Implications of Testing and Segregating Nonbiotech Crops for Grain Grades and Standards

Issues

Testing for the presence of genetic content in grains and oilseeds becomes crucial in order to segregate nonbiotech commodities from the rest of the bulk-commodity supply chain in responding to emerging regulations and shifting consumer preferences in some segments of export markets. Also, testing is required to preserve specific end-use characteristics throughout the supply chain for value-enhanced products. To fit in with the current supply chain for bulk commodities, these tests must be rapid, economical, and accurate.

What tests are currently available for detecting biotech content in grains and processed foods? What tests would satisfy those concerned about food safety? Is there a role for the Federal Government in standardizing the sampling and detection methods used in the commercial market, in implementing genetic modification testing methods, and in providing quality assurance through certification? If producers continue to rapidly adopt biotech crops with input traits and if a string of new, value-enhanced products emerges, can the current grain grades and standards continue to function effectively without change? If not, what changes would be needed to facilitate marketing and trade?

Context

Segregation, as used in this article, refers to a process by which crops are kept separate to avoid commingling during harvesting, loading and unloading, storing, and transporting. This supply chain system thus requires that equipment, such as combines and augers, and transportation and storage facilities be cleaned. Such a handling process has been used for some time for specialty grains, such as high-oil corn. Although this handling process may not involve containerization, testing for the presence of biotech content throughout the marketing system is critical. This process is frequently used to meet a threshold level of biotech content around 5 percent of grain volume.

Identity preservation (IP), in contrast, is the more stringent (and expensive) process of differentiating commodities, requiring that strict separation, which typically involves containerized shipping, be maintained at all times. IP is often used for marketing commodities like food-grade corn and soybeans. Commodities typically are tested for biotech/nonbiotech status just before they are put in containers. IP lessens the need for additional testing as control of the commodity changes hands, and it lowers liability and risk of biotech/nonbiotech commingling for growers and handlers. This handling process might be required to meet a stringent threshold level of biotech content, such as the 1 percent required in European Union (EU) labeling regulations. However, no segregation system can guarantee 100-percent purity.

The current U.S. grain marketing system is characterized by high-volume, high-speed operations. Other than a few niche markets, the system reflects a traditional bulk commodity supply chain with trade taking place at spot markets. However, the rapid adoption of biotech crops with input traits and the emergence of a number of value-enhanced products (including nonbiotech varieties) promise to fundamentally alter the structure of the current marketing system. If foreign buyers in export markets, such as the EU, require that products containing biotech ingredients be segregated, marketing of nonbiotech commodities in the supply chain might be necessary. Also, grain segregation is needed to preserve enhanced value and identity—for example, virtually all high-oil corn varieties are marketed under the OPTIMUM brand developed by DuPont—and unique end-use characteristics. However, such segregated marketing requires rapid, accurate, and economical tests.

Several methods are available for detecting the presence of biotech content in grains and oilseeds and their processed products. A pre-emergence treatment and germination test for determining the presence of the Roundup Ready gene in soybean seeds was recently developed by the Iowa State University Seed Testing Laboratory and approved by Monsanto. The procedure evaluates the presence of the Roundup Ready gene in soybean seed by comparing seedlings from various seed lots. All seed lots are imbibed in a 2-percent solution of the ROUNDUP formulation (41-percent active ingredient). Two replications of 100 seeds of each lot are placed overnight in paper towels treated with the solution. Imbibed seeds are then germinated and evaluated after 7 days. Seedlings of Roundup Ready soybeans developed normally. This test is simple and inexpensive to perform but requires about 7 days to complete.

A more sophisticated technique, called the polymerase chain reaction (PCR), can be used to detect specific foreign genetic material inserted into the plant's DNA. In PCR, specific DNA fragments are separated on a gel, and the size and intensity of the DNA band produced indicates the presence and relative level of foreign DNA within the sample. PCR is not easily adaptable for rapid onsite testing and is currently offered commercially by some private companies.[3] The test takes 2-10 days and costs $200-$450 per test. According to a trade source, a reliable sample size, for example, would be at least 80 pounds for a shipment volume of 1,500 metric tons on the barge. A key issue in deciding the adequate sample size is the sampling procedures, which ideally should reflect that a particular sample accurately represents the biotech content of the entire lot of grains or product lines from which the sample is drawn.

