StarLink: Impacts on the U.S. Corn Market and World Trade

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Abstract: StarLink has disrupted the U.S. corn market since some shipments destined for food uses or export markets tested positive and were rerouted to approved animal feed and non-food industrial uses. The potential (upper-bound) volume of marketed StarLink-commingled corn from the 2000 crop located in areas near wet and dry millers prior to October 1, 2000, is estimated at 124 million bushels. The actual volume of commingled corn may differ from the potential volume estimated in this study. Price differentials between StarLink-free and StarLink corn existed during the early stage of the incident. However, at present, the price differentials are small or nonexistent. The zero tolerance for unapproved biotech varieties adopted by buyers in major export markets (mainly Japan) raises the question of whether the grain industry can segregate grain supplies. Restrictions imposed on the use of StarLink corn in some major U.S. export markets, such as Japan and South Korea, appear to have had a negative impact on U.S. corn exports. The zero tolerance for StarLink and disputes over testing protocol have also disrupted corn shipments destined for these export markets.

Keywords: StarLink, corn, commingled corn, market disruptions, trade effects.

Introduction

On September 18, 2000, a news headline reported that some taco shells sold in retail stores contained a protein from StarLink corn, a Bt corn variety that was approved only for feed and industrial uses but not for human consumption. Ever since, this discovery of StarLink corn in food has had repercussions throughout the grain handling and processing sectors as well as in global grain trade.

StarLink corn was developed by Aventis CropScience (Aventis), a multinational firm based in France. According to Aventis, StarLink corn 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 contains the Cry9C protein, which is toxic to European corn borers and certain other insect pests. The Environmental Protection Agency (EPA) 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 by the Food and Drug Administration 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—by several food manufacturers and caused major disruptions in domestic and export markets. Recently, StarLink was found in more corn products, including corn dogs, corn bread, polenta, and hush puppies.

However, the U.S. grain handling industry quickly became more knowledgeable in addressing the issues. Over time, the government approved more destinations for channeling StarLink-commingled corn to feed and non-food industrial uses, thus opening more market outlets for delivery. Price differentials between StarLink and "StarLink-free" corn that existed in the early stage of the incident eroded quickly. Many grain companies currently do not discount StarLink corn prices paid to producers because Aventis will pay the cost of diverting the grain to approved uses. Thus, at present, the price differentials between StarLink-free and StarLink-commingled corn are small or nonexistent.

The StarLink incident illustrates the complexity of isolating crop varieties within the existing grain marketing system and preventing unwanted commingling.[2] The potential commingling of StarLink with other corn varieties was exacerbated by three factors: (1) some of the corn grown on the buffer zone was probably cross-pollinated with StarLink

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[2] Commingling is defined as the combination or mixing of StarLink and cross-pollinated corn from the buffer zone (a 660-foot strip area between StarLink and other hybrid varieties required by a contract between Aventis and producers) with other varieties during harvest, storage, handling, and distribution of the grain.

corn,[3] (2) a portion of StarLink corn (including that grown on the buffer zone) had entered the marketplace prior to an effort to contain StarLink-commingled corn, and (3) some elevators did not know that they were receiving StarLink-commingled corn. The commingled corn may have come from either the 1999 or 2000 corn crop because StarLink was grown in 1999 but was not detected.

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, offering producers a 25-cents-per-bushel premium above the posted county price to ensure that StarLink corn (both the 2000 and 1999 crops remaining on farms) was fed to farmers' own animals, sold to feed outlets, or sold to the Commodity Credit Corporation (CCC), with the expenses (including extra transportation charges) to be reimbursed by Aventis.[4] This program, however, did not address the 1999- and 2000-crop StarLink corn that had already been delivered to local elevators.

The main purpose of this article is to attempt to assess the magnitude of the impacts of the StarLink incident on the U.S. corn market and global corn trade. Specifically, the objectives are: (1) to examine the disruptions caused by the incident in the domestic and export corn markets, (2) to estimate the potential (upper-bound) volume of StarLink-commingled corn from the 2000 crop that was produced and marketed near wet- and dry-milling facilities, and (3) to estimate the impact of StarLink on global corn trade and U.S. corn exports.

