

# Mycotoxin Contamination of Corn

What it is, what it does to pigs and what can be done about it

John Patience, Ph.D.  
Department of Animal Science  
Iowa State University

Dr. Steve Ensley, D.V.M., Ph.D.  
Department of Veterinary Diagnostics  
and Production Animal Medicine  
Iowa State University

## Summary

Mycotoxins in corn are produced by certain molds which infect the ears of corn. Molds may be present without the production of mycotoxins, but mycotoxins cannot be produced in the absence of molds. The mycotoxins of greatest interest to pork producers are aflatoxin, deoxynivalenol (also known as vomitoxin or DON), fumonisin, zearalenone and occasionally ochratoxin and T-2 toxin. A number of ear rots are capable of producing mycotoxin-producing molds. These include *Fusarium* Ear Rot, *Gibberella* Ear Rot and *Aspergillus* Ear Rot. *Diplodia* Ear Rot is common in Iowa, but so far, it has not been observed to cause formation of mycotoxins. The various ear rots are favored by different environmental conditions, so each may occur in different years.

While weather conditions are an important contributor to mold infection, producers do have some control over the extent of infection that might occur. For example, insect control in corn will help to prevent damage to kernels that encourage mold growth. Screening corn to remove broken or otherwise damaged kernels and storing corn at 14% moisture or less will also discourage mold growth. Cleaning grain storage by removing old grain before new crop corn is added will help to avoid contamination from one year to the next.

Aflatoxin is perhaps the mycotoxin of greatest concern because it represents a risk to human as well as animal health. Because aflatoxin can accumulate in the meat, this is a public health issue that cannot be ignored. Feed for market pigs cannot contain more

than 20 parts per billion (ppb) of aflatoxin, in order to remove risk to the final pork product.

Vomitoxin, or DON (deoxynivalenol,) causes reduced feed intake and weight gain when present in the feed at 1-3 parts per million (ppm), with younger pigs being most susceptible. Cattle and poultry can tolerate much higher levels of DON than pigs. DON is often found in association with another mycotoxin, zearalenone, because both are produced by the same mold.

Fumonisin comprise a family of mycotoxins to which horses and donkeys are most susceptible. For pigs, feed levels of total fumonisin below 10 ppm are recommended.

Ochratoxin affects the kidney first, but also can attack other tissues and organs as well. Feed levels below 0.2 ppm are recommended for swine to protect their health.

T-2 toxin is less common than DON, but more toxic, causing feed refusal, vomiting and damage to the gut. In some cases, it can be fatal. For pigs, levels of T-2 toxin in the feed below 2 ppm are recommended.

Finally, zearalenone is an estrogenic toxin meaning it mimics the effects of estrogen, leading to infertility, pseudopregnancy and prolapse. Levels should be kept below 1 ppm for piglets and 3 ppm for growing pigs.

## Introduction

Mycotoxins in corn are produced when certain molds infect the ears of corn. Molds produce mycotoxins only under certain environmental conditions, so testing for molds is not an accurate way to determine the presence of mycotoxins. Furthermore, not all molds cause mycotoxins, but mycotoxins in corn cannot exist unless molds are present. In fact, thousands of molds are capable of growing on corn, but only a very few species actually produce mycotoxins – and only under certain conditions. Therefore, the safety of corn as a feedstuff for pigs cannot be ascertained simply by its appearance.

The mycotoxins of most concern to pork producers are aflatoxin, deoxynivalenol (also known as DON or vomitoxin), fumonisin, zearalenone, and occasionally ochratoxin and T-2. T-2 toxin is a concern because it is much more potent, but it is much less common than DON even though they are produced by the same molds. These six mycotoxins are produced by ear rot in corn.

Notwithstanding the above, there are unique circumstances when mycotoxins could be present in corn, without any visible mold. For example, treatment with propionic acid can remove the mold but leave the mycotoxins behind because mycotoxins are extremely

stable chemical compounds. However, without exception, mycotoxins will not exist in corn if molds either are not growing or have not grown on the corn.