The PCR test is a very sensitive technique that can reliably detect about 0.1 percent biotech content in a sample. It has the advantage of being easily adapted to screen DNA from several biotech gene lines—such as Bt corn, Roundup Ready corn, or high-lysine corn—in one set of tests (Schuff). However, PCR tests are also susceptible to errors due to contaminants or DNA breakdown, so testing must be performed under rigorous laboratory conditions with appropriate controls. Also, detection of DNA in processed foods derived from biotech crops can be problematic due to breakdown or degradation of DNA during processing.

[3]The Japanese Ministry of Agriculture, Forestry & Fisheries used PCR testing to determine whether biotech content in certain processed products could be detected after processing. Processed products for which PCR testing could not detect biotech contents, such as soybean oil, are exempt from labeling requirements. (Japan is scheduled to begin its labeling requirements in April 2001.)

A British firm, RHM Technology, reportedly has overcome these technical hurdles by modifying the PCR test to detect DNA in processed foods. Several companies, including Cepheid and Qualicon (a subsidiary of DuPont) were developing methods in 2000 for PCR-based diagnostic tests for rapid, simple onsite testing. Genetic ID, also in 2000, developed a program to combine its testing with a certification program for producers who want to sell segregated, nonbiotech crops. The certification program, called "CertID," is a joint venture with LawLabs in the United Kingdom (Schuff).

A third method for detecting biotech content is the protein-based enzyme-linked immunosorbent assay (ELISA). The ELISA test analyzes for a specific antibody reaction that marks the presence of the new protein produced in biotech crops. Strategic Diagnostics, Inc. (SDI), of Newark, Delaware, was working in 2000 with Monsanto and other biotech or seed companies to develop ELISA-based test kits to detect such traits as glyphosate tolerance in soybeans or Bt production in corn.

The ELISA microwell test can be used at grain elevators or processing plants to quantitatively detect biotech content in grain samples within 2 hours at a cost of about $10 per test. This test has been validated by the EU for testing. In addition, SDI has developed a rapid dipstick test that can detect as little as 0.1 percent biotech protein in Roundup Ready soybeans in 5-10 minutes at a cost of about $3.50 per test. That test gives farmers and elevators a "yes-no" (that is, qualitative) answer based on the presence of the Roundup Ready trait. As of September 2000, the test kit had not yet been approved in Europe for compliance with EU food labeling requirements. On September 20, 1999, SDI announced that the Japanese Government had obtained a license to use the test kits (Schuff). A nonexclusive license agreement was signed with Japan Oilstuff Inspector's Corp. (JOSIC) for detecting biotech content in grain and food ingredients.

Current ELISA testing methods require that a separate test be performed to detect the presence of each biotech gene line, so several tests may be required to determine if a truckload of corn is free of any biotech content. ELISA test kits are currently limited to testing Bt corn varieties. SDI is also developing a strip test kit that will detect, in a single test, all the biotech corn gene lines that are approved for use in the United States. The ELISA method could also be adapted for analyzing crops with high-value output traits, such as those containing vaccines or pharmaceuticals.

Another test that shows considerable promise for rapidly assessing output traits in value-enhanced crops, such as high-oil corn, is called near-infrared spectroscopy (NIRS). The pattern of absorption or reflection of NIRS light is unique for every compound, so the identity and quantity of materials like oils, proteins, and starches can be easily determined for both whole seeds or processed grains. Following the initial purchase of the NIRS spectrophotometer (about $20,000), the tests are inexpensive and rapid and can be performed on site at elevators. NIRS potentially could be used to detect the presence of input-trait biotech material. Iowa State University filed a patent application in 2000 to do just that. If permission is granted, NIRS can detect the presence of input-trait biotech material within a few minutes.

Although a rapid test is required to segregate nonbiotech crops from the rest of bulk commodities in order to maintain the efficiency of the U.S. grain marketing system, IP, with carefully supervised contract production, lessens the need for additional testing as control of the commodity changes hands. In addition, it lowers liability and risk of biotech/nonbiotech commingling for growers and handlers. IP preserves the unique end-use characteristics and identity of a nonbiotech crop throughout the production-marketing system through contract production and stringent separation of commodities, including containerized shipments. This process gains some additional value when the lack of consistent test results—a major difficulty facing the current testing methods—is taken into consideration.

At Stake

If consumer demand for nonbiotech food strengthens and/or expands to new markets, segregation or IP marketing might be necessary to accommodate labeling requirements (whether voluntary or mandatory) in these markets. While segregated or IP marketing is nothing new, the viability of segregated marketing would depend on the speed, accuracy, and costs of biotech content testing. Rapid, accurate, and economical testing methods are essential to maintain the efficiency of the existing grain marketing system. Tests to rapidly detect modified DNA or protein in biotech crops are entering the marketplace; however, as of 2000, the most accurate quantitative tests still take several hours to a few days to complete and may add significantly to total marketing costs. Less than 2 minutes are typically required to test grain for physical characteristics such as test weight (U.S. Grains Council); thus, the efficiency of the U.S. grain marketing system could be compromised unless more rapid, accurate, and economical biotech testing methods are developed. This capability is essential in establishing a segregated nonbiotech marketing channel that is able to coexist with the existing high-volume, high-speed bulk commodity marketing.

