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no. .306

Aflatoxins produced from grain

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Quick Facts

- Aflatoxin and other mycotoxins are heat-stable toxins produced by fungi.
- Aflatoxins and other mycotoxins have not been shown to be a problem in the field, but after harvest they may form in corn during storage.
- These toxins can be a serious problem in grain stored under unfavorable conditions.
- Black light screening is not a conclusive test for aflatoxin. Positive tests indicating aflatoxin must be confirmed by chemical analysis.

Aflatoxin, a toxic metabolic by-product of certain fungi, is a threat to the safe use of corn products as food for humans and livestock. National news accounts generally quote that the Midwest to Southeast areas of the United States are experiencing serious problems with aflatoxin in corn. Very little attention is directed to the far West. Dangerous levels of aflatoxin seldom occur in Colorado corn fields when dry cool fall harvest conditions prevail or proper storage conditions are used. When necessary, corn is tested for aflatoxin prior to use.

The fungi (mold) that produce aflatoxins can infect important food and feed crops before, during and after harvest. These fungi especially *Aspergillus flavus* and *A. parasiticus,* are normal soil-borne inhabitants in our environment, growing on both living and decaying plant matter. The major products in which aflatoxins are produced include corn grain, soybeans, dry beans, cottonseed, grain sorghum, wheat, peanuts and tree seeds.

Mycotoxins include metabolic by-products produced by a number of different fungi that may or may not be toxic. One of the mycotoxins, aflatoxin, is produced by the fungi *Aspergillus flavus* and *Aspergillus parasiticus.* Four different aflatoxins, B_1, B_2, G_1 and G_2, have been identified with B_1 being the most toxic, carcinogenic and most prevalent.

Another important family of toxin producers is *Fusarium.* The toxins zearalenone, trichothecenes or moniliformin can be formed by *F. moniliforme, F. oxysporum, F. culmorum, F. avenaceum, F. equiseti, F. roseum,* and *F. nivale.*

Growth, Detection and Testing

Three conditions that favor continued mold growth are necessary for aflatoxin formation, these conditions are: high corn kernel moisture (16 percent to 2 percent); warm temperatures (80 to 100° F); and high humidity (80 percent to 100 percent).

Corn exhibiting mold formation doesn't necessarily contain aflatoxin. Growth of the fungus is poor at temperatures below 50° F but slow growth will occur and low amounts of aflatoxin may be produced under favorable moisture conditions. Moisture levels below 12 percent to 13 percent will prevent mold formation.

The Bright Greenish Yellow test (BGY) using the black light (365 nm) commonly is used as a screening device to detect aflatoxins in corn. Proper use of the (BGY) fluorescence test is only a presumptive test for the presence of toxin. A BYG reference standard can be obtained from Dr. Odette Shotwell (Northern Regional Research Laboratory), Peoria Illinois, 61604. The BGY fluorescence is not emitted by the aflatoxin itself but from kojic acid, a compound produced by *A. flavus* at the same time aflatoxin is produced. The

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black light screening test, when performed by trained personnel, has been widely accepted by the corn dry milling industry as an indicator of possible aflatoxin contamination. Chemical analyses are required to confirm the presence and level of aflatoxin contamination.

Sampling

1. Collect a 10-pound sample by taking a minimum of five random probes throughout the grain lot.

2. Crack the entire sample coursely and examine under long-wave ultraviolet light (365nm) for BGY inflorescence. A reference standard is essential for the untrained technician.

3. BGY florescence found in the cracked sample is a preliminary test and does not prove that corn is contaminated.

Action Levels For Aflatoxin in Corn Grain

The Food and Drug Agency (FDA) Center for Veterinary Medicine (CVM) and the Center for Food Safety and Applied Nutrition (CFSAN) have established the following aflatoxin "action" levels. The CVM and CFSAN prohibit aflatoxin contaminated corn being shipped in interstate commerce when:

1. Corn containing in excess of 20-parts per billion (ppb) aflatoxin is intended for consumption by humans, immature animals (including immature poultry) and dairy animals, or grain sent to an unknown destination.
2. Corn containing in excess of 100 ppb aflatoxins for consumption by breeding cattle, breeding swine, or mature poultry.
3. Corn containing in excess of 200 ppb aflatoxins for feed to finish swine (e.g., 100 lbs or greater).
4. Corn in excess of 300 ppb aflatoxins as feed destined for finishing (i.e., feedlot cattle).

The Agricultural Stabilization and Conservation Service (ASCS) states that corn with aflatoxin levels above 20 ppb is ineligible for crop loans. Growers can receive disaster assistance payments if they agree to destroy contaminated grain. Any blending of affected corn must be approved by FDA.

CFSAN prohibits the sale of milk or milk products in interstate commerce that contain more than 0.5 ppb aflatoxin residue. Research indicates that 0.5 ppb aflatoxin level in milk normally would not be exceeded if the cattle feed contains less than 20 ppb aflatoxin. Toxins fed to dairy cows can be metabolized to aflatoxin M-1 by the liver and secreted in milk.

Animal Symptoms

Losses due to aflatoxin contamination occur at all levels in production, marketing and utilization and cause losses to growers, elevators, manufacturers, and livestock feeders. Extreme toxicity has been known to cause poultry losses and reduced cattle, sheep and hog grains. Losses usually are expressed as reduced grain quality for market.

Diseases produced by mycotoxins are known as mycotoxicoses. There are numerous mold toxins identified. Fungi capable of producing mycotoxins, include *Aspergillus, Fusarium, Penicillium,* and other common contaminants of stored grain. The following are symptoms from ingestion of contaminated feed for specific animals.

Poultry: reduced growth rate, decreased resistance to infection, fatty liver syndrome, death.

Swine: decreased feed efficiency, reduced rate of gain, stunted growth, suppressed immune system.

Cattle: reduced feed intake, reduced rate of gain, reduced feed efficiency and reduced reproductive performance.

Dairy: decreased milk production, conversion to aflatoxin M_1, that is secreted in the milk.

If a toxic level of aflatoxin is eaten, replace contaminated feed with good feed, and call a veterinarian.

Safe Storage

Safe storage of grain requires dry, cool conditions inside the bin. Bins filled in the fall tend to have grain moisture levels between 15 percent 18 percent moisture with lower percent moisture preferred. Average grain temperatures should be maintained within 10° F of outside surrounding temperatures. Rapid temperature changes and moderate moisture reduction is accomplished by using adequate aeration.

Follow these guidelines for safe storage. 1.) Thoroughly clean grain bins before storage. Remove all dust, dirt, crop debris, chaff, cracked, broken and contaminated kernels that would interfere with adequate ventilation, 2.) Harvest as soon as the moisture content is low enough for safe storage, 3.) Store corn safely at 15 percent moisture until spring but to 13 percent for storage of one year or more. Grain temperatures must be reduced where possible, to 35° to 40° F for winter storage, 4.) Intermittent bin aeration at 0.5 cfm/bu is recommended to prevent moisture migration within the bin, 5.) Monitor grain moisture and temperature every one to four weeks to detect "hot" spots, musty odors, and unusual moisture accumulations, 6.) Have any moldy "suspect" grain chemically tested for toxins by a reputable laboratory.

References

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