Molds are caused by organisms called fungi (plural for fungus) that attach themselves to soil, decaying organic matter and plants such as corn. Hundreds of thousands of molds have been identified, but only a few cause health problems in livestock or humans. Other fungi include mildews, yeasts, mushrooms and puffballs. Fungi are a rather primitive form of life, and are either parasitic, meaning they depend on other living things for nutrients, or saprobic, meaning they live on dead and decaying matter for nutrients. Fungi are widespread, and can be either desirable or undesirable organisms. For example, they cause diaper rash, athlete's foot, many allergies and thrush in humans, but are also used to produce antibiotics and antitoxins. The point is that fungi are present in the world around us, and life would be very different without them – both positively and negatively.

This fact sheet has been prepared to provide background information on mycotoxins and practical management recommendations for corn growers, pork producers, nutritionists and veterinarians involved in the pig industry.

## Corn molds

Mold on corn is of particular interest, because it can cause deterioration in feeding quality and produce mycotoxins which affect pig performance and health. Mold also can affect corn stalks, and while that has implications for yield and ease of harvest, it is not of direct interest in the feeding of pigs unless, of course, pigs are being housed on corn stalks for bedding. Some molds, however, may start growing on the stalk, and later migrate to the cob. Molds are more likely to be found in corn grown under minimum till conditions, as compared to fields plowed or mixed-tilled.

Not all molds produce toxins. While non-toxic molds may not be harmful to pigs, the damage they cause to corn kernels can result in low yield, quality and nutritive value.

Mold-free corn can become infected in the grain bin, and mold growth can continue from the field into the storage bin if the conditions are right. Mold growth requires moisture, so drying corn is an important step in breaking the cycle of mold growth in stored corn. However, even seemingly clean, dry corn can become infected in the bin if conditions are right. For example, in the spring, wide changes in temperature and humidity can encourage mold growth, especially when condensation occurs in the bin. Therefore, bins should be checked in the spring to ensure heating and mold growth are not occurring.

A number of molds affect the ears of corn and cause a number of diseases, including Diplodia Ear Rot, Gibberella Ear Rot, Fusarium Ear Rot and Aflatoxin Ear Rot.

### Diplodia Ear Rot

Diplodia Ear Rot is caused by the fungus *Diplodia maydis* which can survive in crop residues and soil, and is spread by tiny airborne spores. Typically, infection begins at the base of the cob and moves upward. However, it also can begin in the stalk as Diplodia Stalk Rot, in which case the infection moves from the stalk into the shank of the cob. Severe infestation will cause kernels to turn a grayish brown color. Diplodia is characterized by a white mold growth covering kernels and small sack-like spore cases inside the infected kernel; these sacs appear on the outside of the kernel or husk as raised black bumps. Diplodia is favored by dry weather prior to silking followed by cool, wet weather occurring in the first 30 days of silk development. Thus, rainfall in August through October often is associated with Diplodia Ear Rot infestation. This fungus grows very slowly when moisture levels in the grain are below 21%. While Diplodia Ear Rot is common in Iowa, mycotoxin formation has not yet been observed in infected grain.

### Fusarium Ear Rot

Fusarium Ear Rot is widespread in the Corn Belt, infecting as much as 90% of corn fields in some years. It is produced by the molds *Fusarium moniliforme*, *Fusarium proliferatum* and *Fusarium subglutinans*. It can be observed with the naked eye as

A cottony white or light grey mold, or possibly a pink or salmon color growing on and between individual corn kernels. Infected kernels will turn grey to brown or have white streaks in them.

At the present time, little is known about the specific conditions that favor Fusarium Ear Rot. However, because it is common – most fields in the Corn Belt are infected every year – the conditions probably are not very specific. For example, it can grow over a wide range of temperatures and moisture conditions. However, it is known that Fusarium Ear Rot is most severe in dry years. It is also thought that Fusarium Ear Rot may be most influenced by the degree of insect damage to the grain. A 2009 survey in Iowa revealed that hail damage also can contribute to mold and mycotoxin problems.

### What Does One Part Per Million (ppm) Really Mean?

*If you think of an acre of land, 1 ppm is one-sixth of a square inch. Des Moines and Minneapolis are 244 miles apart; 1 ppm is 15 inches of that total distance. In other words, 1 ppm is very small, and yet a few ppm of some mycotoxins can cause severe production and health problems in pigs.*

### Gibberella Ear Rot

Gibberella Ear Rot is caused by the fungus *Gibberella zeae* which can survive in crop residue and soil, and like all molds is carried by spores in the air. It differs from other molds in that it appears as a reddish or pink mold that typically starts at the tip of the cob, not at the base or in the middle of the cob. Cool weather during the first 5 days of silking favors Gibberella Ear Rot infection.

