**BEWARE THE RISKS OF MYCOTOXINS**

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Dennis Hancock, Forage Extension Specialist
The University of Georgia

The 2012 crop year will likely go down in the record books as one of the worst in over a century. Widespread drought and other challenges have caused the yields to be low and prices to be high. But, there is another problem that has gotten very little attention: a high risk of mycotoxin contamination.

Forages and grains are exposed to a number of different fungal spores before and during harvest, transport, and storage. If crop moisture, harvest problems, or adverse weather conditions arise, some of these fungi can grow on the forage or grain and contaminate the crop. The contamination comes from toxic chemicals called mycotoxins that are produced by the infecting fungi. Mycotoxins are natural chemicals produced by fungi as defense mechanisms against other micro-organisms. The problem is that some of these mycotoxins can be harmful to animals and humans. In fact, some mycotoxins can cause severe illness or death even at very small concentrations, such as at concentrations of parts per million (ppm) or parts per billion (ppb).

Mycotoxins pose a risk even in "normal" years, but 2012 has been far from a normal year. Drought conditions increase the incidence of some mycotoxins (e.g., aflatoxin) and cool and wet conditions at harvest favor the development of other mycotoxins (e.g., deoxynivalenol, fumonisin, etc.). Nearly 80% of the U.S. experienced some sort of drought in 2012 and many of these areas also experienced cooler, wet conditions at harvest. Consequently, we may see major issues with one or more mycotoxins in our grain and forage crops this year.

## Brief History

Mycotoxins have a long history of causing major disruptions in society (e.g., mass hallucinations, changes in birthrates, etc.). For example, mycotoxins (ergot alkaloids) on grain are the suspected cause of the symptoms associated with witchcraft surrounding the Salem Witch Trials in the 1690s in Salem, MA. Mycotoxin poisonings have also had tragic results in more recent history, as well. Recent incidences include the death of 125 people in Kenya in 2004 from aflatoxin poisoning in corn and the death of 75 dogs in the U.S. in 2005 from aflatoxin contaminated pet food produced in a Gaston, SC facility. Though inspections by the U.S Food and Drug Administration (FDA) help to prevent such problems, no system is perfect and contaminated products could get into animal feeds.

## Mycotoxin Classes

There are a number of different mycotoxins, each having slightly different chemical structures and modes of action. To simplify, the American Phytopathological Society (APS) groups the mycotoxins into six classes (Table 1). Though all of these can be problematic, beef and dairy producers should be aware of aflatoxins, deoxynivalenol (DON), fumonisin, and zearalenone.

The aflatoxins, which are produced by the fungi *Aspergillus flavus* and *A. parasiticus*, are among the most dangerous mycotoxin classes. Aflatoxins are a frequent issue in the Southeast. Consequently, peanuts, corn, cottonseed, and tree nuts are routine tested at buying points, gins, and the local grain elevator for aflatoxin concentration. In addition, dairy products are screened for M1, a derivative of aflatoxin, to assure that this mycotoxin does not make it into the human food supply.

Several fungi in the *Fusarium* genera form problematic mycotoxins, including DON, the fumonisins, and zearalenone. Feed intake is severely reduced when DON, which is also called vomitoxin because it is known to cause hogs to vomit, contaminates the feed. Fumonisins are problematic in several animal diets, but

**Table 1.** Common mycotoxins, the common feeds or food products that may be contaminated with mycotoxins, and the effects of the major classes of mycotoxins.[a]

| Mycotoxin Class | Common Mycotoxins in the Class | Common Products Contaminated | Animals Affected | Clinical Effects |
|---|---|---|---|---|
| Aflatoxins | Aflatoxins B1, B2, G1, G2 | Corn, peanuts, cottonseed, tree nuts, dairy products | Swine, dogs, cats, cattle, sheep, young birds, humans | Liver damage, intestinal bleeding, cancer |
| Ergot alkaloids | Ergotamine, lysergic acid, ergovaline | Rye, pasture grasses, sorghum | Cattle, sheep, humans | Hallucinations, gangrene, loss of limbs, hastening of birth |
| Fumonisins | Fumonisins B1, B2, B3 | Corn, silage | Horses, swine, humans | Pulmonary edema, leuko-encephalomalacia, esophageal cancer, neural tube defects, liver damage, reduced growth |
| Ochratoxins | Ochratoxin A | Cereal grains, coffee, grapes | Swine, humans | Kidney and liver damage, cancer |
| Trichothecenes | deoxynivalenol (DON aka vomitoxin), T-2 toxin, HT-2 toxin | Wheat, barley, oats, corn | Swine, dairy cattle, poultry, horses, humans | Feed refusal, diarrhea, vomiting, skin disorders, reduced growth |
| Zearalenone | Zearalenone (ZEA) | Corn, hay | Swine, dairy cattle | Enlargement of uterus, abortion, malformation of testicles/ovaries |

[a] Adapted from the APS's *Mycotoxins in Crops* ( http://www.apsnet.org/edcenter/intropp/topics/Mycotoxins/Pages/default.aspx).

are extremely dangerous to horses, causing severe damage to the brain, nervous system, and liver (leukoencephalomalacia). In ruminants, both DON and the fumonisins tend to be less problematic because they are largely metabolized and detoxicified in the rumen. However, both can alter rumen function and tend to reduce milk production or animal performance. The same fungus that produces DON can also produce zearalenone (ZEA), which can adversely affect ruminants. ZEA is a mycotoxin that mimics estrogen, causes abnormal reproductive health, and has adverse effects on breeding soundness. Cool, wet weather during harvest increases the risk of DON, the fumonisins, and zearalenone. So, be aware of these problems in years with cool, wet harvest seasons.

