Is Your Organic Farm Safe?

Protecting Your Crops from Genetic Contamination

by Mary-Howell R. Martens

Increasing demand for non-GMO foods has caused farmers to stop and evaluate the risks to their organic operations, and to look for means to keep their crops GM-free.

Recently, my husband Klaas looked across the road at our neighbor's farm and said in a horrified tone, "You know, if Harold plants Bt corn on that field next year, we won't be able to plant organic corn anywhere on this farm." This sudden realization, born in the increasing knowledge that organic farmers can no longer ignore the impact of their neighbor's genetically modified crop varieties, struck us hard. We had thought that the neighbor's corn pollen might affect a small portion of our nearest field, something that appropriate buffer zones would take care of, never really thinking it could render many downwind acres unsuitable for corn. But it certainly could. This is the reality of organic farming today.

The impact of genetic drift can affect my farm, my planting plans, my certification, my income — not on just a few rows, but possibly on many acres. The scariest part of this reality is that the farmer won't know if contamination has occurred until its too late, and then there is relatively little he can do to prevent it. To be prepared for the 2000 crop, organic farmers must start thinking of GMOs as being their problem too.

RESEARCH

A recent study by Catherine Moyes and Philip Dale, of the John Innes Institute in England, has elaborated on the role that genetically modified crop varieties may play in organic agriculture. They conclude that if genetically modified crops continue to be planted near where organic crops are produced, the possibility of contamination is probably unavoidable. Once genetically modified crops are released, they, like all crops, cannot be completely contained and are very likely to impact organic production systems.

The current model of organic farming is based around a host of similar organic standards enforced by different certification agencies. It describes a production or a management system. If an organic farmer manages the farm in a certain way, avoids certain unacceptable inputs, employs certain planting plans and maintains careful records, then the farm is considered certifiable. Ideally, organic management is also an evolving thought process where the farmer learns to work with the natural system to solve problems, maximizing soil and crop health in a proactive and interactive manner. Certification and inspection are carried out according to internationally established and accepted procedures. Rarely is residue testing used to prove whether the management system has been effective in controlling chemical contamination. Ultimately, it is the integrity of the farmer that becomes the bottom line. If the farmer can prove a commitment to organic farm management, as performed according to the organic standards, then his products are considered organic.

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TOLERANCE & TESTING

The rules are changing with the advent of genetically engineered crop varieties, but even that is currently confusing. There seems to be little consensus in the industry, organic or conventional, of what constitutes "non-GMO." Some buyers of organic products, especially those in Europe and Japan, are insisting on "zero tolerance" — there can be no discernible trace of any characteristic genetically engineered DNA in any organic product. Other buyers are willing to accept a level of 0.1 percent GMO DNA — that is, essentially one contaminated bean or kernel in 1,000. The zero-tolerance level of stringency has never been enforced for chemical residue since it is well recognized by the organic industry that requiring absolutely no pesticide residue is probably impossible, given the way the entire planet has been contaminated. But buyers, responding to consumer demand, are trying very hard to provide products that can be certified free of GMO DNA, regardless of how difficult it is to grow such products.

A laboratory test can take a sample of corn, a food product, or any other material derived from natural sources, extract its DNA, and using polymerase chain reaction technology (PCR), determine conclusively whether certain characteristic marker DNA sequences found only in genetically engineered plants are present in the sample DNA.

Genetic ID, located in Fairfield, Iowa,

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is the leading company using this technology. They are able to accurately test a 2-kg sample of product to determine the level of genetic contamination. Genetic ID offers a "non-GMO tested" certification on samples that fall at or below the 0.1 percent level of GMO DNA. There are other genetic testing products on the market, including much less expensive strip tests that are similar to pregnancy tests. A color change indicates whether GMO DNA is present but can only generally gauge the level of contamination that is present. Currently, strip tests are available but are being used primarily as a pre-screening tool to determine which samples need more thorough testing. The strip tests also do not provide third-party verification that some markets demand. Yet another testing approach, called an ELISA test, is more time consuming, requires considerable technical expertise, and has found less market acceptance.

