow the planting of Roundup Ready spring. These include –

- Emergence of Resistance
- Gene Flow
- Disease Pressure and Related Problems
- Impacts on Seed Plus Herbicide Expenditures
- Market Rejection
- Dockage
- Yields
- Grain Quality
- Wheat Prices

Possible economic impacts following the widespread adoption of Roundup Ready hard red spring wheat are estimated for two scenarios. "Widespread" adoption means that 30% of hard red spring wheat acreage is planted in a given year to RR wheat. The impacts of RR wheat adoption under each scenario are estimated relative to a hard red spring wheat baseline that does not include the planting of genetically engineered wheat. The baseline scenario is based on the projections of prices, yields, and acreage contained in USDA's recent Wheat Outlook report (Vocke et al., 2004). Data on production costs is derived from statistics compiled and analyzed by the USDA's Economic Research Service (ERS) (Ali 2002).

The "Optimistic" scenario reflects a series of assumptions that are generally positive in terms of the performance of RR wheat technology and problems triggered by its adoption. It is unlikely that the economic impacts of adoption of RR will be more favorable than projected under this scenario, at least not until RR wheat is fully embraced in export markets.

The second, "Pessimistic" scenario combines a series of assumptions and consequences that collectively reflect "worst case" but still plausible outcomes from the perspective of wheat farmers and the industry. It is not likely that adoption of the technology will impose costs on the industry higher than those estimated in this scenario.

Under the "Optimistic" scenario following widespread adoption of RR spring wheat –

- The 70% of farmers not planting RR spring wheat would lose $5.60 per acre in income as a result of a decline in average market prices not likely to be less than 4%.
- On the 30% of acres planted to RR varieties, gross income would fall $3.95 per acre. But after taking into account the higher cost of RR seed and herbicides, net cash returns would drop $11.03 per acre.
- Industry-wide on average, hard red spring wheat net farm income (after subtracting seed and herbicide costs, but no other costs) is projected to be $110.21 per acre, or $7.23 less than in the no-RR wheat baseline.

Markedly more severe economic impacts would occur if the "Pessimistic" scenario proves closer to actual outcomes –

- The 70% of farmers not planting RR wheat would lose $14.00 per acre from the projected 10% drop in market prices.
- Income over operating costs on farms planting RR wheat seed would decline to $80.13 per acre, taking into account the higher prices paid for seed and herbicides and the drop in market prices. They would earn $37 less per acre than farmers under the no-RR wheat baseline.
- Net farm income averaged across the whole industry drops to $96.50 per acre, $20.94 below the no-RR wheat baseline, or an 18% decline.

Across the whole industry, the "Optimistic" scenario would translate into a loss of $94,000,000 annually based on USDA's recent estimate of 13 million acres planted to hard red spring wheat varieties in 2004 (Vocke et al., 2004). The annual loss would grow to $272,000,000 if the "Pessimistic" scenario proves to accurately reflect actual impacts.

Both scenarios are based on the assumption that foreign buyers will not reject U.S. durum wheat if RR hard red spring wheat is commercialized, and that there will be no negative price impacts on durum wheat shipments from the Pacific Northwest.

The two scenarios combine many assumptions about inherently uncertain events, but each represents a plausible combination of outcomes. The actual economic impact of adoption of RR hard red spring wheat will

likely fall somewhere between the "Optimistic" and "Pessimistic" scenarios.

This prediction will give little comfort to wheat farmers in the Northern Great Plains, or to the region's milling industry and grain exporters. The findings in this report support the conclusion that Roundup Ready hard red spring wheat is a technology that is not necessary and likely to cause more problems than it solves. For this reason, farmers, university specialists, and the industry should cooperate in carrying out a fresh, more in-depth and independent appraisal of the consequences following adoption of Roundup Ready wheat. This reassessment should ideally be completed before further steps are taken toward the approval and commercial release of this technology.

There is another reason for caution. A bad experience with Roundup Ready wheat will surely delay and could jeopardize grower and market acceptance of ongoing and future applications of biotechnology in the development of new wheat varieties, including applications that raise few if any food safety concerns. For example, both university and private sector wheat breeders are working hard to develop spring wheat varieties that are resistant to *Fusarium* head blight, the number one disease across the wheat industry and by far the major cause of mycotoxin contamination in wheat.

Tools with their roots in biotechnology are accelerating progress toward blight-resistant wheat and include genomics and marker-assisted breeding. Blanket rejection of any breeding tool with roots in biotechnology might raise the hurdles faced by new *Fusarium* resistant varieties developed using conventional breeding techniques, augmented with biotech-based gene mapping and gene-marker tools.