Disruptions in the Domestic Corn Market

The StarLink incident has disrupted the U.S. corn market since some shipments destined for food uses or export markets tested positive and thus had to be rerouted to approved uses. The disruption to food producers and exporters can be kept to a minimum by directly channeling a large portion of the commingled corn to feed use, which accounts for about 60 percent of U.S. corn disappearance (USDA, ERS). Alternatively, commingled corn can be channeled to certain non-food industrial users, such as dry-mill ethanol plants where the byproduct feeds produced are typically consumed domestically. Dry-mill alcohol fuel use accounts for about 2 percent of U.S. corn disappearance.

Food processors (including wet- and dry-millers) are testing inbound corn delivered to their facilities. The most frequently used test is the protein-based enzyme-linked immunosorbent assay (ELISA) test, which determines whether the Cry9C protein found in StarLink is present in the sample. The test takes about 10 minutes to perform and indicates the presence or absence of the StarLink-specific protein with a "yes" or "no" response. Presently, the detection sensitivity reported by the test kit manufacturers ranges from 0.25 percent (1 kernel in 400) to 0.125 percent (1 kernel in 800), which is achievable with newer test kits. These tests cost around $4 each.[5] Elevators also face the problem of conflicting StarLink test results, in part, because of the small size of test samples—up to three 800-kernel sub-samples per test. Some elevators even use a more sophisticated, DNA-based technique, called the polymerase chain reaction (PCR) test, which can detect specific foreign genetic material inserted into corn's DNA. The cost of the test ranges from $200 to $450 and takes 2 to 10 days to obtain the results, which disrupts the rapid turnover of grain elevator operations. However, the 10-day upper limit is uncommon. Only one test is required per barge shipment.

When corn shipments are rejected by processors, arrangements must be made to alter grain flow patterns by hauling the grain away from processing facilities or export ports to feed or non-food industrial users. Rerouted shipments of rejected corn impose extra transportation costs on grain elevators. Compensation by Aventis for any extra transportation costs is possible if the expenses are documented (Harl *et al.*). In most cases, rerouting of the rejected grain involves shipment to destinations not far away from the originally intended destination. Demurrage adds an extra cost for grain elevators. Furthermore, grain elevators may face difficulties if processors and exporters no longer accept commingled corn.

The zero tolerance for unapproved biotech varieties adopted by buyers in major export markets (mainly Japan) raises the question of whether the grain industry can segregate grain supplies. Segregation poses logistical problems for grain transportation. Corn is commonly transported to export elevators in unit trains of up to 100 cars (or by barge). If effectively maintaining crop segregation makes it necessary to shift transportation away from unit trains to individual railcars, transportation costs could increase significantly. One industry source suggests that if the threshold for biotech content was 1 percent or lower, transportation costs could potentially double (Lin *et al.*). The cost of segregating non-biotech corn was recently estimated to be around 22 cents per bushel (from country elevators to export ports) if segregation follows the handling process for high-oil corn, which typically meets a tolerance level of about 5 percent in Japanese markets (Lin *et al.*). A recent sale of segregated

[3] The likelihood of the cross-pollination between StarLink and conventional corn had been recognized by Aventis. In a company brochure entitled "2000 U.S. Edition," Aventis stated that "the use of StarLink hybrids and any corn grown within 660 feet of StarLink hybrids is currently limited to domestic animal feed, industrial non-food, or seed production uses" (Harl).

[4] As of April 19, 2001, CCC had purchased 221,000 bushels of StarLink and commingled corn from producers. All the purchased corn was channeled to feed users, such as feedlots.

[5] Some elevators and processors did not incur testing costs because Aventis provided them with test kits free of charge.

non-biotech corn to South Korea suggests a lower cost of segregation at 18 cents per bushel. The zero tolerance for StarLink corn is likely to raise the cost of segregation beyond that incurred with segregating non-biotech corn.