This ability to prove quantitatively whether GMO DNA is present imposes a new model into organic farming. Now there is an absolute product performance standard that must be integrated into a management system based model. Unfortunately, the rules of the existing management model are woefully inadequate to achieve acceptable results for this new performance standard. The entire organic community is caught between the two. The introduction of GMO testing has the potential to alter the face of the organic system entirely, changing certification requirements and increasing costs considerably. However, it is essential to recognize that if organic certification becomes merely the ability to chemically prove the absence of certain toxins and DNA fragments, then many of the benefits of organic management and the products produced by this system will be lost.

Melodi Nelson, vice president of Terra Prima, has had firsthand experience with GMO tolerances. Her company recalled 87,000 bags of corn chips from Europe in 1998 after GMO testing revealed a level of 0.1 percent contamination. This resulted in a major immediate financial loss to the company, but the long-term loss has been even greater. "We have lost shelf space and some markets for our products, even though they have been tested free of GMOs. Name recognition is definitely working against us in some places. Other markets, however, seem to respect our company for voluntarily recalling organic products shown to be contaminated," Nelson said.

The corn used to make the tainted chips came from certified organic farmers who had no idea that their crop was contaminated. The nearest documented commercial Bt corn was at least 100 feet from the edge of an organic cornfield. Because of their experience, Terra Prima will be performing genetic tests on all incoming organic corn in 1999, and any product testing positive for GMO DNA will be rejected. Other buyers of organic products are taking the same precautions.

THE FARMER

Where do the ordinary organic farmers fit into this new situation? Certainly, much can be said about the threat of GMOs to the ecosystem, to human health and to American agriculture, and while many people agree that the best approach would be to ban all GMOs from American agriculture, this is certainly not likely to occur for the 2000 crop. Most organic farmers are also not likely to sue their neighbors or the large agribusiness companies if their crops become contaminated. The possibility of GMO contamination is very real in areas with certain major agricultural crops, and the burden and threat of this problem rests squarely on the organic farmers themselves. Unfortunately, the problem of GMO contamination is largely invisible to most farmers and even somewhat incomprehensible to many. Organic farmers are beginning to realize that their crops are extremely vulnerable, and yet they feel helpless to do anything. What can organic farmers voluntarily do to protect their crops from contamination, and what role should certifiers, inspectors, buyers and consumers play in the process?

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CONTAMINATION

First, it is important to consider how an organic crop can become contaminated with foreign DNA. The two main sources of contamination are through pollen and seed. Pollen from genetically modified plants may fertilize flowers on an organically grown plant, even if they are not in the same field. Pollen contamination is primarily a problem with cross-pollinated crops such as corn and canola, where the wind or insects can carry pollen long distances. Additionally, seed from a genetically modified crop, or from plants grown from such seed, might become accidentally mixed with organic crops or their products. Genetically modified DNA can be present in purchased seeds if the seed company failed to prevent cross-pollination with GMO varieties during seed production or if accidental mixing of GMO and non-GMO seed occurred before sale. Additional on-farm contamination can occur if custom operators are hired for field operations and their machinery is not sufficiently cleaned between crops. Parallel production of organic and GMO crops present many possibilities for cross contamination. The chance then for contamination of organic crops with foreign, genetically modified DNA is fairly substantial.

PREVENTION

Organic farmers should make every effort to obtain non-GMO seed. It is reasonable for an organic farmer to assume that if they purchase a non-GMO variety of corn, a variety without contrived names such as "YieldGuard," "InsectGuard," or "Roundup Ready," then they are obtaining seed that contains no GMO genetics.

Regardless of what seed producers may say, there is no system for the field production of seed that can guarantee absolute genetic purity of seed samples. To their credit, seed companies have had extensive experience in the production of high-purity seed. It is important to a seed company to produce genetically uniform and identifiable varieties. For this purpose, seed production fields are carefully designed to ensure appropriate crop isolation distances, and seed companies employ careful crop rotation and management systems. Seed handling facilities must maintain good separation between seed lots. However, if there is a low level of mixing, if a little foreign pollen fertilizes a few kernels of corn or if the harvesting machinery was not thoroughly cleaned of every last soybean, it probably doesn't matter too much. State laws governing seed purity legally permit a low level of contamination by off-types. For this rea-

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son, reputable seed company representatives are reluctant to state conclusively that a variety of non-GMO seed contains absolutely no traces of GMO DNA. They simply do not know if it is true, and saying so could expose the companies to serious lawsuits if proven otherwise.