Grain that overwinters in the field can be severely infected with Gibberella Ear rot and high levels of associated mycotoxins.

### Aspergillus Ear Rot

Aspergillus Ear Rot can be caused by either of two fungi: *Aspergillus flavus* or *Aspergillus parasiticus*. The former appears as a yellow-green mold, the latter as a gray-green mold, and both are powdery in appearance, as opposed to cottony. They are most common in dry hot years, and more common in southeastern and southwestern United States than in the Corn Belt. The greatest likelihood of infection is when ideal weather conditions occur during the silk and fill stage, and when there is insect damage, hail, drought-stress or early frost; all of which expose the kernels to fungal infection.

Aspergillus Ear Rot can produce aflatoxins which are harmful to both animals and humans. The amount of aflatoxin that is produced in corn is favored by high temperatures (80°F or higher), elevated grain moisture content as low as 15% (18% ideal), nitrogen deficiency in the plant and insect infestation. Drying corn to 14% moisture or less will inhibit further mold growth and thus toxin production.

## Prevention of Mold Growth in Corn

While corn producers have no control over weather conditions, there are management practices that can be implemented to minimize the presence and extent of mold infection.

- Control insect damage: insect damage to corn kernels encourages infection by mold-causing fungi.
- Adjust the combine to minimize kernel damage. Broken kernels are more easily infected than intact kernels.
- Manage corn moisture levels. For example, corn at 18% moisture can only be safely stored for 1.1 months at 70°F, while corn at 13% moisture can be stored for 26 months at the same temperature.
  - ◇ If drying capacity is overwhelmed in a given harvest, consider one of these options. First, dry the corn to 17-18% in the fall and then aerate, which will bring the moisture down to the 14% needed for summer storage. Second, dry the corn to 17-18% and either sell or use it before the warmer summer months arrive. The third option is to dry the corn in two passes, first to 17-18% and later to 14%.
  - ◇ Typically, corn is dried to 15% moisture; however, corn infected with mold should be dried to 13%.
- Low test weight corn will not store as well as regular corn. Some studies show that storage times are reduced by up to 50%. Therefore, low test weight corn should be sold or used first, since it deteriorates more quickly.
- Wet corn should not be stored overnight in a wagon or truck if at all possible.
- Use aeration if drying is not possible; recommended rates for wet corn are 0.2 cfm/bu. Properly managed aeration will see the grain temperature decline from 40 to 45°F in October to 28 to 35°F in December, where it should stay for the rest of the winter. Check the temperature of wet corn weekly.

### What Does One Part Per Billion (ppb) Really Mean?

*If you think of 640 acres (one square mile), 1 ppb is one-quarter of a square inch. New York City and Los Angeles are 2,784 miles apart; 1 ppb is 6 inches of that total distance. If you think of the total population of the world, 1 ppb is only 7 people. If you think of a unit train hauling 10, 000 tons of corn, 1 ppb is ~30 kernels.*

*In other words, 1 ppb is very small, and yet 100 ppb of some mycotoxins can cause severe health problems in pigs.*

## Management of Mold Infection

When mold infection occurs, there are options to minimize the further growth of molds and production of mycotoxins.

- Early detection: fields should be checked at both the black layer stage and again prior to harvest. If mold is detected, samples should be tested using rapid-on-site testing kits to determine if toxins are present. Some specialized test kits based on the ELISA (enzyme linked immunoabsorbant assay) procedure can be done on site by the producer, but some training is required. Although most ELISA kits require a special reader to give results, several companies are producing a dip stick testing procedure that can be read visually.
- Infected fields should be harvested as soon as possible and the grain dried as quickly as possible, to minimize further accumulation of aflatoxin in the grain.
- Clean corn can be stored at 16-17% moisture during the winter, but moldy corn must be dried immediately to 15% to prevent further growth. When warmer weather arrives in the spring, the corn must be dried to no more than 13% moisture.
- Aeration of stored corn can prevent the accumulation of moisture in certain locations within a storage bin.
- Monitoring bin temperatures will provide some indication of mold growth and mark the need for corrective action before mold growth in storage becomes too extensive.
- Indecision can contribute to greater infection, because delays in harvest and drying can lead to increased mycotoxin production.
- Remove fines from the corn, as broken kernels are 3-4 times more susceptible to mold growth.
- Fields of corn containing significant amounts of ear rot should be harvested separately and the grain stored separately from non-infected corn.
- Corn that is clean when harvested from the field still can become infected during storage. So it's important to ensure that storage facilities are thoroughly cleaned before filling, any damage is repaired to prevent moisture entry, and that corn is dried to recommended levels. If contaminated, old corn left in the bin can infect new crop corn as well.
- Control insects because insect damage makes corn much more susceptible to mold growth.
- Mold inhibitors such as propionic acid will effectively impair mold growth, but will not destroy mycotoxins already present.