Potential price discounts for StarLink corn are another disruption in the corn market. The USDA-Aventis buyback program guarantees farmers market outlets for their StarLink corn by offering a 25-cents-per-bushel premium above the posted county price to divert the StarLink corn to feed or non-food industrial uses. However, price discounts or differentials may arise at the grain-handler level. Aside from additional transportation that may be needed to channel the commingled corn to approved uses, the value of StarLink corn could be discounted by buyers upon rejection by food processors or exporters. According to trade sources, price differentials between StarLink and StarLink-free corn under the identity preservation (IP) program ranged between 7 and 12 cents per bushel and in some rare instances, reached as high as 15 to 20 cents during the early stage of the incident.[6] Compensation by Aventis for any market losses (besides any extra transportation costs) is possible if they are documented (Harl *et al*.). Price discounts for StarLink corn reportedly were widespread, especially in the Southeastern poultry market and export markets. However, trade volume for StarLink-free corn in the domestic market was very thin, especially in those areas commanding higher premiums.

Premiums for StarLink-free corn eroded quickly for several reasons. First, the U.S. grain handling industry became more knowledgeable in addressing the issues. As more destinations for channeling were approved by the government, StarLink corn found more market outlets for delivery. Second, several agreements involving the Federal and State governments paved the way to channel StarLink corn to approved uses, including the Aventis-USDA agreement on the buyback program in late September 2000, the Aventis-Iowa State Attorney General agreement reached in mid-October 2000, to extend compensation coverage to grain elevators, and the agreement made by the U.S. and Japanese Governments in November 2000 to resolve trade-related issues. Finally, premiums for StarLink-free corn were also reduced as more exporters were willing to market their StarLink-free corn under the IP program, increasing the StarLink-free corn's exportable supplies. At present, the price differentials are small or nonexistent. Many grain companies do not discount StarLink corn prices paid to producers because Aventis will pay the cost of diverting the grain to approved uses.

[6] IP refers to a handling process by which crops are kept separate to avoid commingling during harvest, loading and unloading, storage, and shipping. This supply chain system thus requires that equipment (such as combines and augers), transportation, and storage facilities be cleaned. In the context of StarLink, this process is designed to meet the zero-tolerance requirement.

Estimating the Potential Volume of StarLink-Commingled Corn

This section discusses the estimation of the potential volume of StarLink-commingled corn from the 2000 crop that was produced and marketed near wet- and dry-milling facilities.[7] The assumptions of the scenario analysis and the data sources will be discussed first, and then the results of the estimation for both wet- and dry-milling facilities will be presented. The results from this scenario analysis are only one of many possible outcomes, which vary depending on the assumptions and procedures used. The findings from this study are not intended to reflect the actual or most likely volume of commingled corn, but should be interpreted as an upper-bound estimate.

Scenario Development

The Aventis-USDA StarLink buyback program, announced on September 29, 2000, aimed to contain StarLink and commingled corn at the farm gate. That is, the program covered corn that had been harvested but not marketed, as well as corn that had yet to be harvested. The buyback program, however, did not address commingled corn that had already been marketed.[8] As a result, the potential for commingling StarLink with other varieties existed in areas near wet- and dry-milling facilities.[9]

To determine the potential volume of StarLink-commingled corn from the 2000 crop in areas near wet- and dry-milling facilities, this study analyzes county-level production and marketing data to identify local "hot spots." Hot spots are defined as areas where large StarLink acres were planted or significant amounts of commingled corn were marketed near wet- and dry-milling plants. A high concentration of

[7] This study does not estimate the potential volume of StarLink-commingled corn from the 1999 crop due to a lack of detailed data on StarLink acreage and marketing in that crop year.

[8] The issue of losses resulting from commingled corn in the grain handling system was addressed later by Aventis' agreement to settle those claims on a case-by-case basis. The volume of marketed StarLink-commingled corn in 2000 depended on the percent of corn harvested by October 1 that year. For example, the percentage ranged from 27 percent to 37 percent in Iowa regions where food processors are located. In contrast, the percentage ranged from 54 percent to 88 percent in Nebraska. The 2000 corn crop was harvested earlier than normal due to warm spring weather.

[9] There are two different processes that convert corn into food products for human consumption. The wet-milling process tempers and soaks corn in steep water to soften and swell the kernels, which aids in the separation of starch, solubles, gluten, and hulls. The Cry9C protein is retained in gluten meal and feed, but not in starch, oil, or corn syrup, which are intended for human food consumption, as concluded in a recent EPA white paper. In contrast, corn dry milling is basically a grinding procedure. Corn is degerminated by tempering it with steam heat or spraying it with warm water for oil extraction, and the remaining corn is ground and sieved into many fractions. The dry-milling process does not remove proteins from its products intended for human consumption. As a result, theCry9C protein can be detected in dry-mill products, including corn meals, corn flour, and corn grits.