What options then do organic farmers have? They can ask their seed dealer if specific lots of seed can be tested for GMO DNA before purchase. This lab test would provide written documentation that the organic farmer has done their homework and that, to the best of their ability, they have obtained seed shown to be free of contaminating DNA. Bob Gates of Genetic ID stresses that it is important for organic farmers to obtain the very cleanest possible seed, preferably well below the 0.1 percent level of GMO contamination. If any GMO DNA is present in the original planting stock, this can be magnified in the final product, resulting in an unacceptably high detectable level.

Producing as much seed as possible on-farm or purchasing seed from other organic farmers is also a very good option but not a viable one for all crops. Farmers saving seed must realize that there is a possibility that organically produced seed, especially from cross-pollinated crops such as open-pollinated corn, could become contaminated by drifting GMO pollen. This contamination would likely go undetected but would produce crops that test positive for GMO DNA in following year. Saving and sharing organically produced seed from self-pollinated crops would probably carry little risk, and with some deliberate in-field selection, it could provide a good source of regionally and organically adapted varieties.

Pollen contamination is the most difficult factor of this entire issue. Some organic crops are likely to become contaminated by pollen from GMO crops that may be growing many miles away. Of the major crops, corn and canola are the most vulnerable to contamination from foreign pollen.

As a naturally wind-pollinated crop, corn has several built-in mechanisms that make outcrossing likely. In nature, the purpose of cross-pollination is to facilitate outcrossing and to increase the genetic variability of the offspring. Therefore plants employing this approach to reproduction are often physically designed to maximize outcrossing. Corn is one example. First, corn tassels produce copious quantities of lightweight pollen that is easily lifted and carried long distances on air currents. Corn silks are constructed to intercept passing pollen grains, but not necessarily those originating from their own tassels. The resulting kernel is actually a fruit, with the fleshy part of the kernel expressing genes from both male and female parents. This is why isolation between sweet corn and field corn is so important — no one wants their ear of sweet corn to taste like green field corn. Corn contaminated with GMO DNA will not only carry the foreign DNA in their cells, the corn kernel itself will actually produce some of the protein products, such as Bt toxin, encoded for that foreign DNA.

While the majority of shed pollen lands quite close to the point of origin, pollen can travel great distances. The actual pattern and distance of pollen distribution is highly erratic and unpredictable, dependent greatly upon environmental and geographic conditions. A localized strong wind during tasseling may normally carry corn pollen quite far before it settles, quite likely into another cornfield. Studies originating in England have recorded clover pollen drift as far away as 1,600 meters (about one mile) from the source; from plants in the cabbage family, over 1,500 meters (0.93 miles) away; and from beets and grasses, more than 1,000 meters (0.62 miles) away. Some studies have documented corn pollen drift up to 150 kilometers (93 miles) away from the source; other research has shown that the distance may be greater under certain weather conditions.

Insect pollination presents yet another problem. Canola or oilseed rape is a member of the crucifer, or cabbage, family. Most members of this group rely on bees to carry pollen from one flower to another and to distribute the pollen inside the flower to facilitate pollination. Bees have no apparent preference organic or conventional canola or any of the many closely related wild crucifer relatives such as wild mustard. Covered with pollen, the bees deposit and receive a genetic payload at each flower they visit, freely spreading genes throughout their range. Pollen carried by insect pollination can travel as far as bees forage. British studies have found that bees visiting onion flowers can forage for distances of more than 4,000 meters (2.48 miles) and that a three-mile radius range from the hive is likely. Additional research has also documented oilseed rape pollen at more than 4,000 meters (2.48 miles) from the source, but Dr. Ann Clark, of the University of Guelph in Canada, feels that canola pollen may be carried up to eight kilometers (nearly five miles) under specific conditions. Other research has indicated that the distance can be even greater.

Insect pollination can result in GMO pollen transfer not only to neighboring organic crops but also to related wild species. These wild species can then serve as unpredictable reservoirs of GMO DNA in subsequent years. Transformed wild plants can then pollinate other members of the same species or can cross with yet additional wild relatives, thereby extending the range of contamination far beyond the original source. The real danger here is not the development of "super weeds" resistant to herbicides, though that is certainly a possibility; rather, it is the unpredictable and widespread movement of modified pollen back into cultivated crops. Once wild species in an area are contaminated by GMO genes, this should be considered permanent — that land will continue to have a high probability of GMO contamination.

