Reducing Losses from Aflatoxin-Contaminated Corn

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The cause of the problem:

Aflatoxin is a toxin produced by a fungus (*Aspergillus flavus* and other related species) in the seeds of corn, oilseeds and other grain crops. The fungus survives on crop residue on soil and its spores can move with wind, or be carried on insects that feed in corn ears. The fungus can also enter the ear by growing down the silk, but it requires a wound or damage to the kernel as a site of entry to infect the seed. Wounds can be caused by insects or natural splits of the seed coat . Some hybrids are more prone to splitting than others. Aflatoxin accumulates as the fungus grows in the seed. Fungal growth is inhibited by high moisture, therefore aflatoxin will not accumulate in sweet corn which is harvested at high moisture. As moisture drops below 32% the toxin starts to accumulate in the seed until it dried down below 15% moisture. At lower than 15% moisture no additional toxin accumulates in the seed. This can occur as the seed is drying down on the stalk or in post harvest storage.

Drought is a major causal factor for infection and accumulation. High temperatures, particularly at night, stress plants and are also important for aflatoxin accumulation. This is why irrigated corn in hot environments can have aflatoxin contamination. Late-planted corn is at higher risk for aflatoxin accumulation because corn is developing at temperatures that exceed its

optimum temperature requirements. Late-season rains may increase aflatoxin in hybrids that have erect ears.

Why aflatoxin is regulated in food and feed:

Aflatoxin is acutely toxic to livestock and birds, primarily affecting the liver. It is also highly carcinogenic. Animal species vary in their sensitivity to aflatoxin, which is reflected in different allowable levels in feed. Cattle are more tolerant than poultry, for example. There is a low aflatoxin tolerance for dairy cattle or lactating animals because it passes into the milk. Undetected aflatoxin contamination of feed can have serious effects. Numerous deaths of livestock, pets, and wildlife are documented due to consumption of aflatoxin contaminated grain and feed.

Testing for aflatoxin:

There are defined protocols for aflatoxin analysis, which are accurate and reliable when properly conducted. The most critical issue for testing is obtaining a representative sample because most kernels are not contaminated, while a minority has incredible variability of contamination, ranging up to several hundred thousand ppb. For example, just one contaminated kernel with 400,000 ppb will cause a 10-lb. sample to measure 26 ppb.

There are defined protocols for obtaining a representative sample, but these samples will not give identical test results because of the aforementioned variability of contamination.

On-farm use of aflatoxin contaminated corn:

If corn is designated for on-farm use, i.e. does not enter commercial trade, no testing and/or inspections are required. However, because of the serious health effects of the toxin on livestock, testing lots that are suspected to be contaminated is highly recommended ensuring appropriate handling of the grain.

Regulations for commerce:

Restrictions on feed with aflatoxin increase as levels of the toxin increase. These restrictions apply to any grain and or feed entering commerce whether from sale at the turn-row, after an indefinite time of on-farm storage, or any time in between. The restrictions are governed by state and federal law and implemented by the Texas Feed and Fertilizer Control Service located

within the Office of the Texas State Chemist (OTSC) (intrastate commerce) and the US Food and Drug Administration (FDA) (interstate commerce). Violations of these regulations are considered a class C misdemeanor offence.

In grain with levels of aflatoxin exceeding 20 ppb, sale for consumption by humans or dairy and other lactating animals are prohibited. Feed exceeding 50 ppb cannot be used for wildlife. Feed not exceeding 100 ppb can be used for most livestock and mature poultry, although higher levels are allowed for finishing swine (not exceeding 200 ppb) and finishing cattle (not exceeding 300 ppb). Grain containing greater than 300 ppb aflotoxin but not exceeding 500 ppb can be blended or ammoniated, but a permit for both is required from OTSC. Grain containing more that 500 ppb cannot enter commerce. Blended or ammoniated aflatoxin containing feed cannot be distributed in interstate commerce. Details of the regulations are given in memorandum 5-12 and other memoranda at the website of the OTSC (http://otsc.tamu.edu).

Procedures for reducing contamination:

Pre-harvest:

Because of differences in soil type, topography, drainage and fertility within a field, there can be a difference in plant stress, which can affect aflatoxin accumulation. Where there is a risk of aflatoxin contamination, the harvest from areas of a field with poor corn growth relative to other areas should be segregated from the rest of the crop, so that highly contaminated corn is not mixed with less contaminated corn.