StarLink acreage may have contributed to significant commingling. Moreover, commingling may have occurred in areas with large corn production even though StarLink acreage was relatively small. The potential for commingling could be greater in certain locations where the proportion of the corn crop harvested by October 1, 2000, was higher than in other areas. For example, States in the South harvest their crop in August, thus potentially moving corn (StarLink and other varieties) into the grain handling system before the buyback program began.

Data and Methodology

The locations of corn wet- and dry-milling facilities were obtained from the Corn Refiners Association and the *Grain and Milling Annual* (Sosland Publishing Co.), respectively. Based on the geographic information, 2000 county-level data on harvested corn acreage and yields were gathered from the USDA's National Agricultural Statistics Service (USDA, NASS website). The potential volume of StarLink-commingled corn is estimated at the "greater-county" area level, which is defined as the county in which one or more wet or dry millers are located as well as the adjacent counties within the same State. Greater-county area production is the sum of corn production in the specified counties. Multi-county corn production that had been harvested and marketed (including StarLink and other varieties) prior to October 1, 2000, was estimated by multiplying the greater-county corn production by the estimated percent harvested in the area (USDA, NASS website) and by the estimated percentage marketed up to that date in 1999/00 (State-level data), which is the latest available USDA data on the distribution of corn sales (USDA, *Ag Prices*). The volume of marketed StarLink corn by county (including the corn grown on the buffer zone) was obtained from Aventis' survey of StarLink producers. The acreage, production, and marketing data employed in this analysis are provided in table B-1.

For illustrative purposes, Linn County, Iowa, is used as an example to show how the volumes of 2000-crop corn (3.9 million bushels) and StarLink (324,400) sold by October 1, 2000, were estimated for a greater-county area. The counties that surround Linn County are Buchanan, Delaware, Benton, Jones, Cedar, Johnson, and Iowa Counties. The 2000 harvested acreage in the greater Linn County area (1.1 million acres) consisted of 136,100 acres in Linn County and 978,700 acres in the other counties. Corn production in each county was computed by multiplying the county's 2000-crop harvested acreage by its average corn yield that year. Much of the estimated volume of corn in the greater Linn County area (161 million bushels) came from the surrounding counties (141.7 million bushels), while only 19.3 million bushels were produced in Linn County itself. To calculate the estimated volume of corn sold by October 1, 2000, in this greater-county area, the regional production was multiplied by the estimated percent harvested in the area prior to that date, which was about 27 percent. Then, that value was multiplied by the estimated share of corn sold up to that date (9 percent) based on 1999/00 marketing year sales data. The 324,400 bushels of marketed StarLink and buffer-zone corn were obtained from Aventis.

We assumed that the StarLink corn marketed prior to October 1, 2000, in a greater-county area was commingled with conventional corn from the area sold before that date. The volume of potentially commingled conventional corn (excluding StarLink and buffer-zone corn) in a given area was calculated as the difference between the total volume of corn marketed and the volume of StarLink corn sold by October 1, 2000 (table B-2). For example, in the greater Linn County area, the 3.6 million bushels of potentially commingled corn was calculated by subtracting the 324,400 bushels of marketed StarLink from the 3.9 million bushels of total corn sold by October 1, 2000 (table B-1). A commingling ratio—the estimated volume of the potentially commingled corn relative to the volume of marketed StarLink corn—was computed for each greater-county area where one or more processing facilities are located.

Results

This section presents, for illustrative purposes, the possible results in terms of the potential commingling of StarLink with conventional corn in areas near wet- and dry-milling facilities if the assumptions of the scenario analysis hold. The analysis identified seven greater-county areas across the States that had StarLink sales prior to October 1, 2000, that were estimated to be greater than 100,000 bushels. The greater-county area around Nebraska's Butler County marketed the largest amount of StarLink at 528,000 bushels (table B-1). Other regions with large volumes of marketed StarLink corn include the greater Linn (Iowa), Lancaster, Washington, and Saline (Nebraska), Castro (Texas), and Atchison (Kansas) county areas.