## Corn mycotoxins

As mentioned, there are four main corn mycotoxins of concern to pork producers: aflatoxin, deoxynivalenol (also known as vomitoxin or DON), fumonisin and zearalenone; T-2 toxin and ochratoxin are also of interest. *Fusarium graminearum* (*Gibberella Zeae*) produces deoxynivalenol, zearalenone and T-2 toxin. *Fusarium moniliforme* and *Fusarium proliferatum* produce fumonisin and possibly other toxins. It's quite common for contaminated corn samples to contain more than one toxin. Different mycotoxins affect pigs in different ways, so it's important to properly identify all mycotoxins present. The following table shows the molds that are capable of producing the mycotoxins of greatest interest to Iowa pork producers.

Mycotoxin	Mold
Aflatoxin	<i>Aspergillus flavus</i> <i>Aspergillus parasiticus</i>
Deoxynivalenol	<i>Fusarium graminearum</i> <i>Fusarium culmorum</i>
Fumonisin	<i>Fusarium moniliforme</i> <i>Fusarium proliferatum</i>
Ochratoxin	<i>Aspergillus ochraceus</i> <i>Penicillium viridicatum</i>
T-2 toxin	<i>Fusarium graminearum</i> <i>Fusarium culmorum</i> <i>Fusarium sporotrichioides</i> <i>Fusarium equiseti</i>
Zearalenone	<i>Fusarium graminearum</i> <i>Fusarium culmorum</i> <i>Fusarium acuminatum</i> <i>Fusarium equiseti</i> , <i>Fusarium poae</i>

### Aflatoxins

Aflatoxins are a family of toxins that are particularly worrisome because they are potential carcinogens and thus represent food safety, swine health and production issues. The most common aflatoxins are B1, B2, G1 and G2. In swine, aflatoxin may cause reduced weight gain, impaired immune system, liver damage and death. The U.S. Food and Drug Administration (F.D.A.) has established maximum acceptable levels of aflatoxin in grain and feed (20 ppb) and in milk (0.5 ppb). Breeding swine diets should contain no more than 100 ppb and growing swine diets no more than 200 ppb. Aflatoxins are produced by the fungi *Aspergillus flavus* and *Aspergillus parasiticus*, which cause Aspergillus Ear Rot in corn.

### Deoxynivalenol (Vomitoxin)

Deoxynivalenol, also known as vomitoxin or simply DON, causes reduced feed intake and weight gain, even when present at only 1-3 ppm. Depending on the level in the feed, DON can cause nausea, diarrhea and suppression of the immune system, and may damage the kidneys. Actual vomiting and total feed refusal occur at much higher levels – about 10 ppm. While cattle and poultry can tolerate DON at levels as high as 10 ppm without problems, pigs are much

more sensitive. Younger pigs are particularly sensitive. DON at 1 ppm in the feed causes reduced feed intake and the effects increase proportionately until complete feed refusal occurs at 10 ppm or more. The effect of DON at a given concentration is highly variable in pigs for reasons that are not yet completely clear. Therefore, DON should not exceed 0.5 ppm in starter diets and 1 ppm in all other pig diets.

Experience and research has shown that 1-3 ppm DON in the diet of feeder pigs reduced feed intake in 1 to 5 days, while 5-10 ppm reduced feed intake by 50% and induced vomiting over the same period. Ten to 40 ppm resulted in complete feed refusal and vomiting. Three to 5 ppm fed to sows during gestation and lactation lowered fetal weights or had no effect.

