StarLink™:

WHERE NO CRY9C CORN SHOULD HAVE GONE BEFORE

The discovery of StarLink corn in food products intended for human consumption caused considerable disruption in corn markets in 2000 and 2001. The authors take a closer look at the market impact, and look at ways to avoid a return trip.

BY WILLIAM LIN, GREGORY K. PRICE, AND EDWARD ALLEN

photo courtesy USDA

On September 18, 2000, a news headline reported that some taco shells sold in retail stores contained a protein from StarLink™ corn, a genetically engineered variety that was approved only for domestic feed and non-food industrial uses but not for human consumption. This discovery quickly rippled through the mass media and became yet another cause celebre for opponents of agricultural biotechnology. It also had significant repercussions throughout the grain handling and processing sectors, as well as in global grain trade during the 2000-2001 marketing year.

How Did That Get There?

StarLink corn was developed by Aventis CropScience (Aventis), a multinational firm based in France. This Bacillus thuringiensis (Bt) variety was grown on less than 1 percent of the total U.S. corn acreage in 2000 (about 362,000 acres), with 40 percent of the acreage concentrated in Iowa. StarLink corn has been genetically engineered to express a protein known as Cry9C, which is toxic to European corn borers and certain other insect pests. The Environmental Protection Agency did not approve the protein for human consumption due to lingering questions about Cry9C's potential to cause allergic reactions. A testing lab indicated that it found the presence of the Cry9C protein in a sample of Taco Bell taco shells. Kraft Foods, Inc., the company that produced the taco shells, recalled all of its taco shells after further testing confirmed the initial results. The incident led to the recall of nearly 300 food products, including more than 70 types of corn chips, more than 80 kinds of taco shells, and nearly 100 food products served in restaurants, a precaution taken by food manufacturers. More recently, StarLink was found in additional corn products, including corn dogs, corn bread, polenta, and hush puppies.

To contain the extent of commingling, Aventis reached an agreement with the U.S. Department of Agriculture (USDA) on September 29, 2000, to launch a buyback program. This program offered producers a 25-cents-per-bushel premium above the posted county price to ensure that StarLink corn is fed to farmers' own animals, sold to feed out-

lets, or sold to the Commodity Credit Corporation, with Aventis providing reimbursement for extraordinary expenses (including extra transportation charges). This program, however, did not address the 1999- and 2000-crop StarLink corn that had already been delivered to local elevators. In mid-October 2000, Aventis reached an agreement with 13 state (including Iowa) attorneys general to extend compensation coverage to grain elevators. Then, in November 2000, the U.S. and Japanese Governments reached an agreement that establishes testing protocols, which would be implemented through sales contracts, for detecting StarLink in U.S. food-grade corn shipments to Japan.

Segregation – Theory vs. Practice. Segregating biotech crops from their conventional counterparts has proven difficult in practice. Some data suggest the costs of segregation are not matched by price premiums.

photo courtesy USDA

Early in fall 2000, Aventis voluntarily withdrew the registration for StarLink, in effect removing StarLink corn from the marketplace for 2001-crop plantings. USDA also worked with the seed industry to ensure that hybrid corn seed sold and planted in 2001 was tested for the presence of the Cry9C protein. To further support this effort, Aventis and USDA reached an agreement in March 2001 to launch a seed corn buyout program that would purchase seed containing Cry9C from seed companies.

Domestic Disruption

Disruptions in the U.S. corn market occurred when shipments destined for food use or export markets tested positive for StarLink and had to be rerouted to approved uses. Players kept market disruption to a minimum by directly channeling the commingled corn to feed use, which accounts for about 60 percent of U.S. corn disappearance. Alternatively, commingled corn was channeled to certain non-food industrial users, such as dry-mill ethanol plants. Dry-mill alcohol fuel use accounts for about 2-percent of U.S. corn disappearance.

How much commingling of StarLink with other corn may have occurred in the marketplace? USDA's Economic Research Service (ERS) estimates the potential (upper-bound) volume of marketed StarLink-commingled corn from the 2000 crop located near wet and dry millers prior to October 1, 2000, at 124 million bushels (Lin, Price, and Allen). Most of the "hot spots" — areas with large StarLink acreages or significant amounts of marketed commingled corn — are in the Midwest (especially Iowa and Illinois) and nearby states, such as Nebraska, Tennessee, and Kentucky. The volume of commingled corn could be significantly larger if the 1999 crop is also taken into consideration. Aventis' own estimate indicates that the commingled corn stored at grain elevators as of March 2001 was in excess of 430 million bushels (3.7 percent of total corn supplies), mostly from 1999.