This analysis identifies a number of hot-spot areas near processing facilities where large volumes of potentially commingled corn existed prior to October 1, 2000. Not surprisingly, most of the hot spots are in the Midwest (especially Iowa and Illinois) and other neighboring States, such as Nebraska, Tennessee, and Kentucky (table B-2). Overall, the potential volume of marketed commingled corn from the 2000 crop located in areas near wet and dry millers prior to October 1, 2000, is estimated at 123.8 million bushels, or about 1.2 percent of the 2000 crop. The actual volume of commingled corn may differ from the potential volume estimated in this study.

In Iowa, where 40 percent of the StarLink corn was grown (Harl *et al*.) and seven wet millers and one dry miller are located, the volume of potentially commingled corn was found to be large in a few greater-county areas—Linn (3.6 mil. bu), Clinton (2.3 mil. bu.), and Mahaska (2.6 mil. bu.).

Table B-1--Input data

State	Greater-county area	Estimated 2000 harvest		Estimated total corn sold by Oct.1, 2000	Total marketed StarLink
		Acres	Bushels		
AL	Morgan	41,700	3,546,700	1,853,151	9,165
IA	Linn	1,114,800	161,010,920	3,912,565	324,435
	Clinton	639,800	93,984,580	2,283,825	28,200
	Mahaska	540,300	78,008,120	2,597,670	36,715
	Muscatine	511,700	75,038,000	1,823,423	84,790
	Lee	269,900	39,591,300	1,318,390	70,496
IL	Macon	1,225,600	207,079,500	10,933,798	14,800
	Cook	138,600	18,533,600	355,845	2,000
	Tazewell	1,150,700	179,715,900	9,489,000	18,200
	St. Clair	462,100	66,513,100	3,511,892	77,595
	Vermilion	1,123,500	159,630,600	7,534,564	33,191
	Edgar	747,600	109,613,500	3,069,178	13,991
	Kankakee	1,041,800	149,780,600	7,069,644	19,200
IN	Lake	369,900	51,954,700	1,143,003	84,705
	Daviess	364,100	59,017,500	1,298,385	31,135
KS	Atchison	283,200	36,506,500	2,496,909	198,429
	Wyandotte	32,600	3,446,700	243,935	12,128
KY	Logan	185,700	19,697,200	3,398,753	52,250
	Henderson	353,600	49,228,600	8,285,073	16,800
	Christian	212,900	25,208,300	4,270,656	30,790
MN	Lyon	825,100	118,549,600	1,849,374	86,716
MO	Clay	215,300	30,535,670	4,763,565	91,016
	Buchanan	185,500	26,015,630	4,058,438	20,706
NE	Washington	375,900	49,398,240	2,667,505	105,216
	Butler	863,300	104,575,160	5,647,059	527,571
	Saline	712,000	82,187,200	7,232,474	116,437
	Lancaster	878,000	97,718,800	5,276,815	312,431
TN	Madison	130,400	14,199,500	4,352,851	15,950
TX	Castro	236,800	40,300,320	12,412,499	169,126
VA	Hanover	36,300	5,703,300	751,667	7,020
WI	Columbia	623,900	85,461,400	538,407	23,600
Total		15,892,600	2,241,750,740	126,440,313	2,634,804

Table B-2--Potential volume of StarLink-commingled corn in areas near wet and dry millers