The high costs of segregated marketing for nonbiotech grains and oilseeds to a segment of export markets and the current weak demand for nonbiotech crops contributed to limited segregation by producers and elevators during fall 1999. A survey conducted in mid-September 1999 by Sparks Companies, Inc., found that only 8 percent of Midwest grain elevators were segregating nonbiotech soybeans from commingled soybeans and only 11 percent were segregating nonbiotech corn (Muirhead). However, the extent of segregation could well increase in the 21st century. Elevators are likely anticipating food-labeling regulations in other countries. In mid-October 1999, most premiums for nonbiotech soybeans averaged around 10-15 cents per bushel, while the premiums offered for corn were in the range of 5-10 cents per bushel (Muirhead).

According to a 1999 ERS study, the average preliminary cost to the U.S. grain handling system of segregating nonbiotech corn (excluding a purchasing premium for nonbiotech crops) was an estimated $0.22/bushel (12 percent of the farm price for corn forecast for 1999/00). Similarly, the 1999 cost of segregating nonbiotech soybeans was an estimated $0.54/bushel (12 percent of the forecast farm price for soybeans) if the segregation is patterned after that for Synchrony Treated Soybeans—a herbicide-tolerant, but nonbiotech variety of soybeans (Lin, Chambers, and Harwood).[4] However, the costs of segregating nonbiotech soybeans become smaller, at $0.18/bushel (4 percent of the farm price for soybeans forecast for 1999/00), if segregation follows that for high-oil corn. The costs of segregation would become considerably higher if segregation is performed in the same manner as that for food corn and food soybeans through IP.

Sampling problems will be a key issue in addressing low or zero tolerance for biotech ingredients in foods or the demand for meeting labeling requirements. Small sample size and a lack of standardized sampling procedures contribute to the lack of consistent test results. At a 99-per-

[4]The cost of segregation varies among grain elevators and is subject to change as testing methods for detecting the presence of biotech content in grains and oilseeds evolve and as economies of scale are achieved in segregating larger volumes of nonbiotech crops from the rest of the grain supply chain. The cost estimates presented here are intended to show only an approximation of the general magnitude relative to farm prices of corn and soybeans.

cent purity level, a typical ELISA test at country elevators currently uses a sample of 50-60 kernels out of close to 1,000 bushels in a truckload. A smaller sample size (40-50 kernels) would be used for testing at a 95-percent purity level. Detecting biotech content in grain has other uncertainties, depending on where the truck is in the system and how often a truck is probed.

In the near- to mid-term, increasing sophistication and specificity will be added to contract specification as well as to the grading system. In some export markets, labeling regulations may well require an amendment to contract specification indicating that the presence of biotech content cannot exceed a specified tolerance level. In the case of high-oil corn, a nonbiotech variety, a minimum oil content of 6 percent is now included in contract specification. It is conceivable that a specialty grade of high-oil corn, similar to the case of waxy corn, which is particularly suited for certain food processing and industrial uses, eventually could be included in the grading system if the demand for the specific output trait becomes more common. Thus, U.S. grain grades and standards, by and large, are likely to remain intact in their current basic structure in the near- to mid-term so long as output-trait biotech crops remain as niche markets.

However, in the longer run, the current grain grades and standards could begin to cease their basic functions if specialty grades become widespread and if these specialty grains and oilseeds account for a majority of imports from the United States by foreign buyers. These specialty grains and oilseeds (including those biotech varieties presently in the commercial market and in the pipeline) could include high-oleic-acid soybeans, modified-starch corn, low-phytate corn, and stacked high-oil and high-lysine corn. At that point, it might be difficult to reconcile between the physical characteristics-dominated grain grades and standards and the dominance of specialty grades in foreign buyers' imports. The value of output-trait biotech crops may then be discovered primarily through the price that buyers are willing to pay for intrinsic characteristics of the commodity, not the price discovered for the base grade in grain trade (for example, U.S. No. 2 yellow corn). Physical characteristics in the current grain grades and standards, in essence, would likely play a minimal role in pricing the commodity.

Alternatives

Alternatives for addressing issues related to testing and segregating nonbiotech crops are included here for discussion and consideration.