Another common mycotoxin issue is one that is more problematic in pasture-based systems: ergot alkaloids. These mycotoxins are behind animal production issues such as dallisgrass staggers and fescue toxicosis. In general, ergot alkaloids in the diet will cause animals to be nervous, reduce weight gains, produce less milk, and have suppressed immune systems.

## Prevention Through Management

Seldom is there much that a producer can do to alter weather-related factors that increase the risk of mycotoxin development. However, there are several management practices that can help reduce the risk of several of these mycotoxins. For example, adhering to recommended planting dates, plant population, hybrids, N fertilization rates, and insect management can substantially reduce aflatoxin levels. The use of Bt hybrids has also been associated with substantial reductions in fumonisin, though it hasn't consistently had a demonstrably positive effect on aflatoxin levels. Proper adjustments to the combine cylinder speed and concave settings can reduce damage to the grain and prevent fungal infection. Having the combine's fan speed at an appropriately high setting will also blow out the low-density, moldy kernels that serve as inoculum for these infections. Drying the grain soon after harvest and storing the grain in closed bins with proper aeration and insect controls can also prevent the development of toxigenic fungi.

## Prevention Through Detection

The standard axiom of "if in doubt, throw it out" is especially costly in years like this when feed supplies are tight. Certain levels of a specific mycotoxin can still be tolerated in a diet. In addition, it is possible for a nutritionist to dilute the toxin(s) when developing a ration by mixing with other feedstuffs that are low in mycotoxins (Table 2). Therefore, one should consult with their county extension agent or nutritionist to obtain a mycotoxin analysis for any suspect sample. Historically, lab staff had to conduct multiple analyses to provide a broad-spectrum screen. These procedures were costly and time consuming. However, advanced analytical techniques and the use of immunoassays have substantially reduced the cost and time required of these analyses without sacrificing accuracy. In fact, there is now a technique to rapidly screen for more than 37 different mycotoxins at one time. Some laboratories even offer this mycotoxin screening for free.

**Table 2.** Recommendations and regulations for safe limits on mycotoxin concentrations in grain in the U.S. (as of 2008[a]) and reports of average and maximum mycotoxin concentrations in random samples from the 2011 U.S. crop (including grain, grain by-products, silage, and haylage).[b]

| Mycotoxin | Grain for human food | Grain for animal feed | Average | Maximum |
|---|---|---|---|---|
| | ---------- (ppb) ---------- | | | |
| Aflatoxins | 20 | 20-300[d] | 5.2 | 128 |
| Deoxynivalenol (DON) | 1000 | 5,000-10,000[d] | 2,326 | 41,356 |
| Fumonisins | 200-4,000[c] | 5,000-100,000[d] | 16,612 | 1,157,644 |
| Zearalenone | No guidance levels; case-by-case basis | 1,000-200,000[d] | 89 | 1,240 |

[a] Adapted from the APS's *Mycotoxins in Crops* (http://www.apsnet.org/edcenter/intropp/topics/Mycotoxins/Pages/default.aspx).

[b] Adapted from Swamy et al. in April 9, 2012 issue of *Feedstuffs* magazine.

[c] Varies among specific food items.

[d] Varies among livestock species.

## Feed Additives

Occasionally, a situation presents itself where one is forced to use a particular feedstuff, even if it is higher in mycotoxins than what would be recommended. In these instances, there are some feed additives that can be used that can bind to or adsorb mycotoxins in the feed, limit the toxicity of the mycotoxin, and aid the elimination of the toxin in the feces. Historically, several types of clays or minerals (bentonite, zeolite, kaolin, etc.) that bind to certain mycotoxins have been used with reasonable success. However, these additives may only be helpful with a subset of the mycotoxins that are present and can cause adverse effects, such as reducing feed intake and animal performance. More recently, scientists have developed additives that enable multiple mycotoxins to be bound without impacting feed intake or animal performance. These include microbiological additives (e.g., cell walls of certain strains of some bacteria species, cell wall extracts from certain yeasts, etc.). These products bind multiple mycotoxins without compromising feed intake and animal performance, making them a better and less risky choice, especially given the current uncertainty about mycotoxin levels in feed.

## More Information

More detailed information on mycotoxins in forage and grain crops can be found on the www.eXtension.org website and on our website, www.georgiaforages.com. If you have additional forage management questions, visit our website or contact your local Cooperative Extension office.

**got questions?**

Have a question or topic that you want Dr. Hancock to address? Email him at: questions@georgiaforages.com.