State	Greater-county area	Number of wet millers	Number of dry millers	Potentially commingled corn in 2000	Commingling ratio
				Bushels	
AL	Morgan	1	1	1,843,986	201.2
IA	Linn	3	1	3,588,130	11.1
	Clinton	1	0	2,255,625	80.0
	Mahaska	1	0	2,560,955	69.8
	Muscatine	1	0	1,738,633	20.5
	Lee	1	0	1,247,894	17.7
IL	Macon	2	0	10,918,998	737.8
	Cook	1	0	353,845	176.9
	Tazewell	1	0	9,470,800	520.4
	St. Clair	0	1	3,434,297	44.3
	Vermilion	0	1	7,501,373	226.0
	Edgar	0	1	3,055,187	218.4
	Kankakee	0	1	7,050,444	367.2
IN	Lake	1	0	1,058,298	12.5
	Daviess	1	0	1,267,250	40.7
KS	Atchison	0	1	2,298,480	11.6
	Wyandotte	0	1	231,807	19.1
KY	Logan	0	1	3,346,503	64.0
	Henderson	0	1	8,268,273	492.2
	Christian	0	2	4,239,866	137.7
MN	Lyon	1	0	1,762,658	20.3
MO	Clay	1	0	4,672,549	51.3
	Buchanan	0	1	4,037,732	195.0
NE	Washington	1	0	2,562,289	24.4
	Butler	1	0	5,119,488	9.7
	Saline	0	1	7,116,037	61.1
	Lancaster	0	1	4,964,384	15.9
TN	Madison	0	1	4,336,901	271.9
TX	Castro	1	0	12,243,373	72.4
VA	Hanover	0	1	744,647	106.1
WI	Columbia	0	1	514,807	21.8
Total		19	18	123,805,509	47.0

In Iowa alone, the volume of potentially commingled corn in the greater-county areas is estimated to have reached 11.4 million bushels, which is nearly 20 percent larger than the 9.6 million bushels of U.S. StarLink and buffer-zone corn marketed in the U.S. prior to October 1, 2000 (Aventis). Other greater-county areas with large amounts of potentially commingled corn include regions in Illinois (Macon, Kankakee, Vermilion, and Tazewell), Tennessee (Madison), Nebraska (Butler, Saline, and Lancaster), Kentucky (Henderson and Christian), and Texas (Castro).

This county-level scenario analysis does not address the risk of commingling StarLink corn with other varieties outside of these counties. Furthermore, the scenario analysis does not address possible intrastate and interstate corn shipments beyond the surrounding counties because of a lack of information about current grain flow patterns. These shipments could compound the risk of commingling StarLink corn with other varieties in the grain handling system. However, some elevators can directly unload corn onto vessels, which lowers the risk of commingling.

The 123.8 million bushels of the commingled corn identified above applies only to the 2000 crop and refers to the potential volume of commingled corn that could have been marketed near wet and dry millers. Alternatively, the volume of commingled corn could be estimated at grain handling facilities. In a separate study, Aventis estimated that the commingled corn from the 1999 and 2000 crops exceeded 430 million bushels (Wichtrich). Most of this estimated volume of commingled corn came from the 1999 crop, which entered the grain handling system undetected throughout the entire marketing year. According to an Aventis spokesperson, the estimate was derived from information that the company gained from individual grain handlers' reports on the positive detection of Cry9C protein in their grain supplies. Those grain handlers contacted Aventis for assistance in directing the corn to approved animal feed and nonfood industrial uses.

Effects of StarLink on Global Grain Trade and U.S. Corn Exports

Restrictions imposed on the use of StarLink corn in some major U.S. export markets, such as Japan and South Korea, appear to have had a negative impact on U.S. corn exports. The zero tolerance for StarLink and disputes over testing protocol have at times disrupted corn shipments destined for these export markets.

Disruptions in U.S. Corn Exports

There is evidence that the presence of StarLink in U.S. corn exports temporarily disrupted shipments to Japan during the first half of the 2000/01 marketing year. The first wave of disruptions occurred during late October and early November 2000 before the U.S. and Japanese Governments reached an agreement to address StarLink-related trade issues (fig. B-1).[10]

The disruptions continued over the next few months as disputes over StarLink testing results arose. U.S. corn exports to Japan from September 1 to the week ending December 28, 2000, totaled 4.5 million metric tons (mmt),[11] down about 11 percent from a year earlier (table B-3). This 11-percent decline persisted through mid-March 2001, but narrowed to about 7 percent by mid-April 2001. Outstanding sales of U.S. corn to Japan at the end of calendar year 2000 were down about 21 percent from a year earlier. By mid-April 2001, the gap had widened to 44 percent. Accumulated U.S. corn exports and outstanding sales to Japan together were down 2.2 mmt from a year earlier on April 12, 2001. While market forces (e.g., larger than anticipated corn crops and exports from Argentina and Brazil) probably accounted for a large portion of the decrease in U.S. corn exports to Japan (as well as South Korea), the StarLink incident also appeared to be an important factor.

