Case by Case: The GMO Question

By Katie Pratt, University of Kentucky The mAGazine

Bernard Peterson, his two brothers, and nephew are ninth and 10th generation farmers. They pride themselves on sustainability, innovation, and productivity.

In the heart of Kentucky bourbon country, Peterson Farms produces [several thousand] acres of non-GMO soybeans, wheat and canola, and both non-GMO and GMO corn.

GMOs. Genetically modified organisms. The very mention of this technology might cause praise or picketing, eye rolls or enthusiasm, but one thing is certain; GMO crops have changed American agricultural production since they were first introduced in the mid-1990s. Currently eight crops have GMO varieties available: corn (field and sweet), soybeans, canola, papaya, cotton, alfalfa, sugar beets, and squash.

The Petersons transport much of their corn and wheat to area distilleries, many of which now accept GMO crops after years of only using non-GMOs. Their soybeans are sold to international markets. Market demand is the biggest factor in their decision on what to grow.

"Our history of GMO usage follows the requirements the bourbon industry has put on growers over the years," Peterson said. "In the global market, there's quite a demand for non-GMO crops."

For him, the main production differences between the two are weed and insect control.

"The level of management to grow non-GMO crops is a little higher, as they require more attention and they cost more per bushel to produce. But historically, we've thought it was worthwhile to do," Peterson said.

Farming before GMOs

Before genetically engineered crops became available, producers often needed to make several herbicide applications to control weeds and regularly scout and treat for insect pests or suffer losses.

"We didn't have any herbicides that basically controlled everything, so we had to mix things together to get the full spectrum of weed control," said Mike Barrett, UKAg weeds scientist in the Department of Plant and Soil Sciences. "Typically, we'd use soil-active materials at planting, and oftentimes after the crop was up, we'd come back and apply other herbicides to tackle weeds that weren't controlled."

This system had problems, time being one of them. Producers had to apply pre-emergent herbicides to the soil surface while they were also planting. These herbicides required rainfall to work; if an area didn't receive timely rains, farmers could have a major weed problem. In addition, post-emergence herbicides only had a short window in which they were effective.

Then, just prior to the introduction of GMO crops, populations of weeds developed resistance to commonly used herbicides called ALS inhibitors, which hinder an enzyme critical to weed growth.

The first GMO crops, glyphosate-resistant corn and soybeans, came on the market in the mid-1990s. Farmers readily adopted both, because they could plant faster, scout less, use only one herbicide, and control the ALS inhibitor-resistant weeds. According to the National Agricultural Statistics Service's Acreage Reports, national acreage in genetically engineered corn increased from 25 percent in 2000 to 90 percent in 2013. During the same time frame, genetically engineered soybean acreage jumped from 54 percent to 93 percent.

"Food production is extremely risky," said Chad Lee, UK grain crops specialist. "Farmers are always looking for ways to minimize that risk, and GMOs help us do that."

Weeds resistant to herbicides pose major concerns in the agricultural community. For Peterson, the widely used cropping system in Kentucky that produces three crops in two years by rotating corn, soybeans, and wheat has played a big role in helping him with weed control. He has had very few problems with resistant weeds.

"The chemistry changes every year in our crop rotation, so the chances for chemical-resistant weeds are less. It's not non-existent, but it is less," he said.

The first glyphosate-resistant weed in Kentucky, marestail, appeared in 2001 in Trigg County. Growers have struggled to control it, and it is now endemic to the state.

In 2010 and 2011, bottomland growers along the Ohio and Mississippi rivers observed glyphosate resistance in two pigweeds, waterhemp and Palmer amaranth. These weeds—sometimes termed "super weeds"—have spread from their river bottom origins to much of Western Kentucky within just a few years. Growers turned to UK specialists for help.

"We have had both weeds for years, but they weren't found in large numbers until they began developing glyphosate resistance," said Jim Martin, UK weeds scientist.

"There are populations of waterhemp in other states that are resistant to four different types of herbicides," Barrett said. "In the past when we had a resistant weed, we were able to adapt and control it, but these seem to be different kinds of animals, because they have this propensity to develop resistance to different types of herbicides by mixing up their genetics pretty quickly."

They also require intensive scouting, as Palmer amaranth has the ability to grow 2 inches in a single day and must be controlled by the time it reaches 3 inches tall.

"Farmers need to diversify their weed management system," Barrett said. "We encourage them to use combinations of herbicides together, rotate the herbicides they use, rotate their crops, use mechanical weed control when appropriate, scout fields, and control a resistant weed before it sets seed."

