Corn Facts
UNIVERSITY OF MISSOURI Extension
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Testing Grain for Biotechnology Traits

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Testing grain for the presence of biotechnology traits is necessary for producers selling certified non-GMO grain. It is still not clear how consumer reactions in Europe and Asia to biotechnology traits will affect American grain exports. Although many of the varieties and hybrids we grow in Missouri have been accepted for import into Europe and Asia, labeling of food products may greatly impact the demand for our grain. So, there may be a niche market for non-biotech corn. There are several ways to test grain for biotechnology traits and grain entering a specialty market will probably be tested several times. Unfortunately, the allowable degree of contamination has not been set for all countries, but 0.5 to 1.0% is most often mentioned. To put these numbers in perspective, 0.5% tolerance is less than five kernels per ear of corn.

There are three main categories of tests for biotech traits: bioassays, ELISA, and PCR. These tests differ considerably for sensitivity, expense, and time required. Bioassays are most useful for herbicide tolerance and much less useful for other traits such as Bt corn or cotton. Several procedures for bioassays exist, but include either germinating seeds in the presence of the herbicide or spraying the herbicide on recently emerged seedlings. Typically 400 seeds are used and the test requires 7 to 21 days to complete. Bioassays are often performed by seed-testing laboratories because germination technologists can conduct the tests with equipment common to most laboratories. Detection levels depend on the number of seed used, but may be as low as 0.5%.

The acronym ELISA stands for Enzyme Linked Immunosorbant Assays. Genes that are inserted during biotech transformation express themselves by producing unique proteins. For example, the protein produced by the gene conferring tolerance to glyphosate (Roundup Ready) is different from the protein produced by one of the Bt events. ELISA uses antibodies to detect the presence of these proteins. The simplest form of ELISA is often called “lateral flow strips” and is similar to a home pregnancy test. The test strip shows one band for a negative test and two bands for a positive test. This test cannot quantify the amount of protein present (i.e. the amount of contamination), but is sensitive to about 0.5%. Little training and no sophisticated laboratory equipment is necessary so this test is usually the choice of producers and elevator operators. Each test costs from $1 to $5 and takes less than 30 minutes, but multiple tests are required for multiple biotech traits. This test is most likely not acceptable for specialty markets requiring definitive assays. More complicated ELISA tests are available that can quantify the amount of protein. However, these tests require more time and training to complete and are usually more expensive.

The acronym PCR stands for Polymerase Chain Reaction. The PCR assays test for the actual gene (or promoter) that was inserted during biotech transformation. These tests, depending on procedures, are either semi- or fully quantitative and extremely sensitive. Some PCR tests can detect just a few strands of DNA (less than 0.1%). This extreme sensitively can lead to false positives if sterile technique procedures are not followed. PCR assays must be performed in well-equipped laboratories by trained technicians so the cost is quite high (more than $100/sample).

Standards for required tests or tolerated contamination have not been set and may vary among possible contractors. Before signing contracts for non-biotech grain, producers should make sure these requirements are specified. Producers should also know which party is responsible for testing and the consequences if the grain is found to exceed allowances. I recommend that producers avoid contracts that set contamination tolerances that a nearly impossible to obtain (less than 1.0% for soybean; less than 2.0% for corn).