Trade Effects

The markets most affected by Starlink have been the non-feed corn markets in Japan and South Korea. Import statistics from South Korea and Japan show a dramatic decline in the U.S. share of corn imports that are not purchased for feed use. From November 2000 through February 2001 (4 months), Japan's imports of U.S. corn for starch manufacturing dropped 27 percent from a year earlier, a decline of over 0.3 million tons. Meanwhile, imports for starch from non-U.S. origins, mostly South Africa, increased from zero to over 0.2 million tons.

U.S. corn exports to Japan in the "NES" category (not for feed, starch, seed, or popcorn, so likely including some food uses) were down 11 percent during the same period, a drop of over 75,000 tons. Meanwhile, shipments from non-U.S. origins to Japan for the NES category more than tripled. Only 2 months of import data are available from South Korea (November and December 2000), but they show the same pattern. Non-feed corn imports from the United States were down 27 percent, while shipments from non-U.S. origins were 10 times greater than their year-earlier levels.

Competing exporters' trade data give similar results. As of April 16, 2001, Argentina reported corn sales to Japan at 0.65 million tons during the current marketing year, more than double the previous year. Sales to South Korea were up even more, reaching 0.8 million tons—an increase from 0.25 million a year earlier.

[10] According to this agreement made in November 2000, USDA will test for StarLink in U.S. corn shipments destined for Japan, and shipments will take place if the corn is certified by USDA as StarLink-free.
[11] One metric ton equals 39.4 bushels of corn.

Figure B-1

Cumulative weekly exports of U.S. corn to Japan, Sep. 7, 2000 to Apr. 12, 2001

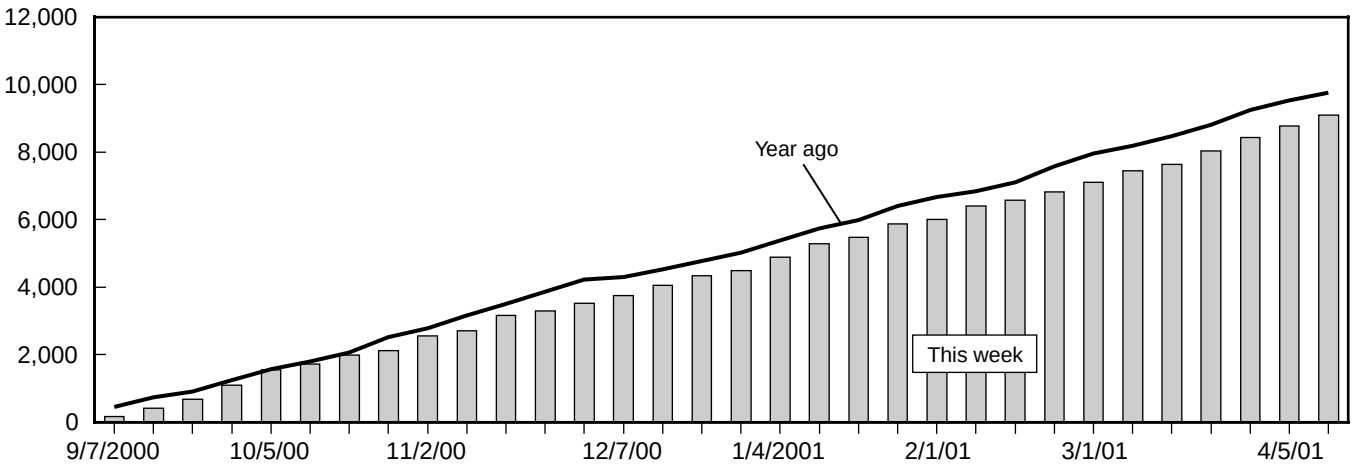

Table B-3--Comparisons of 2000/01 U.S. accumulated corn exports and outstanding sales with those during 1999/2000