Deoxynivalenol is produced by the mold *Gibberella zeae*, sometimes referred to as *Fusarium graminearum* or *Fusarium moniliforme*. *Gibberella* is readily observed in corn standing in the field. Peeling back the husk reveals a pink or reddish mold growing on the tips of the kernels. Once the grain is harvested, it is very difficult to determine infection visually. After harvest, DON production is favored by grain moisture greater than 20% and temperatures in the range of 70 to 85°F. DON production will be effectively halted by drying the grain to 15% moisture or less; obviously, the sooner this is done, the better.

Deoxynivalenol is part of a family of mycotoxins called trichothecenes which are in turn produced by a number of different *Fusarium* mold species, such as *Fusarium sporotrichioides*, *Fusarium poae*, *Fusarium equiseti* and *Fusarium graminearum*. There are both Type A (T-2 toxin, HT-2 toxin, Diacetoxyscirpenol) and Type B (DON, nivalenol, 3- and 15-acetyldeoxynivalenol) trichothecenes. All impact swine in a similar manner – causing reduced feed intake, vomiting and a suppressed immune system. More than 150 different trichothecenes have been isolated.

Because it is produced by the same mold, corn containing DON also may have zearalenone as well. A recent Iowa survey showed a very strong correlation between the presence of DON and the presence of zearalenone. The results were so compelling as to suggest that if one mycotoxin is found in a sample, the other is most likely present. If a test does not confirm both are present, this might be explained by sampling errors.

### Fumonisin

Fumonisin is a family of mycotoxins produced by molds of the *Fusarium* family, including *Fusarium moniliforme* and *Fusarium proliferatum*, both of which cause Fusarium Ear Rot in corn (see above). More than 10 fumonisins have been identified, but B1, B2 and B3 are the most common mycotoxins in this family. B1 fumonisin is the most commonly found form in corn, and unfortunately, it is also the most toxic. Unlike DON, in which pigs are most sensitive, fumonisins are a particular concern to equines, such as horses, donkeys and mules. Swine can tolerate up to 10 ppm in their diet. Pulmonary edema is a common symptom of fumonisin contamination of swine diets.

Past research and experience shows that feeding greater than 25 ppm fumonisin (FB1/FB2) for 30 days can reduce weight gain and feed efficiency and cause mild damage to the liver. Levels greater than 50 ppm had the same effect in only 10 days and a 100 ppm level fed for only 5 days caused severe pulmonary edema and death.

Infected kernels are more brittle than healthy corn. Because broken kernels may end up in screenings, corn screenings should be used with great care in swine diets. Of greatest concern is the fact that fumonisins have been detected in otherwise healthy kernels of corn, making prevention and detection particularly challenging.

Fumonisin formation is encouraged by a period of drought followed by warm, wet weather.

### **Ochratoxin**

Ochratoxin is primarily a kidney toxin with the threshold for health issues starting at 0.2 ppm. Ochratoxin can contaminate other organs, fat, muscle tissue and blood. Acute ochratoxicosis (concentrations greater than 5 ppm in the diet) is characterized by kidney damage, enteritis, fatty liver, necrosis of the lymph nodes and a suppressed immune system. In acute cases, death may occur due to acute renal failure. Interest in this mycotoxin has focused on the carcinogenic nature of the compound as it can accumulate in the meat of animals, leading to human health issues. Clinical signs and post-mortem findings of renal damage are indicative of ochratoxicosis which can be confirmed by identifying the toxin in the feed or in the kidney at slaughter.

### **T-2 Toxin**

T-2 toxin tends to be less common than DON, but it is more potent and thus more toxic to the pig. It is produced by the same molds as DON, including *Fusarium graminearum*, *Fusarium culmorum*, *Fusarium sporotrichioides* and *Fusarium poae*. T-2 toxin causes feed refusal, vomiting, reduced weight gain, inflammation of the digestive tract and diarrhea. Levels of 1 ppm appear to have no effect on pigs, while 2 ppm will reduce feed intake, and greater than 4 ppm will result in skin and mouth irritation as well as suppression of the immune system. In some cases, T-2 toxin can be fatal.

