Rensselaer Swine Services, P.C.™

E-Letter
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Mycotoxins and the 2009 Corn Crop

News Flash

It is not new to any of you that mycotoxins are present and causing problems, but recent close outs throughout the practice have shown a lengthening of seven to fourteen days longer to market without finding any other concern. The working theory is that before the intense sampling of grain occurred, a negative impact was occurring. In addition, reproductive concerns have surfaced, i.e. abortions, abnormal intervals for repeats and smaller piglets at birth. The following explanation enlightens us on why this can occur.

The cool and wet harvest season is having a significant impact on this year's crops, resulting in an increased prevalence of mold in not only corn, but many different grains, including wheat, barley, rye and oats. The mold itself is not usually harmful, but many molds have the ability to produce mycotoxins, which can reduce the nutrient quality of grain as well as result in decreased production and even death in livestock. These mycotoxins use up the nutrients by damaging the kernel, resulting in decreased fat, protein, and vitamins within the grain. Mold can grow and produce mycotoxins before or after the crop is harvested; therefore, mycotoxins may already be present in the grain before it is stored, and proper drying will not be able to eliminate the presence of harmful mycotoxins.

- Mold growth and mycotoxin contamination
  - Corn ear molds, particularly ***Giberella*** and ***Fusarium*** molds, have been reported throughout Indiana at levels that have not been observed in the state for decades
- All mycotoxins are by-products of mold growth, but not all molds produce mycotoxins
  - *Diplodia* (white fungus) <u>will not produce toxins</u>
  - *Fusarium* and *Giberella* (pinkish to salmon-colored fungus) <u>WILL produce toxins;</u> examples are:
    - Deoxynivalenol, zearalenone and fumonisin mycotoxins
  - *Aspergillius* (storage fungus) <u>will produce aflatoxins</u>
- Mold Inhibitors
  - Reduce mold growth in grain or feed after harvest but will do nothing to reduce mycotoxin that is already present

There are many different mycotoxins, but the most concerning for swine production are aflatoxin, zearalenone, deoxynivalenol (DON, more commonly referred to as vomitoxin), fumonisin, and T-2. Aflatoxin is the most common mycotoxin found and results in a decreased weight gain, liver damage, and decreased immunity in swine. Swine are the most sensitive species to zearalenone. Zearalenone is a mycotoxin that mimics estrogen, causing swollen vulvas, infertility, and a decrease in reproductive performance. Vomitoxin results in a decrease in feed intake, decreased weight gain, and vomiting. Fumonisin is mainly associated with corn and also results in a decrease in feed intake, decreased weight gain, but can also cause liver damage and respiratory compromise. T-2 can lead to a decreased weight gain and feed intake as well as skin lesions and reduced fertility in sows. Mycotoxins are more harmful in younger pigs and breeding stock. Late finishing pigs are less susceptible. Feed samples can be tested for levels of these mycotoxins. See table 1.

However, testing is difficult due to the inconsistency of the presence of mycotoxins throughout the sample. It is suggested that several samples be taken throughout different locations within one load since mycotoxins are not present in every kernel. Testing for mycotoxins often results in confusion, with the majority of testing errors being due to sampling technique.

Mycotoxin	Cautionary Levels
Aflatoxin	0.02 ppm
Zearalenone	0.5 ppm
Vomitoxin	1.0 ppm
Fumonisin	5.0 ppm
T-2	0.5 ppm

There are many products available to add to feed to bind to mycotoxins, and it is important when using these, to make sure the binder is not going to bind up key nutrients in the feed.

Binders:

- hydrated sodium calcium aluminosilicate
- bentonite (sodium or calcium) (adsorbent clay)

Others:

- increase dietary protein level, provide adequate vitamin supplementation
- β-glucans (yeast wall polysaccharide)

Maximum Tolerable Level of Mycotoxins Commonly Found in Swine Feeds[a]

Mycotoxin	Maximum tolerable level	Comments
Aflatoxins (B1, B2, G1, G2)	< 20 ppb for human use, dairy feed, feed for immature animals < 100 ppb for breeding swine < 200 ppb for finishing swine (>120 lbs body weight)	Carcinogenic. Immunosuppressant. Acute signs: anorexia, depression, ataxia, epistasis. Chronic signs: reduced feed efficiency, reduced milk production, icterus, decreased appetite.
Zearalenone	< 1 ppm for young growing	Estrogenic effects. Swollen vulvas,

	pigs < 2 ppm for breeding herd < 3 ppm for finishing pigs and young and old boars	vaginal or rectal prolapses in pre-pubertal gilts. Enlarged uterus, swollen or twisted uterus, shrunken ovaries. In boars, testes atrophy, enlarged mammary glands, decreased fertility.
Deoxynivalenol (vomitoxin)	< 5 ppm on grain and grain by-products. DON contaminated feedstuffs should not exceed 20% of the diet. (< 1 ppm in complete feeds)	Reduction in feed consumption and weight gain are inversely proportional to concentration of DON. High concentrations cause feed refusal and vomiting.
T-2 toxin	< 1 ppm	Potent immunosuppressive agent that directly affects immune cells and modifies immune response as a consequence of other tissue damage. Frequent defecation, vomiting, weight loss and feed refusal.
Fumonisin	Not established < 5 ppm (extrapolated from horse data)	Carcinogenic in laboratory tests using rats. Associated with pulmonary edema in pigs.
Ochratoxin	< 200 ppb has been associated with kidney damage in swine	Ochratoxin A is most common and potent. Reduction in growth, feed efficiency, increased mortality, liver and kidney damage.
Ergot	< 200 ppb	Vertigo, staggers, convulsions, temporary posterior paralysis, eventual death. Decreased peripheral blood supply. Reduced growth, tail loss, reduced reproductive efficiency of sows.

