



The Impact of Herbicide Tolerant Crops on North Carolina Farmers

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Introduction

The percent of total crop acres planted to herbicide tolerant (HT) crops has been steadily rising, although the rate of increase differs by crop. HT crops are those varieties that can tolerate over-the-top, postemergence spray applications of broad spectrum herbicides, mostly Roundup® (glyphosate). This system also lends itself to farming with less (or no) tillage because no soil cultivation is needed to control weeds. The reasons given by farmers for adopting HT varieties vary, but most farmers mention that the HT crops are more profitable, “easier,” or “more convenient.” This issue of the *NC State Economist* reports estimates of the net benefit of HT crops, including convenience values, to farmers in North Carolina in 2001.

Study Methods

A telephone survey of 293 N.C. crop farmers was conducted during spring, 2003 by Doanes’ Market Research. Respondents were asked in detail about their most profitable crop in 2001 (corn, cotton, or soybeans). The questionnaire was designed so that we could compile a “partial budget” on all *additional* costs and benefits to each crop. Many of the cost or benefit questions were asked in terms of “gains” or differences from the non-HT technology in terms of dollars per acre per year.

Weed Control Costs

Weed control costs were assessed by asking farmers directly for their average herbicide materials costs and application costs per acre for each technology. If a farmer was growing only one of the technologies, we asked him to give his “best guess” as to what the cost would be for the technology he was not growing at the time. Since farmers generally know their costs and are familiar with HT technology, we assumed the best guess approach was reasonable. We did this because a large proportion of the farmers had adopted HT technology on 100% of their acreage, and so they no longer were able to make a direct comparison. The difference in HT and non-HT herbicide material costs for cotton and soybeans was not statistically significant. For corn, the difference was statistically significant and averaged about \$4.50 per acre more for non-HT varieties. We found no statistically significant difference between the herbicide application costs for HT and non-HT varieties in any of the crops. Herbicide application cost averaged about \$10 - 11 per acre.

Seed and Harvesting Costs

Seed costs per acre were expected to differ for the two technologies since technology fees are included in the HT seed cost. Seed costs per acre averaged higher for the HT technology on all

the crops except corn. Our data showed the average seed cost difference in corn in North Carolina was not statistically significant. The difference in seed costs for cotton averaged about \$9.50 per acre higher for HT varieties, and for soybeans averaged about \$6.30 per acre higher. The difference in harvest costs was not statistically significant for any crop.

Convenience

Convenience is a characteristic usually not measured when researchers attempt to evaluate the net benefit of a new agricultural technology. Convenience may include savings in management time; simplicity in herbicide selection; and more flexibility as to herbicide rates, time of application, and placement. We believe farmers can assess these changes competently for their farms, as they make these comparisons frequently each season. Regardless of crop, growers placed a value of \$10-12 per acre on the time savings component of HT crops. The value placed on equipment savings varied across crops with corn farmers' values averaging a little over \$5.50 per acre; cotton farmers, \$8.50 per acre; and soybean farmers, \$7.00 per acre. The value growers placed on any additional convenience beyond time or equipment savings ranged from about \$1.50 – 2.00 per acre. Total convenience value ranges from \$14 per acre for corn to \$18.40 per acre for cotton.

Human and Environmental Safety

Both worker safety benefits and environmental benefits are difficult to measure for any technology. Farmers were first asked separate questions on whether they thought there were human and environmental safety benefits from switching to HT crops. They then were asked to place a value on these gains, if any, in dollars per acre. All farmers reported an average increased human safety benefit of \$3.65 per acre and an increased environmental safety benefit of \$3.80 per acre. Human safety benefits ranged from \$2.40 per acre for

corn to \$5.54 for soybeans. The increased benefit from environmental safety ranged from \$2.67 for corn to \$5.26 for soybeans.

Tillage Benefits and Costs

We asked about tillage cost changes when growers shift to reduced tillage, including no-till, from conventional tillage. The percent of conservation tillage in acres planted to the HT varieties was higher than the percent in the non-HT varieties, except for cotton, where the percentage was about the same. Overall, about 76 percent of HT acres were grown with conservation tillage as opposed to about 64 percent of non-HT acres. Corn farmers tended to use more no-till and less reduced tillage in the HT varieties, while cotton and soybean farmers showed the opposite tendency.

Overall, we found a savings in direct tillage costs of about \$1.70 per acre with conservation tillage in HT crops, but the savings are not statistically significant for cotton or soybeans. Corn farmers reported a savings of about \$6.00 per acre. The time saved by switching to conservation tillage in HT crops ranged from \$11.60 per acre for corn farmers to \$18.00 per acre for cotton farmers. The overall average value of time saved with conservation tillage in HT crops was \$14.67 per acre.