Damaged kernels tend to have higher levels of aflatoxin than intact kernels. During combining, adjust the ground speed and cylinder speed to minimize broken kernels in the hopper. This involves operating at a slow speed, using a lower gear than normal, and then gradually increasing the speed just before the point that broken kernels enter the hopper. Increase the fan speed to blow out broken kernels.

If the grower has access to drying facilities, corn could be harvested at moisture levels greater than 15%. If this is the case, the corn should be stored and transported to the dryer as quickly as possible to prevent post-harvest accumulation.

In a drought year, when the corn crop is lost, caution should be used in salvaging corn stalks for hay, as these stalks may have small ears that are highly contaminated with aflatoxin [see FS_FC005].

Post-harvest:

Aflatoxin is very stable and will not disappear over time in stored corn. Strategies in reducing post-harvest contamination include diluting contaminated corn with "clean" corn or neutralization by reaction with ammonia ("ammoniation"). The commerce of blended or ammoniated corn is subject to OTSC regulations [see memo 5-12]. Specifically, only a high temperature/high pressure process can be used for ammoniation of corn to enter commerce, and there is no company currently doing this. Growers with their own, non-dairy livestock could seal corn in containers with ammonia. See [TAEX L-2459] for details.

Gravity tables and shaker screen devices could be used to remove damaged kernels that have higher levels of aflatoxin than non-damaged kernels. This may reduce aflatoxin to acceptable levels.

Aflatoxin-contaminated corn can be used for ethanol production, but the process concentrates aflatoxin in the solid fraction (distillers grains), which is not desirable if that is to be used for feed.

At this time, there are no feed additives labeled for use for neutralization of aflatoxin. Afla-Guard, a commercial, non-toxin producing strain of *Aspergillus flavus* labeled for biological control of aflatoxin, is used in the crop during the growing season and will not reduce aflatoxin levels once corn is harvested.

Financial and insurance consideration when dealing with aflatoxin contaminated corn:

When aflatoxin issues are suspected, there are a number of procedures that must be followed in order to comply with crop insurance adjustment protocols and assess the best economic course of action. Prior to harvest, take a representative sample of corn ears and send it to a reputable laboratory for analysis. If the sample comes back with more than 20 ppb aflatoxin, consider your options with consultation from your insurance provider (and landlord, if a crop share arrangement is involved). This preliminary assessment will help to determine the likely reductions in value that will apply to commercial sale versus the discount factors that apply to your crop

insurance guarantee. This comparison is especially warranted for producers that selected Crop Revenue Coverage insurance. In cases where aflatoxin levels are excessive, it is possible that destruction of the crop may result in a higher net economic return than harvesting the crop and absorbing aflatoxin price discounts. This evaluation will include estimating factors such as harvest costs, expected price for the contaminated lot, yield level, insurance coverage and other parameters affecting crop profitability/loss.

Producers should be aware that storing grain may delay settlement of insurance claims, if the producer does not want to accept the discount factors attach to the aflatoxin levels determined through testing. If you are storing your grain in a commercial elevator or selling your grain and receive a reduction in value due to aflatoxin, request that the elevator pull and save a sample for the insurance adjuster, then contact your insurance agent. For insurance adjustment purposes, the sample must be tested from a disinterested third party, the elevator's test cannot be used. If you are storing your grain (on farm or in private storage), grain must be tested prior to going into the bins. Once again, samples must be tested from a disinterested third party. From an economic standpoint, the major considerations involve a preliminary assessment of the aflatoxin levels and communication with your crop insurance agent (and possibly landlord) to ensure that all alternatives are examined.

Planning for future corn production:

There is no trade-off in recommendations for managing aflatoxin and optimizing yield. Unfortunately, under Texas growing conditions, the best-managed crop from a standpoint of yield may still have aflatoxin contamination. However, poor crop management (e.g. the use of poorly-adapted corn hybrids) can result in an even greater level of contamination.

Best-management practices for aflatoxin management involves planning before planting and include: planting hybrids that have adaptation for southern U.S. growing conditions, requesting information from seed suppliers about tolerance/resistance of corn hybrids to aflatoxin, planting during the time window known to provide the best yields for your growing area and avoiding late planting, reduce environmental stress on plants by breaking hardpans in the field before planting and minimizing tillage operations before planting to conserve moisture, controlling insects and

weeds, and maintaining optimal nitrogen fertility, especially with high plant populations .

Treating the crop with an atoxigenic strain of Aspergillus flavus can contribute to the reduction of aflatoxin [FS_FC004].

Financial planning includes selecting the best insurance option for you (and your landlord, if in a crop share agreement) to protect yourself from potential losses to aflatoxin contamination of corn.

References:

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