Is this a problem for self-pollinating crops such as soybeans, wheat, oats and dry edible beans? In these plants, a relatively small quantity of pollen is produced, and pollination has usually already occurred before the flower has opened. Bees are usually not very interested in these flowers because they are small, often relatively inaccessible, and commonly do not produce much aroma or nectar. That doesn't necessarily mean that no outcrossing occurs, because there is still a natural low level of outcrossing in all species that ensures valuable genetic variability. However, this random outcrossing probably results from pollen produced nearby and is not likely to produce significant contamination of a field

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of soybeans or wheat. This will probably not be considered an important threat to organic integrity.

It is worth noting that not all small grains are self-pollinated. Rye is nominally cross-pollinated and could become contaminated if genetically engineered rye is grown nearby. However, at this time, there are no genetically engineered varieties of rye on the market. Clover and alfalfa are also usually cross-pollinated. In fact, the pollen from one alfalfa flower is generally chemically prevented from fertilizing the same flower; therefore, outcrossing is required for seed set. Seed saved from these crops or plants that grow naturally from self-sown seed could contain GMO DNA once genetically engineered varieties of these crops are on the market. When GMO varieties of alfalfa and clover become available — there are reports that varieties of Roundup Ready alfalfa are currently in the testing phase — the organic industry will need to consider the impact of this pollen on forage quality and livestock production.

What practical and economically feasible methods of prevention can organic farmers adopt to protect their organic corn and canola from promiscuous GMO? While there is no true consensus on the answer to this question, most experts agree that in all likelihood nothing will provide complete protection under all conditions. Most in the organic community agree that the current organic buffer zone standards are completely inadequate for GMO protection; that 25 to 30 feet is certainly not enough separation, especially if the buffer is mowed and presents no vertical barrier. However, as U.S. certifiers struggle to develop guidelines to limit GMO contamination, some are providing their farmers with information about the risks of genetic contamination so they can make reasonable choices. Certifiers are being placed in the difficult position of establishing management recommendations that are bound to fail under many conditions. The inspectors, traditionally sources for advice and direction for organic farmers, may not be any better prepared than the farmers themselves when designing approaches to minimizing the harvest of contaminated grain.

The seed industry isolation standard for corn seed production is a physical separation of at least 660 feet between fields when there is no vertical buffer. Where there are "male" border rows, 30 to 40 rows (900 to 12,000 feet) between seed lines are considered adequate separation. In Britain, government rules are enforcing a 200-meter (about 660 feet) "exclusion zone" buffer between genetically modified and non-modified crops, but many in the industry feel this is not sufficient for complete control. Most experts recognize that these distances may not be sufficient to eliminate all GMO pollen contamination of organic corn, depending on the prevailing wind direction, the lay of the land, and local weather conditions. Quite understandably, many organic farmers will see any of these approaches as removing an economically painful amount of acreage from their organic production, especially since they have no way of knowing whether it is, in fact, necessary. If it is possible to grow a different color corn variety than the neighbor's GMO corn, then the degree of accidental pollination can be assessed. That won't prevent the situation from occurring, but it could give a useful clue as to where contamination has occurred and how much buffer must be removed.

Many in the industry recommend talking to the neighbors to determine what varieties they plan on planting and to try to work out cooperative agreements to prevent the adjacent planting of GMO and organic corn. The American Corn Growers Association, representing over 14,000 corn farmers, has actively started a campaign to discourage members from planting GMO varieties. Gary Goldberg, CEO of this organization, feels that the uncertainty of markets seeing widespread consumer rejection of GMO products, possible legal risks to farmers, and the deleterious effects on farmers by corporate consolidation justifies this position. The American Corn Growers Association will have promotional material available by early 2000 introducing their "Farmer Choice — Customer First" program that organic farmers may consider sharing with their non-organic neighbors.

If the neighbors plan to plant long-season corn, an organic farmer might be able to avoid cross-pollination by planting a short-season variety or by staggering planting dates, but these strategies alone should not be relied on as adequate protection. Environmental conditions may bring the two tasseling times much closer together than anticipated, and a bag of seed corn will often contain a low percentage of a "pollinator" line of seed that tassels at a slightly different time. Additionally, just because a neighbor has soybeans planted this year next to a field of organic corn doesn't mean that contamination is entirely prevented. Is there any volunteer corn growing from last year's GMO plants? Those plants will also produce pollen that can contaminate organic corn.