We also asked if there were environmental benefits from moving to conservation tillage and, if so, we asked the grower to place a dollar value on these benefits. The average environmental benefit from conservation tillage reported was \$17.39 per acre. Corn farmers reported a benefit of \$17.59 per acre; cotton farmers, \$17.22 per acre; and soybean farmers, \$19.78 per acre.

Growers were asked to place a dollar per acre value on any additional convenience benefits from conservation tillage. This value ranged from an average of \$8.54 per acre for corn farmers to \$12.99 per acre for cotton farmers.

Yield

Some farmers in the survey planted both non-HT and HT varieties, some planted only non-HT varieties,

but most planted only HT varieties. Yield comparisons were further complicated because of differences in weed densities, weed types, and soil types. To measure yield we asked farmers their yield per acre in 2001 and 2002 for each of their non-HT varieties and HT varieties. We also asked farmers who grew only non-HT or only HT crops to give their “best guesses” of yields for the other technology. We found no significant difference in yields between HT and non-HT varieties in any crop.

Potential Disadvantages of HT Crops

One part of the survey was designed specifically to find the magnitude of costs that are likely to increase with the HT varieties. These include marketing uncertainty costs, which are usually omitted in production studies, and higher harvest costs. We found no statistically significant difference in harvest costs, regardless of crop. The average value of the loss from marketing uncertainty was about \$10.88 per acre. The loss was estimated to be the highest for corn growers (\$15.40 per acre). Cotton farmers reported the lowest average market uncertainty loss, as expected, at about \$7.82 per acre, and soybean farmers valued the loss at about \$9.75 per acre.

Net Benefits per Acre

The net benefit from HT crop production relative to non-HT crops was similar across crop. Cotton and soybean growers reported significantly higher seed costs (\$9.56 and \$6.32 per acre, respectively), but corn growers showed the only significant difference was in herbicide product cost, a savings of about \$5.50 per acre. The rest of the comparisons in these two categories, as well as all of the application cost and harvest cost differences were not statistically significant.

Soybean producers reported the highest additional values for the human safety and environmental benefits (\$5.54 and \$5.26 per acre, respectively). Corn farmers valued the difference in human safety and environmental benefits at about \$2.50 per acre each; cotton farmers, about \$4.00 per acre each. Cotton farmers reported the highest value for the additional

convenience of the HT crops (\$18.41 per acre), while corn and soybean farmers reported the convenience value to be just above \$14.00 per acre. As expected, cotton farmers placed a lower value on the potential loss due to market uncertainty. Corn farmers valued the loss about twice as much (\$15.40 per acre), and soybean farmers valued the loss at about \$9.75 per acre. *In total, the net benefit of planting HT varieties was about \$9.30 per acre per year.*

The reported net benefits of conservation tillage (reduced tillage and no-till) in growers’ HT crops ranged from \$43.67 per acre for corn growers to \$48.22 per acre for cotton growers, with an overall average net benefit of \$44.32 per acre. *The overall stated net benefits of the HT crops and conservation tillage combined averaged \$53.54 per acre per year in our sample.*

Aggregate Benefits

The aggregate benefit is the sum of the benefit from HT adoption and the benefit from conservation tillage associated with HT adoption. This calculated to be \$957,390 for corn farmers, \$7,780,758 for cotton farmers, \$12,105,989 for soybean farmers, for a total benefit of \$20,844,137 in 2001 to N.C. farmers.

There are several things left out of the analysis that might affect the measure of total benefits for North Carolina farmers and North Carolina as a whole. First, we did not ask the respondents to quantify any differences in crop quality. We also did not ask the growers to quantify the effect, if any, of potential future weed resistance to glyphosate. It is difficult to estimate the net effect of these two omissions. Third, all of the second-round effects have been left out. These include the multiplier effect in rural communities, the value of the environmental benefits to non-farmers who don’t live in rural areas, and the effects on local markets for herbicides and seed, if any. Some of these effects would impact farmers and some would apply only to the aggregate impact on North Carolina.

Another potential bias that could be present is “part-whole” bias. That is, the sum of the values of the separate characteristics generally is found to be greater than the stated value of the total package of the characteristics embodied in the good. This could make our per-acre estimates larger than the true impact. Since it is unclear what the net effect of all the above omissions and biases would be, the results reported here must be viewed as baseline estimates that will be refined over time. What is clear, however, is that the HT crops have had a significant, positive impact on North Carolina farmers. For more details about the survey and results, contact the authors.

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