Managing rotten corn: An overview of corn ear rots

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Ear rots of corn can reduce yield and grain quality. Several economically important ear rots impact the Corn Belt, including Diplodia ear rot, Gibberella ear rot, Fusarium ear rot, and Aspergillus ear rot. A different fungus causes each of these rots, and the environmental conditions at and just after silking influence which ear rot may be problematic in a given year. Additionally, some of these fungi are able to produce mycotoxins as a byproduct of the infection process. Mycotoxins can be toxic to humans and livestock, and are carefully regulated in food and feed. Proper identification of ear rots is key for managing affected grain.

Aspergillus ear rot

Aspergillus ear rot is caused by the fungus *Aspergillus flavus*, and is one of the most concerning ear rots due to its associated mycotoxin, aflatoxin. This fungus infects during hot, dry weather after pollination occurs. Drought stressed areas are most affected by the disease. Aspergillus ear rot is typically identified by an olive green, dusty mold that is often at the tip of the ear, but can be scattered on kernels throughout the ear. Symptoms usually appear first in fields with dry soils or other issues, such as nutrient deficiencies, or insect damage. The mycotoxin aflatoxin is a potent carcinogen, and is regulated in feed and silage. Table 1 specifies the U.S. Food and Drug Administration (FDA) action thresholds for various end uses of grain. Aflatoxins are of concern to dairy producers in particular because the FDA regulations require aflatoxin residues in milk to be less than 0.5 ppb. To prevent the carry over of aflatoxins into milk, silage and other feed components should not contain greater than 20 parts per billion (ppb) aflatoxin.

Table 1. U.S. FDA action levels for aflatoxin contaminated corn. Source: FDA Regulatory Guidance for Toxins and Contaminants. www.ngfa.org/files/misc/Guidance_for_Toxins

Aflatoxin action level (parts per billion)	End use of grain
20	Corn for animal feed and feed ingredients for dairy animals
20	Corn for human consumption
100	Corn grain for breeding cattle, swine and mature poultry
200	Corn grain intended for finishing swine of 100 lbs or greater
300	Corn grain intended for finishing beef cattle

Diplodia ear rot

Diplodia ear rot is caused by the fungus *Stenocarpella maydis,* and is very common in cornfields across the Corn Belt. This fungus survives in residue and infects plants approximately two weeks after pollination. Humid weather and rains prior to and after pollination will favor disease development. Diplodia ear rot is identified by white fungal growth on the cob, often forming a mat of fungus across the ear. Infected kernels may also be brown-gray in appearance. Small, black fungal structures called pycnidia may form on the kernels or the cob. The fungus is reported to produce a mycotoxin called diplodiatoxin in South America and South Africa, however, no reports of toxic effects of grain on livestock or humans due to Diplodia ear rot have been reported in the United States. Grain dockage may still occur, however, due to moldy grain.

Fusarium ear rot

Fusarium ear rot is primarily caused by the fungus *Fusarium verticilliodes*. This fungus infects corn after pollination, and often overlaps with Aspergillus ear rot since infection is favored by warmer temperatures. Fusarium-infected ears may have white fungal growth on the cob, or symptoms may appear as discolored kernels scattered throughout a cob or associated with insect feeding. Visible fungal growth may not be obvious on the cob, but a white "starburst" pattern in kernels can sometimes be observed on ears infected by this fungus. The mycotoxin fumonisin is associated with Fusarium ear rot.

Table 2. U.S. FDA action levels for fumonisin contaminated corn in animal feed. Source: FDA Regulatory Guidance for Toxins and Contaminants. www.ngfa.org/files/misc/Guidance_for_Toxins

Animal	Maximum fumonisin levels allowed in grain or grain by-products
Equids and Rabbits	5 ppm (not to exceed 20 percent of ration with finished feed = 1 ppm)
Swine and Catfish	20 ppm (not to exceed 50 percent of diet with finished feed = 10 ppm)
Breeding ruminants, breeding poultry	30 ppm (not to exceed 50 percent of diet with finished feed = 15 ppm)
Ruminants 3 months or older being raised for slaughter	60 ppm (not to exceed 50 percent of diet with finished feed = 30 ppm)
Poultry being raised for slaughter	100 ppm (not to exceed 50 percent of diet with finished feed = 50 ppm)
All other species or classes of livestock and pet animals	10 ppm (not to exceed 50 percent of ration with finished feed = 5 ppm)