[a]Feedstuffs Reference Issue (1997)

Comments by Dr. Steve Ensley, ISU VDL toxicologist that indicate what is happening inside the body of the animal:

- Chronic effects of DON include reduced growth (anorexia and decreased nutritional efficiency), immune function changes, (enhancement and suppression), and reproductive effects (reduced litter size) (Petska, 2004).

- DON causes feed refusal in swine. DON appears to affect serotonergic activity or serotonin receptors (Rotter et al., 1996). One part per million or more of DON results in reduced feed intake in swine, resulting in lower weight gains.

- Two independent midwestern field studies (Vesonder et al., 1978; Côté et al.,1984) have shown that DON to be the primary mycotoxin associated with swine disorders, including feed refusals, diarrhea, vomiting, reproductive failure and deaths.

- Vomiting has been reported in some outbreaks with high DON concentrations. Diets containing pure DON decrease feed consumption on a dose-related basis (Marasas et al., 1984). Danicke et al. (2006) demonstrated that DON reduces protein synthesis in the kidney, spleen and ileum but not the liver, skeletal and heart muscle, mesenteric lymph nodes, duodenum, jejunum, jejunal mucosa cells, pancreas and lung of exposed pigs. Other mycotoxins such as 3- and 15-acetyl DON often co-occur with DON. Foster et al. (1986) found that feeds naturally contaminated with DON were more toxic to pigs than equal amounts of pure DON added to diets. Smith and McDonald (1991) have indicated that fusaric acid interacts with DON to produce the symptoms previously attributedjust to DON.

- DON is in the class of mycotoxins called trichothecenes. Trichothecenes are a family of 200-300 related compounds including T-2 toxin, diacetooxyscirpenol (DAS) and deoxynivalenol (DON), which are commonly found in agricultural commodities (Desjardins et al., 1993). They exert their toxicity through protein synthesis inhibition at the ribosomal level, are immunosuppressive, toxic to cell membranes and induce apoptosis (increased cellular death) (Sharma, 1993; Shifrin and Anderson, 1999). The toxic effects of trichothecenes include gastrointestinal effects such as vomiting, diarrhea and bowel inflammation. Anemia, leukopenia, skin irritation, feed refusal, reduced growth and reproductive failure are also common. Several species of Fusarium and related genera produce trichothecenes. Except for DON, it appears that most contaminations with trichothecenes occur post-harvest.

Summary and key points:

Mold growth and mycotoxin contamination
- ✓ Corn harvested throughout the Midwest is testing high
- ✓ Conditions: infected residues in field, cool moist weather

All mycotoxins are by-products of mold growth, but not all molds produce mycotoxins
- ✓ Diplodia (white fungus) **will not** produce toxins
- ✓ Fusarium and Giberella (pinkish to salmon-colored fungus) **WILL** produce toxins
- ✓ Aspergillius (storage fungus) **will** produce aflatoxins

Mold Inhibitors
- ✓ Reduce mold growth in grain or feed
- ✓ Will do nothing to reduce mycotoxin that is already present
- ✓ Problem – will tie up other important ingredients as well as bind some of the mycotoxin

Detection
- ✓ Presence of mold via black lighting or mold counting will not indicate presence of toxin
- ✓ Representative sample of grain or feed must be analyzed for toxins by commercial lab or reliable "table top" test kits
- ✓ DDGS will have 3x the level of mycotoxin as the original corn source

Toxins and cautionary levels for swine in complete feed (1 ppm = 1000 ppb)
- ✓ Vomitoxin (DON) – 1.0 ppm – reduced feed consumption
- ✓ Zearalenone – 0.5 ppm – reduced reproductive performance
- ✓ Fumonisins – 5.0 ppm – reduced feed consumption
- ✓ Aflatoxins – 0.02 ppm – depressed immune system
- ✓ T-2 – 0.5 ppm – reduced feed intake (cereal grains and by-products)
- ✓ Ochartoxin – 0.2 ppm – reduced feed intake (cereal grains and by-products)

Toxins are additive – combinations of toxins (even at low levels) can cause problems
- ✓ **Rarely is there only one mycotoxin present**

The initial goal is to dilute the mycotoxin present in the feed stuff, which most of you have achieved. The second goal is to find the binder or combination of binders that work for you without "reducing" other key ingredients.