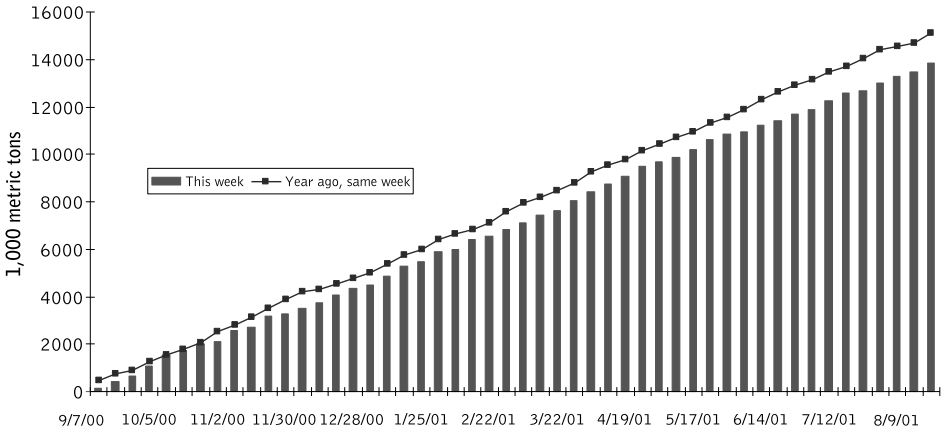
In response to the potential commingling of StarLink with other corn in shipments, local elevators owned by large grain companies, which own and operate both grain handling and processing facilities, have begun testing inbound corn shipments for StarLink. In addition, many other local elevators, which normally do not test for the presence of biotech content in corn shipments, are conducting StarLink tests as well because of the compensation provided by Aventis.

The extent to which corn shipments have tested positive is an indication of the degree of market disruption. According to the grain industry, the positive shipments vary by mode of transportation. In the case of truck shipments, the share of shipments testing positive has averaged about 5 percent. In contrast, the percentage is lower for barge shipments and higher for rail shipments. The zero tolerance for StarLink corn adopted by buyers in major export markets (mainly Japan) and domestic food processors raises the question of whether the grain industry can segregate crop supplies consistent with this tolerance. A recent ERS study estimated the cost of segregating non-biotech corn to be around 22 cents per bushel (from country to export ports) if segregation follows the handling process for high-oil corn, which typically meets a tolerance level of about 5 percent (Lin, Chambers, and Harwood). A zero-tolerance policy is likely to raise the cost of segregation even more.

The real problem is that the price premium for StarLink-free corn does not cover the costs of segregation. According to trade sources, price differentials between StarLink and StarLink-free corn ranged between 7 and 12 cents

per bushel and, in some rare instances, reached as high as 15 to 20 cents during the early stages of the incident. Premiums for StarLink-free corn eroded quickly as the U.S. grain handling industry became more knowledgeable in addressing the issue and in delivering StarLink-commingled corn to approved uses. Buyers were able to source StarLink-free corn, the Aventis-state attorneys general agreement extended compensation coverage to grain elevators, and testing protocols improved. At present, the price differentials are small or nonexistent.

Figure 1. Accumulated exports of U.S. corn to Japan during the weeks from 9/7/00 to 8/16/01



Source: U.S. Dept.. Agriculture, U.S. Export Sales, Selected issues from Sept. 14, 2000 to Aug. 23, 2001.

Foreign Commotion

The presence of StarLink in U.S corn exports temporarily disrupted shipments to Japan and South Korea during the first half of 2000-2001. The first wave of disruptions occurred during late October and early November 2000 before the U.S. and Japanese Governments reached an agreement on testing protocols to be implemented through sales contracts (Figure 1).

The disruption continued over the next few months as discrepancies over StarLink testing results arose. U.S. corn exports to Japan from September 1 to the week ending December 28, 2000, for example, were down about 11 percent from a year earlier (USDA). This decline was narrowed to about 7 percent by mid-April and then widened to about 10 percent by mid-July 2001. Outstanding sales of U.S. corn to Japan at the end of calendar 2000 were down 21 percent from a year earlier. The gap widened to 44 percent by mid-April but closed by mid-July 2001 (Figure 2). Accumulated U.S. corn exports and outstanding sales to Japan together were down about one million metric tons from a year earlier, as of August 16, 2001, a decline of 6 percent.

