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Biotechnology Issues for Crop Producers

by

Steve Wentworth
Vice-President
Foundation EARTH

I come from a long line of Macon county Illinois farmers who have adopted emerging technologies over the last 130 years to improve their farms. In the 1870's my great-great grandfathers saw how John Deere's steel moldboard plow could enhance the productivity of sticky Illinois prairie soils. They soon realized Cyrus McCormick's reaper would allow them to harvest more grain in a day. In 1870, 53% of the US population were farmers. By the turn of the century, my great grandfather used the power of steam engine to run a threshing machine. At the turn of century, 37.5% of all US workers were farmers; by 1920 that percentage had dropped to 27%. When A.E. Staley Company of Decatur Illinois first started processing soybeans in October 1922 it profoundly changed my grandfathers' crop rotation and all of US agriculture. Soybeans were no longer a hay crop or a nitrogen source to be plowed under, but a cash crop. With the use of hybrid seed corn starting in the 1930s, Macon county farmers saw a tremendous increase in yield. During that the same decade gas powered tractors were used for the first time to till the soil.

In 1950, the year I was born, and two years after my father started farming, 11.6% of the working population of this country were farmers. During my Dad's farming career, he saw our farm's productivity zoom through the use of soil testing, greater use of commercial fertilizers, herbicides to control yield robbing weeds, insecticides to prevent disastrous insect infestations, advances in electronics that allowed more accurate planting, spraying and harvesting operations. By 1970, only 3% of the US work force were farmers.

Since 1974, the year I started farming, we have gone from moldboard plowing to soil conserving minimum tillage and No-till. Back then our big tractor was a state of the art John Deere 4430 with 125 horsepower, now our large tractor is a Case 9370 with 365 horsepower. The John Deere 4400 combine we used in the early 70's would harvest 4,000 bushels of corn in a big day. With our current John Deere 9600 it is not uncommon to shell 20,000 to 22,000 bushels of corn a day. The machine that is used the most on our farm is the computer. We are currently on our fifth computer. Unlike combines that do wear out, computers are obsolete minutes after you walk out of the store. In the past it took 8 to 10 pounds per acre of herbicides to get satisfactory weed control. Now, as little as 4 ounces per acre of the new generation herbicides will give a farmer a weed free field. When I started farming I would spread the same analysis of fertilizer across an entire field.

For the last few years I have been using variable rate fertilization technology coupled with Global Positioning to apply phosphate and potash in the most economically optimum ration for

that exact location in the field. My combine is now equipped with a yield monitor and a GPS unit so I know what every square meter of a field yields. Now the challenge is to interpret the data, and determine what causes the differences between the lowest yielding areas and the highest areas. Precision farming combined with the advances in biotechnology promises to further speed the incredible rate of change in production agriculture.

Advances in technology have allowed me and the rest of American agriculture to become more productive and environmentally sustainable at the same time. Currently, less than 1.5% of working Americans are farmers. I believe biotechnology holds a promise for even more improvement, but should not be viewed as some kind of a silver bullet solving all of agriculture's problems. Each of technological advances I have described over the last 130 years have created both new opportunities and management challenges for the American grain farmer. None of these advances were problem free or easy. Likewise, the use of transgenic crops is extremely promising, but it would be naive for anyone to believe there are not tough issues to be dealt with.

Roundup Ready soybeans have been probably the most visible of the early transgenic crops. 1998 will be the third year I have grown Roundup Ready soybeans. The rapid acceptance of this technology has been nothing short of astonishing. Representatives of some of the leading seed companies tell me the market share of Roundup Ready has grown from 0 in 1995 to over 60% for the 98 growing season. They expect in 1999 over 75% of all soybeans they sell in this country to be Roundup Ready.

If we look at the economics involved, it is easy to understand why this new technology has gained such a rapid acceptance among farmers. On my conventional soybeans, before planting I apply a pre-emerge grass herbicide followed in June by postemerge broadleaf chemical at a cost of \$38 per acre for the chemicals plus two applications at \$4.50 each per acre for total expense of \$47 per acre. With Roundup Ready soybeans I spend \$13 per acre for the Roundup and \$4.50 per acre for a single application. Monsanto collects a technology fee of \$5.00 per 50 pounds of Roundup Ready seed used. This amounts to \$5.00 to \$7.50 per acre depending on seed size and planting rates. Overall, I am saving \$22 to \$24.50 per acre, which on our farm's 1300 acres of soybeans is a \$28,000 to \$31,000 cost reduction. Roundup kills a wider spectrum of weeds while at the same time being gentler on the growing beans. It is obvious why Roundup Ready soybeans have gone from nothing to over 60% market share in 4 years.

There are number of management issues about Roundup Ready soybeans that farmers need to address. If any conventional beans are planted in a Roundup Ready field or sprayer operator treats the wrong field all of those soybeans will die. If the winds are too strong or out of the wrong direction a neighbor's corn, or worse, his wife's tomatoes will be destroyed. This year, for the first time, Dekalb is offering Roundup Ready corn. If a farmer plants any of these fields to Roundup Ready soybeans in 1999, any volunteer corn growing in his soybean field would also be resistant to Roundup. If farmers kept using Roundup on both their corn and soybeans for years, in theory, it would be possible for a weed to develop a resistance to the chemical. The Monsanto people say the chances of that happening are almost nil.