### **Zearalenone**

Zearalenone, also known as F-2 toxin, is an estrogenic toxin, meaning that pigs fed contaminated grain will show signs similar to those seen in animals treated with estrogen – infertility, vaginal and rectal prolapse, swollen vulvas and other breeding problems. Zearalenone also can cause pseudopregnancy in sows and gilts. The female exhibits a normal standing heat, although she does not conceive nor show repeat estrus at 21 days, leaving the producer to assume she's settled. Zearalenone has been known to cause the estrus period to last 40 to 80 days in some cases when fed at only 3 ppm. There also are suggestions that it may cause boars to become infertile. Zearalenone at levels as low as

1 ppm can cause these symptoms. Diets fed to young piglets should not exceed 1 ppm zearalenone and for growing and finishing pigs, 3 ppm is the upper limit. Because of the impact of zearalenone on the breeding herd, grain contaminated with zearalenone should not be fed to gilts, sows or boars.

Based on previous experience and research, 1-3 ppm zearalenone, fed for a period of 3 to 7 days, can lead to hyperestrogenism and prolapses in prepubertal gilts. Three to 10 ppm fed in the middle of the estrus cycle leads to anestrus and pseudopregnancy. Fifteen to 30 ppm fed during the first trimester of pregnancy leads to early embryonic death and reduced litter size. Ten to 50 ppm reduces libido and causes testicles to shrink in young boars, yet 200 ppm in mature boars was found to have no effect.

Because zearalenone can be produced by the same mold as DON (*Fusarium graminearum*; also called *Gibberella zeae* and *Fusarium moniliforme*), the same conditions that favor DON production will favor zearalenone: temperatures in the range of 70 to 85°F and moisture greater than 20%. It is intuitive that reducing moisture in corn to less than 15% will halt zearalenone production as well as DON.

### **Detection of Mycotoxins**

Detection of mycotoxins is fraught with problems. For example, a portion of a field may be heavily infected while the rest of the field is clean. Sampling corn from the clean part of the field will result in a clean bill of health when in fact mycotoxins are present. Therefore, proper sampling procedures are imperative when testing corn for mycotoxins. The best sampling procedures are those that assure the highest likelihood of detecting mycotoxins, even when the level of infection is low. Sampling from a single probe is essentially a waste of time unless the whole load is uniformly infected.

Two options are available. The first option requires a grain probe, which is used to sample corn from throughout the whole truckload. This approach has the advantage that detection can occur before the grain is unloaded, if a rapid test kit is being used.

The second option, considered to be the best method, is to collect samples throughout the load while the truck or rail car is being unloaded. It requires that someone stands by for the whole unloading process, but is the procedure most likely to represent the corn contained in the total load. A small container is held in the corn stream at various stages of the unloading. Taking a single sample is essentially a waste of time unless the whole load is uniformly infected.

Regardless of the sampling method employed, mix the load sample thoroughly, and retain a 10 lb sample. If possible, coarse grinding of the sample helps to ensure a thorough and effective mix is achieved. A 1-2 lb subsample is taken from the larger sample and used either for a rapid detection test or for submission to a laboratory.

## Field Test Kits

Following is a list of companies providing rapid test kits for mycotoxins. It is important to note that the manufacturers are constantly improving their products as the technology is rapidly advancing. This list is not intended to be comprehensive, but will provide readers with companies' names, addresses and Web sites for further information. Listing of a company and its product does not imply endorsement of any company, product or one product over another.

### ***Charm Sciences Inc.***

659 Andover St.  
Lawrence, MA 01843-1032  
(978) 687-9200

[www.charm.com](http://www.charm.com)

Offers qualitative test kits for aflatoxin (20 ppb) with no special equipment required.

### ***Envirologix Inc.***

500 Riverside Industrial Parkway  
Portland, ME 04103-1486  
(866) 408-4597

[www.envirologix.com](http://www.envirologix.com)

Offers qualitative test kits for deoxynivalenol (2, 1 and 0.5 ppm) and aflatoxin (20 ppb).

### ***Neogen Corporation***

620 Leshner Place  
Lansing, MI 48912-1595  
(800) 234-5333

[www.neogen.com](http://www.neogen.com)

Offers quantitative test kits for aflatoxin, ranging from 5 to 50 ppb.

### ***Romer Labs Inc.***

Mycotest: a TLC rapid test kit  
1301 Stylemaster Drive  
Union, MO 63084  
(314) 583-8600

[www.romerlabs.com](http://www.romerlabs.com)

Offers qualitative test kit for aflatoxin (4 ppb, 10 ppb and 20 ppb) with no special equipment required.