Destination	2000/2001 marketing year cumulative exports			Outstanding sales		
	This week (ending Dec. 28, 2000)	Year ago (ending Dec. 28, 1999)	Percent change	This week (ending Dec. 28, 2000)	Year ago (ending Dec. 28, 1999)	Percent change
	--1,000 metric tons--			--1,000 metric tons--		
Japan	4,494.6	5,020.5	-10.5	2,783.8	3,525.7	-21.0
S. Korea	704.6	1,568.8	-55.1	212.5	756.1	-71.9
Mexico	1,754.6	1,536.8	14.2	551.3	491.3	12.2
Algeria	492.1	310.6	58.4	30.0	0.0	n.a.
Israel	336.4	193.7	73.7	131.9	63.0	109.4
All exports	15,269.0	17,010.4	-10.2	6,697.1	7,894.1	-15.2

Destination	2000/2001 marketing year cumulative exports			Outstanding sales		
	This week (ending Apr. 12, 2001)	Year ago (ending Apr. 12, 2000)	Percent change	This week (ending Apr. 12, 2001)	Year ago (ending Apr. 12, 2000)	Percent change
	--1,000 metric tons--			--1,000 metric tons--		
Japan	9,096.0	9,764.0	-6.8	1,888.3	3,391.8	-44.3
S. Korea	1,710.2	2,418.2	-29.3	304.7	459.9	-33.7
Mexico	3,963.2	2,617.8	51.4	518.0	869.6	-40.4
Algeria	926.5	546.9	69.4	0.0	18.0	-100.0
Israel	555.5	385.9	43.9	12.0	34.0	-64.7
All exports	28,786.6	30,593.4	-5.9	5,215.6	7,258.1	-28.1

n.a.= Not applicable.

Source: USDA-FAS, U.S. Exports Sales, Jan. 5, 2001 and April 12, 2001.

Japanese buyers have purchased additional corn for food processing from South Africa—more than 300,000 tons over the past few months.[12] Most of this corn is from the large crop harvested last year. Some food processors in Japan and South Korea have turned to Brazil to source corn because of concerns over StarLink-commingled corn from the United States. Brazil's record corn crop and the devaluation of its currency have made the country more competitive in the world market. Finally, larger than anticipated corn exports from China have also contributed to the decline in U.S. corn exports. Despite a drought-reduced crop, China's Government has continued to subsidize exports (a decision not related to StarLink), thereby reducing its large stocks.

Most of the reduction in U.S. corn exports is due to increased competition from the large back-to-back crops in Argentina, the record Brazilian crop, and the decision by China to continue to subsidize exports. The net effect of the StarLink incident on U.S. corn exports has been reduced somewhat as additional U.S. corn is diverted to other markets, including Mexico, Algeria, and Israel (table B-3).[13] As of the week ending April 12, 2001, cumulative weekly U.S. corn exports and outstanding sales together to those specific markets were up about 1.5 mmt from a year ago.

Conclusions

The large volume of StarLink-commingled corn that was produced and marketed near wet- and dry-milling facilities presents an unprecedented challenge to the U.S. grain handling industry. To the extent that the commingled corn can be channeled into approved uses, disruptions in the U.S. corn market can be kept to a minimum. The large volume of potentially commingled corn in grain elevators suggests that the grain industry would have to continue its efforts to channel the commingled corn to approved uses.

Segregating U.S. corn into StarLink-free and StarLink-commingled corn presents another challenge for the grain industry. Testing for the presence of the Cry9C protein in a specific lot of corn may yield different results when different samples are drawn for the test. Many recognize the importance of proper sampling procedures and knowledge of the issues at hand in determining the proper number and size of samples. More importantly, the zero-tolerance allowance adopted by buyers in Japan and South Korea (only for food use) compounds the difficulties because corn shipments will be rejected even if any traces of the StarLink-specific protein are found. Also, segregation to meet zero tolerance (because StarLink is an unapproved variety in some countries, such as Japan) is nearly impossible and would involve much greater expenses than segregating non-biotech corn.

Restrictions imposed on the use of Starlink corn in major U.S. export markets, such as Japan and South Korea, appear to have had a negative impact on U.S. corn exports. The zero tolerance for StarLink and disputes over testing results have also disrupted corn shipments destined for these export markets.

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[12] Japanese buyers pay a large price premium for South African corn, due, in part, to its high starch content. Preferences of Japanese buyers for StarLink-free corn have also contributed to the price differentials.
[13] Much of Mexico's imports are not for feed.