(1) ***The Federal Government plays an active role in implementing a voluntary quality-assurance program for nonbiotech products to facilitate a voluntary labeling program.*** The existing testing methods for detecting the presence of biotech content in grains and oilseeds are either too slow or too costly, far from meeting a rapid testing of less than 2 minutes for measuring physical characteristics in the current grain handling system (U.S. Grains Council).

Also, some of the test kits developed by private firms, such as the ELISA test kit developed by Monsanto and marketed by SDI, were available in 2000 only to allied seed companies, research laboratories, and limited groups of producers. Although the company reportedly sold 6 million units of the soybean tester in 1999, it was ***not*** available to all producers or handlers as of late 2000.

However, at this writing, USDA's Grain Inspection, Packers and Stockyards Administration (GIPSA) is assessing the need for a quality-assurance program for the production, handling, and processing of nonbiotech crops to facilitate a voluntary food-labeling program, as announced by the Clinton Administration in May 2000. A quality-assurance program could provide the food industry with an independent, third-party verification and certification process for differentiating and segregating biotech and nonbiotech crops, and strengthen high consumer confidence in labeling programs implemented by the food industry.

In addition, GIPSA is establishing a reference laboratory in Kansas City, Missouri, to (1) evaluate and verify analytical procedures applied to the detection and quantification of biotech content in grains and oilseeds, (2) evaluate the performance of detection methods, (3) evaluate and accredit, upon request, non-USDA testing laboratories for their certification programs (that is, to certify tests), and (4) establish recommended sampling procedures for use in testing biotech content in grains and oilseeds. However, the certification will not be a prerequisite for grain exports. Also, GIPSA will not be involved in providing a testing regimen.

(2) ***The buyer can augment contract specification by setting the maximum tolerance level of biotech content in grains and oilseeds.*** A zero tolerance for the presence of biotech material in grains and oilseeds through segregation is a scientifically

untenable expectation. Instead, the buyer can request delivery of material that meets or exceeds a specified tolerance limit. EU food labeling regulations, which took effect in April 2000, require that foods be labeled if they contain individual ingredients that exceed a 1-percent threshold of biotech content. Furthermore, exporters and retailers must show that any biotech content present in grain shipments is accidental and therefore will require some sort of paper trail to prove that only nonbiotech ingredients were used. In contrast, Japan's 2000 labeling regulations have a 5-percent tolerance level for biotech ingredients in foods.

(3) ***The buyer can augment contract specification in the case of soybeans by setting the maximum tolerance level of biotech corn in foreign material.*** Increasing sophistication and detail might be added to contract specification in the case of soybeans in order to meet consumer demand in a segment of exports market, such as the EU. In U.S. soybean grades and standards, corn is a part of soybean foreign material, a grade-determining factor, which has a 2 percent maximum limit for the base grade (U.S. No. 2). If European buyers are not willing to accept soybeans that contain more than 1 percent of any biotech material (including biotech corn), for example, a contract specification without this additional specificity could cause a stalemate in which sellers can meet the U.S. soybean grades and standards, but EU buyers would not accept its importation.

(4) ***The buyer can augment contract specification by setting the minimum level of a certain intrinsic, end-use characteristic in the case of biotech crops with a single output trait, or specific end-use characteristics in the case of stacked output traits.*** More specificity will likely be added to contract specification to reflect a string of emerging value-enhanced biotech or nonbiotech crops. In the case of high-oil corn, for example, a 6 percent minimum oil content could be added to current contract specifications. With the increase in the multitude of specialty grains and oilseeds in future years, more specificities (such as high-protein corn with desired amino acid, high-lysine soybeans, etc.) could be added to contract specification.

(5) ***The Government could augment the U.S. grain grades and standards to include specialty grades that are determined outside the numerical U.S. grading system.*** Increasing sophistication and specificity could be added to the current grain grades and standards to explicitly reflect buyers' quality preference in intrinsic, end-use characteristics, which are typically excluded in the grades and standards. In the case of high-oil corn, for example, a specialty grade could be created, similar to the case of waxy corn, to reflect the higher value buyers place on high-oil corn. The price that buyers agree to pay for high-oil corn, in this case, would exclusively reflect its higher oil content, not any of its physical characteristics.

Policy Issues

Contract specifications are augmented voluntarily by grain sellers and buyers. As a string of new specialty grains and oilseeds emerges, the rate and the number of possible commodities that require specific testing could increase as well. At a certain point, if the rate of change and multitude of products accelerate, IP marketing could become the only way to market these specialty crops.

References

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