Some producers have started using tillage as a means of weed control or, in the case of some cotton farmers in the South, deep tillage to bury the weed seed and reduce populations of Palmer amaranth.

"Probably the biggest concern is if we have to move away from reduced tillage systems. We'll lose the soil saving advantages that they give us," Barrett said.

Two Faces of Bt

Soon after developing glyphosate-tolerant crops, seed companies began to release corn containing traits from Bacillus thuringiensis (Bt), a naturally occurring bacterium in the soil that disrupts the gut of some types of immature insects. Bt is the basis for a variety of natural insecticides that are widely used in crop production, but there is a difference between the insecticide and the GMO crop.

Earworms cause yield losses and quality issues and are one of the causes of fungal contamination in the ear. Bt GMO technology has made controlling the pest easier.

"When sprayed on crops as a natural insecticide, Bt will kill what's there then degrade over time, whereas genetically modified crops are expressing Bt all the time and might be expressing multiple forms of it," said Mark Williams, UK associate professor of horticulture.

Producers using the natural insecticide often spray it more than once, and the product has the potential to drift onto other crops.

Many farmers quickly began using the Bt GMO technology, which primarily targets the European corn borer and the corn rootworm, but also controls some insects such as the southwestern corn borer, a major pest in Western Kentucky in the 1990s.

"Prior to Bt corn, both European corn borer and corn rootworm were considered billion dollar pests in the United States, meaning yield losses and treatment costs surpassed $1 billion for each insect," said Ric Bessin, UK extension entomologist. "Research studies have shown that European corn borer populations have declined since the development of Bt corn."

The GMO technology has helped growers lower the amount of insecticide applications and reduced the amount of scouting for these pests. Studies have shown that Bt corn has little impact on beneficial insects that provide biological control against these pests.

Ric Bessin displays a corn earworm.

"GMOs are tools that can advance integrated pest management, but also require specific stewardship practices to increase their sustainability and maximize their value to producers," Bessin said. "I think it is a mistake to think that GMOs replace IPM or best management practices."

The Petersons were early adopters of IPM and continue to use the program to control insects. While at times, he may have had to make more herbicide or insecticide applications to his crops, Bernard Peterson credits the program with helping him be judicious with his chemical applications.

"We do not treat every non-GMO crop every year for certain insects and weeds. They are only treated when they get over certain thresholds," he said.

Corn rootworm is beginning to show GMO resistance in states north of Kentucky. Growers are combating these insects by using crops with stacked GMO traits, meaning those that contain more than one insecticide.

They are combining these traits in some cases with a soil-applied insecticide.

In addition to resistant insects, Bt corn seed is more expensive than non-Bt seed.

"In Kentucky, the risk for corn rootworm pressure is very low if growers are rotating their crops. European corn borer is here every year, but its populations vary in size annually and are not predictable," Bessin said.

"There is a potential for people to save money by selecting GMOs containing insecticides for pests they are concerned about. There is no advantage to planting seed with the Bt gene if these pests are absent, and growers won't recover the added seed costs."

Because GMOs have allowed for fewer chemical applications and reduced scouting, farmers have been able to increase their grain crop acreage.

"It allowed farmers to really manage bigger acreages. Here, we were pretty much already using a no-till system, but in a lot of places it allowed for the adoption of no-till," Barrett said. "Because they didn't have to slow down at planting, they could cover a lot of ground fast with the treatments. If the rain kept them off the fields, they weren't really in trouble."

While Bernard Peterson is unsure what his future usage of GMOs will be, he plans on his farm being around for generations to come.

"Most farmers want to improve the land and make things better than they were," Peterson said. "Both GMO and non-GMO cropping systems are cultural practices that farmers decide to use based on their marketing scheme, and either one will work."

Questions

1. What does the acronym GMO represent? What are the eight crops that currently have GMO varieties (at the time of the article)?
2. Prior to the use of GMO crops, how was farming different? Give two specific examples from the text.
3. What was the first GMO crop introduced and when?
4. Why did farmers adopt these crops so quickly?
5. What are "super weeds"? Why are they a problem facing farmers?
6. What types of insects/pests can be controlled using the Bt GMO technology?
7. How has the use of GMO crops impacted farming?
8. THINK ABOUT IT: If you were a farmer, what factors would you consider in choosing a GMO vs. non-GMO corn variety to plant on your farm?

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