Gibberella ear rot

Gibberella ear rot, caused by the fungus *Gibberella zeae*, is common during cool, rainy years. The fungus infects during early silking and pollination, and is favored by cooler temperatures than the previously described ear rots. This fungus produces a fungal mat on the ear, similar to Diplodia ear rot, but often with a pink or reddish color to the mold. *Gibberella zeae* produces the mycotoxin deoxynivalenol (DON), commonly referred to as vomitoxin. This mycotoxin can be extremely harmful to swine, and is carefully regulated according to the FDA action levels defined in Table 3.

Table 3. U.S. FDA action levels for DON contaminated corn. Source: FDA Regulatory Guidance for Toxins and Contaminants. www.ngfa.org/files/misc/Guidance_for_Toxins

Animal	Maximum DON Level Allowed
Swine	5 ppm (not to exceed 20 percent of ration with finished feed = 1 ppm)
Ruminating beef and feedlot cattle (more than 4 months old)	10 ppm (not to exceed 50 percent of diet with finished feed = 5 ppm)
Poultry	10 ppm (not to exceed 50 percent of diet with finished feed = 5 ppm)
All other animals	5 ppm (not to exceed 40 percent of diet)

Mycotoxins

Mycotoxins are a byproduct of fungal infection, and are not living organisms themselves. Often farmers or crop advisors incorrectly believe that they can kill or remove mycotoxins from grain, which is not the case. Mycotoxins are extremely stable in grain and plants, and heat, freezing, and chemicals will not degrade these compounds. Mycotoxins are at higher levels in fines and foreign material in grain and it is possible to screen or clean grain to remove these smaller particles containing mycotoxins. Coring bins can also help reduce mycotoxins if affected grain accumulates in this area. None of these practices remove mycotoxins directly from grain, but remove grain affected by mycotoxins.

Testing for mycotoxins

Sample collection and preparation are extremely important to get an accurate test for mycotoxins in silage or grain. A sample submitted for analysis should be made up of several samples combined and taken from different areas within the silage mass or grain. Sampling several different times from a moving stream of grain while the grain is loaded or unloaded is the preferred method for sample collection. The USDA Grain Inspection Handbook has specific recommendations and methods for sampling to ensure that the sample to be tested represents the grain population accurately. This handbook can be found at www.gipsa.usda.gov/GIPSA/.

Mycotoxin production in silage represents a particular challenge. Mycotoxins will occur in the area of silage exposed to air, so samples from moldy silage should also be submitted for analysis. If sampling moldy silage for analysis, it is important to take a separate sample from an area that is not moldy and submit that also. Care should be taken with handling samples to assure that mycotoxins do not accumulate in the sample during shipping. Drying the sample below 15% moisture will slow fungal growth and mycotoxin production. Freezing the sample and shipping on ice by a one-day delivery service is another option. It is important to test silage for mycotoxins, such as aflatoxin, since chemicals such as nitrates can cause similar animal symptoms to those caused by mycotoxins.

Mycotoxins can be assessed by using several different chemical and immunocapture technologies, but analyzing mycotoxins can be a challenge due their complex nature. It is important to not rely solely on visual methods, such as the blacklight test, for confirmation of mycotoxins. Visual test results can be inconsistent, and therefore samples should be sent to professional laboratories for analysis.

Ear rot management

Preventative management of ear rots is critical, and can be accomplished by selecting less susceptible hybrids and reducing the amount of corn residue that can serve as a source for the fungus to overwinter. This is accomplished through crop rotation and tillage. In-season management of ear rots is limited at this point, with few fungicides and anti-fungal products available for specific ear rots. Efficacy data for these fungicides are limited.

If conditions in-season are favorable for ear rot development, farmers should scout fields prior to harvest and determine the level of incidence of any ear rot in the field. If ear rots are observed in a field, affected areas should be harvested early and grain segregated to avoid mycotoxin contamination of non-infected grain. Silage and grain harvested with suspected ear rots should be dried to below 15% moisture. If grain or silage (with kernels present) is kept above this moisture content, mycotoxin can continue to accumulate in grain. All grain contaminated by any ear rot fungus should be stored separately from good grain, and if stored long term, stored below 13% moisture to prevent further growth of fungi.

References

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