Canadian organic standards require that organic farmers establish a 10-kilometer (6.2 mile) "radius of notification" and be able to produce statements from any neighboring farms within that 10-kilometer radius stating whether GMO varieties were planted. This makes a lot of sense until human nature is factored in. What does an organic farmer do if their neighbors refuse to cooperate or if they lie? Does an organic farmer have to decide not to plant corn or canola simply because their neighbors declare that they will be planting GMO varieties? Canadian standards can also put an organic field back to the very start of transition if GMO contamination is detected. This raises an enormously important question — must the sole financial and management burden rest on the organic farmer?

THE BURDEN

Jim Riddle, an organic inspector and longtime participant in the U.S. organic industry, states that the big problem with extended buffer zones is that the financial and management burden is placed on organic producers to protect themselves against contamination caused by the manufacturers and users of biotech products. He feels that it is imperative that the responsibility for GMO contamination, and protection of organic and other non-GMO crops, must be shifted to the users and manufacturers of the GMO products, essentially making the "polluter pay." Many lawyers

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agree that such contamination constitutes a violation of property rights, or a "taking" of the organic producers' right to produce a crop free from contamination. By imposing expanded buffer zones and implementing "tolerance levels," the organic industry may be accepting responsibility for contamination control that will be difficult to reverse later. Ultimately, the integrity of an organic farm must be protected against genetic trespass by legal means.

The prevention of accidental mixing of GMO and non-GMO crops on the farm is imperative. It was inconceivable to Michigan grain farmer John Simmons when a proposal to prohibit the parallel production of GMO and organic crops on certified farms was rejected at the 1999 annual meeting of the Organic Crop Improvement Association. But at that time, GMOs were not yet considered a big issue to organic farmers, and no other U.S. certifier was expressly prohibiting this practice. In light of the numerous routes in which contamination can occur by using the same equipment for planting and harvesting both types of crops, not to mention the increased possibility of pollen drift, it would almost be surprising if a low level of contamination did not occur. Many of the same possibilities exist when an organic farmer hires a commercial custom operator to plant, harvest or transport their crops.

It is a major responsibility of an organic farmer engaging in such practices to take personal responsibility for the thorough cleaning of equipment and the documentation of this operation. This must be seen not as just another detail that will need to be shown to the inspector. The organic farmer must realize that the organic integrity, and therefore the marketability of their product, rests on thoroughness in this procedure.

SUMMARY

The bottom line is that there is no totally effective way to guarantee that organic products are not going to be contaminated by traces of GMO DNA. Most leaders in the organic industry conclude that the only solution for GMO contamination of organic crops is to actively push for an immediate ban on all commercially grown genetically engineered crops. However, the chance of this happening is slim. The large agribusiness companies have invested too much into this technology, and the products have not yet met with substantial rejection from commercial American farmers. With the loss of many international commercial markets over this issue, this situation may change, but that possibility should not be counted upon. In the meantime, organic farmers must educate themselves on the problem and determine what management changes are necessary on their farm to minimize exposure. They should cooperate with their neighbors as much as possible, and they should support those in the industry who are working to establish legal precedents concerning genetic trespass. They should also support activist groups who are seeking to ensure that consumers are given the choice to avoid buying GMO products by requiring GMO labeling laws. A ban on GMOs is already happening in Europe, India, and other areas of the world. It is time for consumers in the United States to become educated and be given a choice.

One last thought. Brian Magaro, an organic inspector from Pennsylvania, has said that with the widespread planting of commercial GMO corn varieties, it may become more difficult to grow organic corn in the United States than it is to produce organic honey. That is a pretty scary thought. We must prevent this from happening.

The full text of the article "Organic Farming and Gene Transfer from Genetically Modified Crops," by Catherine Moyes and Philip Dale of the John Innes Institute, is available over the Internet by selecting "organic farming research" at the website <www.gmissues.org/frames.htm>.

The American Corn Growers Association will have promotional material available by early 2000 on their "Farmer Choice — Customer First" program. Their address is P.O. Box 18157, Washington, D.C. 20036, website <www.acga.org>.