StarLink Trade Effects

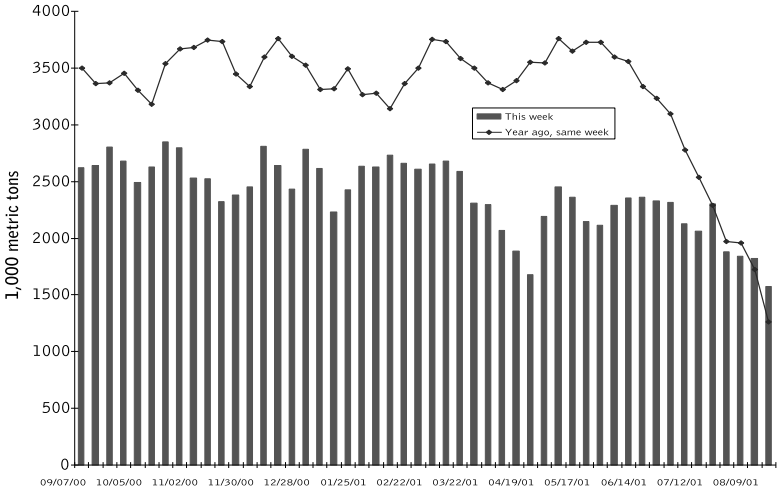
The markets most affected by StarLink have been those for non-feed corn in Japan. Import statistics from Japan and South Korea show a sizeable decline in the U.S. share of corn imports that are purchased for non-feed use. From November 2000 through June 2001, Japan's imports of U.S. corn for starch manufacturing were down 35 percent from a year earlier, a drop of 0.8 million tons. As a result, U.S. share of corn imports by Japan for starch use declined from 100 percent last year to 69 percent. Corn from South Africa, China, Argentina, and Brazil made up most of the difference.

Similarly, South Korea's imports of U.S. corn for food manufacturing (mostly starch) during this same period were down 34 percent from a year earlier, a decline of over 400,000 tons. U.S. share of corn imports by South Korea for non-feed uses declined from 90 percent last year to 60 percent.

Testing. Testing...

Food processors (including dry and wet corn millers) test inbound corn delivered to their facilities. The most frequently used test is the protein-based enzyme-linked immunosorbent assay (ELISA) method, which determines whether the Cry9C protein found in StarLink is present in the sample with a "yes" or "no" response. USDA's Grain Inspection and Packers and Stockyards Administration (GIPSA) has evaluated the performance of some test kits and verified that they are capable of detecting the presence of Cry9C. The detection sensitivity reaches 0.125 percent (1 StarLink kernel in 800) for most of the test kits and 0.01 percent (1 StarLink kernel in 10,000) for two highly-sensitive ones. A common practice (for example, under the Japan food corn protocol) is to test three 800-kernel sub-samples. If all three tests (2,400 kernels) are negative, there is a 99-percent probability that the sample does not contain more than 0.2 percent of StarLink corn.

Figure 2. Outstanding export sales of U.S. corn to Japan during the weeks from 9/7/00 to 8/16/01



Source: U.S. Dept. Agriculture. U.S. Export Sales Selected issues from Sept. 14, 2000 to Aug. 23, 2001.

Virtually all the decline was offset by imports from non-U.S. origins for food manufacturing. However, as of August 16, 2001, cumulative U.S. corn exports and outstanding sales together to South Korea for all uses during 2000-01 were actually ahead of a year earlier.

Competing exporters' trade data from November 2000 to June 2001 give similar results. While StarLink has had a negative impact on U.S. corn exports, most of the reduction is due to Japan's increased purchases from South Africa, China's decision to continue to subsidize exports, increased competition from the large back-to-back crops in Argentina, and a record Brazilian crop. The net effect of StarLink on U.S. corn exports has been reduced somewhat as U.S. corn that otherwise would have been exported to Japan was diverted to other markets.

Was This a "Teachable Moment?"

The StarLink incident illustrates the complexity of isolating crop varieties within the grain marketing system. Contrary to value-enhanced crops where producers follow an identity preservation (IP) program to segregate them from bulk commodities in exchange for price premiums, no market incentive mechanism exists for StarLink corn. Instead, the Aventis-USDA buyback program and legal arrangements with the state attorneys general have provided a mechanism for channeling StarLink corn to feed or non-food industrial uses.

IP or segregation is likely to become crucial in the release of future biotech crops, especially biotech food grains (such as herbicide-tolerant wheat). Channeling commingled StarLink corn to feed use significantly mitigated the supply impact on food producers and exporters. However, in the case of the future release of herbicide-tolerant wheat, the commingled volume could be limited to flour milling in the domestic market because of price disparity between food and feed uses. Having a workable IP system in place prior to the commercial release of these biotech crops is essential to minimize market disruptions.

Zero tolerance, which applies to any use of StarLink corn in Japan and food use in South Korea as well as domestic food use, compounds the difficulties in segregation and IP. Segregation to meet zero tolerance is impossible, given limitations of production and handling processes and testing technology. For example, based on USDA's GIPSA and the Food and Drug Administration sampling and testing recommendations, if StarLink were present in concentrations of 0.2 percent, there would be a 99-percent probability that a lot of corn would be rejected using a 2,400-kernel sample size.

Institutional arrangements play a strategic role of preventing further commingling of StarLink corn and facilitating trade. What is less clear is whether it is necessary for USDA to become involved in certification of IP systems, or whether large grain companies or private firms can adequately perform the task.

For More Information

Lin, William, William Chambers, and Joy Harwood. "Biotechnology: U.S. Grain Handlers Look Ahead." *Agricultural Outlook,* USDA-ERS, April 2000, pp. 29-34.

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