There has been much debate in farm circles this fall and winter if Roundup Ready soybeans yield as well as conventional beans. From the data I have seen and my own experiences, I am convinced that the best Roundup Ready soybeans will yield with any conventional variety. Seed companies are working feverishly to get the Roundup Ready characteristic into their best genetic package.

For years farmers planted soybeans saved from the previous crop for seed. This practice is called using "bin run seed". Over the last 25 years farmers have increasingly purchased new seed every spring to insure themselves of the best genetics and the highest quality. Today, when a farmer buys a bag of Roundup Ready soybean seed he pays the \$5 technology fee that goes to Monsanto and he signs an agreement that he will not keep any production back for seed. If he is caught in violation of this agreement he can be fined over \$1,000 per acre. Most producers understand that the tech fee allows Monsanto to recover their previous research costs, give a return to the stockholders, and provide research dollars for the development of future transgenic crops. But, it is a new and difficult mind set for a few farmers that those soybeans he just harvested cannot be kept for seed.

The European corn borer does more economic damage than any other insect to corn, with losses and control costs exceeding \$1 billion annually. The decision on whether or not to grow Bt corn is not as clear cut as it is with Roundup Ready soybeans. A central Illinois farmer knows with a great deal of certainty what the weed pressure will be in his soybean fields, but the reliability of predicting the level of European corn borer infestation before planting is not very consistent. The severity of the previous winter; a farmer's and his neighbor's tillage; the timing, velocity, and direction of summer and fall winds; and number and strength of summer thunderstorms all impact corn borer survival. Farmers in the Western Corn Belt usually have greater corn borer economic losses and on a more regular basis. Integrated pest management (IPM) offers some defense against European corn borer, but is not practiced to any great degree. IPM requires skillful scouting multiple times in extremely uncomfortable conditions and is very time consuming. Even if economic levels of corn borer are detected, the treatment insecticides are expensive and not always very effective. There also can be health and environmental concerns. Beneficial insects will be reduced.

Bt corn basically offers a corn farmer an insurance policy against moderate to severe infestations of European corn borer. Bt, *Bacillus thuringiensis*, is a naturally-occurring soilborne bacterium. Bt produces crystal-like proteins that kill certain insects when ingested. Plant geneticists create Bt corn by inserting selected exotic DNA into the corn plant's own DNA. This is called an "event". The EPA has registered four unique events for commercial use: 176 (Novartis Seeds and Mycogen Seeds), BT11 (Northrup King/Novartis Seeds), MON810 (Monsanto) and DBT418 (DEKALB Genetics Corp.). Event 176 hybrids produce Bt protein only in green tissues and pollen, whereas BT11 and MON810 produce Bt protein throughout the plant. While all the events do control corn borer larvae, but to different degrees.

Bt is a defensive characteristic. Putting Bt into a corn with mediocre genetics isn't going to make that variety great. Giving me the latest set of Calloway Big Berthas won't make me a better golfer than Tiger Woods with 1950 vintage irons. Also some corn varieties, such as

Pioneer 3489 or Garst 8481IT, can tolerate more corn borer injury than others. As a farmer, I need to decide if the extra \$14 to \$15 per acre I will spend for Bt corn is justified. This spring, I will be planting my first Bt corn on about 5% of my acres. The yield monitor on my combine will show me how these Bt corns perform against my favorite non-Bt hybrids in 1998. But that will be no guarantee of Bt being advantageous in 1999. My best guess is that as more companies start putting Bt into their highest yielding genetics the market share of Bt corn will grow dramatically.

The concern of farmers, seed companies, universities, and others is that European corn borer will develop resistance to Bt if growers start planting whole farms to corn with this technology. To prevent this farmers are being advised to plant Bt only on acres where there is risk of severe infestations. Also, corn farmers are instructed not to plant any single field to more than 75% of Bt varieties. Planting a 25% refuge of non-Bt-corn will allow susceptible European corn borers to mate with potentially Bt-resistant corn borers. If not managed properly, Bt-corn will be a short-lived benefit to corn farmers. Future transgenic crops, like rootworm resistant corn, will not be released unless farmers show good stewardship of biotechnology products such as Bt-corn.

Farmers are intently following the rapid structural changes of the companies selling them inputs. They are asking themselves, what does it mean to us for Monsanto to purchase Asgrow and Holden seed companies or for DuPont to buy 20% of Pioneer? Is it good or bad? Only time will tell. What is obvious, is that biotechnology is the primary catalyst. The first generation of biotech traits have been input related. What is truly exciting for me as a farmer is the prospect of biotechnology increasing the value of my corn and soybeans. Maybe because of biotechnology I will be growing a different commodity. Crops will be genetically engineered to replace materials that now come from petroleum such as chemicals, fuel, and plastics. Transgenic crops have great potential in animal health, nutraceuticals, and pharmaceuticals. For generations American farmers have adopted to changing technologies. The rate of change facing farmers today is truly incredible. Biotechnology is another tool for farmers to utilize to bring abundance to America.