### ***Strategic Diagnostics Inc.***

111 Pencader Drive  
Newark, DE 19702  
(800) 544-8881

[www.sdix.com](http://www.sdix.com)

Offers qualitative test kit for aflatoxin (20 ppb).

### ***Vica***

34 Maples Street,  
Milford, MA 01757  
(800) 338-4381

[www.vicam.com](http://www.vicam.com)

Offers qualitative test kits for aflatoxin (10 or 20 ppb) and DON (1 ppm) with no special equipment required.

*While every attempt was made to prepare an accurate list, we do not guarantee any particular product or the completeness of the list. If companies marketing rapid test strips are not listed, please contact us and we will include your name in the next printing of this document. Most of the companies listed also offer quantitative tests for mycotoxins, but these tests require specialized equipment such as incubators and readers at additional cost.*

## Use of infected corn

One of the greatest frustrations on the whole topic of mycotoxins is what to do after you learn you have contaminated corn. Fortunately there are a few options, although none may be completely satisfactory. The relevance and practicality of any particular action will vary among farms.

- Sell contaminated corn and buy back non-contaminated corn.
- Analyze the corn for the common mycotoxins and dilute contaminated corn with clean corn, to bring the mycotoxins down to acceptable levels. Please note that because of risk to human health, the FDA does not allow dilution of grains containing aflatoxin.
- Clean corn to remove fines and broken kernels, where mycotoxins levels are likely to be highest.
- Feed contaminated grain to market hogs and keep them out of the diets for the breeding herd and weanling pigs.

## Mycotoxin Binders

The development of mycotoxin binders has been an area of intense research interest over the past decade. The objective of these binders is to prevent the absorption of mycotoxins by the gastrointestinal tract of the pig. There are many types of binders: aluminosilicates (e.g., clays, bentonite, zeolite), activated carbons, complex carbohydrates (cellulose, yeast or bacteria cell wall components), enzymes and synthetic polymers.

The effectiveness of binders is uncertain. Some products on the market have been researched more than others and we therefore characterize the binder marketplace as “buyer beware.” As a general rule, binders such as the clay products have tended to show more promise with aflatoxin than other mycotoxins, although the amount of research under way suggests there will be a growing number of products on the market. Relatively recent additions to the mycotoxin binder market are the yeast and bacteria cell wall components such as glucomannans. Currently some of these products on the market appear to provide some benefit, but none allow producers to feed contaminated corn and still achieve performance equal to that of pigs fed non-contaminated corn. At this time, good quality research published in peer reviewed journals is sadly lacking on this important topic.

## Laboratory Analysis

There are many laboratories performing mycotoxin analysis for mycotoxins. It is important to know what method of analysis is being performed to ensure the particular feedstuff is analyzed correctly and a correct result is generated. For example, many ELISA kits for mycotoxin analysis are designed only for certain feeds such as corn and should not be used for pelleted feed. Many laboratories have reported detection limits of mycotoxins at levels below any clinical relevance, meaning a positive report of a mycotoxin at levels with no clinical relevance will cause needless concern for the producer. Every laboratory should have adequate quality control to be able to validate all results generated. A positive and negative control sample should be analyzed every time a sample is analyzed to make sure the results generated are accurate.

Iowa State University College of Veterinary Medicine’s Veterinary Diagnostic Laboratory has a chemistry section that can analyze any feedstuff for mycotoxin concentration. Both wet chemistry and ELISA testing are done. This laboratory and chemistry section are accredited by the American Association of Veterinary Laboratory Diagnosticians. This lab is located at 1600 South 16<sup>th</sup> Street in Ames, Iowa, and can be reached by phone at (515) 294-1950.

**File: Animal Science 11**

Prepared by John Patience, associate professor, Animal Science Department; Steve Ensley, clinician, Veterinary Diagnostic and Production Animal Medicine Department; and Sherry Hoyer, Iowa Pork Industry Center, Iowa State University.

**IOWA STATE UNIVERSITY**  
University Extension

... and justice for all

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or family status. (Not all prohibited bases apply to all programs.) Many materials can be made available in alternative formats for ADA clients. To file a complaint of discrimination, write USDA, Office of Civil Rights, Room 326-W, Whitten Building, 14th and Independence Avenue, SW, Washington, DC 20250-9410 or call 202-720-5964. Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Jack M. Payne, director, Cooperative Extension Service, Iowa State University of Science and Technology, Ames, Iowa.