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Mycotoxin contamination of corn, IPIC 12 (pdf)

Mycotoxins Today
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Molds & Mycotoxins

- Two different issues
  - Molds produce mycotoxins
  - Molds aren’t the problem, mycotoxins are, and can impact animal performance
  - All molds aren’t bad
  - Can be mycotoxins on wheat, barley, oats, corn

Factors Affecting Mold Growth

- Molds need moisture and heat to grow
- Weather - probably #1 factor
  - temperature, humidity, rain, hail
  - Previous year’s mycotoxins have no effect
- Kernel damage
  - insects, physical damage, quality factors
- pH level, oxygen, moisture migration (in bins)
- Can grow any time of year

Mold is inhibited by:

- Dryness (12-14% grain moisture)
  - 18% corn can be stored for 1.1 months at 70F
  - 13% corn can be stored for 26 months at 70F
- Cold conditions (temps below 50 deg. F)
- If drying capacity is overloaded (it probably is):
  - Dry to 17-18% and then aerate to 14% moisture
  - Dry to 17-18% and either sell or use by spring
  - Dry corn in two passes (17-18% first & then 14% later)
Mold is inhibited by:

- Proprionic acid, preservatives
  - make grain un-saleable
- Ensiling properly
- Light test weight corn does not store as well, and storage time can be reduced by 50%

Maximum Tolerance Levels of Selected Mycotoxins

<table>
<thead>
<tr>
<th>TOXIN</th>
<th>Class of Swine</th>
<th>Maximum Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aflatoxin</td>
<td>Breeding</td>
<td>.1 ppm</td>
</tr>
<tr>
<td></td>
<td>Nursery</td>
<td>.020 ppm</td>
</tr>
<tr>
<td></td>
<td>Growing</td>
<td>Not determined</td>
</tr>
<tr>
<td></td>
<td>Finishing</td>
<td>.2 ppm</td>
</tr>
<tr>
<td>Vomitoxin (DON)</td>
<td>All classes</td>
<td>1 ppm</td>
</tr>
<tr>
<td>Zearalenone</td>
<td>Breeding</td>
<td>2 ppm</td>
</tr>
<tr>
<td></td>
<td>Nursery</td>
<td>1 ppm</td>
</tr>
<tr>
<td></td>
<td>Growing</td>
<td>1 ppm</td>
</tr>
<tr>
<td></td>
<td>Finishing</td>
<td>3 ppm</td>
</tr>
<tr>
<td>Fumonisins</td>
<td>All classes</td>
<td>18 ppm</td>
</tr>
</tbody>
</table>

Why Can There Still Be Problems Even If Grain is at Acceptable Levels?

- Not a representative sample taken
- Dealing with more than one mycotoxin
- Difference between natural and “spiked” mycotoxins in research
- Masked mycotoxins:
  - conjugated mycotoxins that aren’t detected but are released after hydrolysis in the GI tract

Cladosporium, Penicillium, Trichoderma

- Surface contaminants mostly
- Easily rubbed-off
- “Generally” non-toxigenic
- May increase mold losses in storage
  - spoilage, dry matter reduction
- May be less palatable to livestock
Aspergillus

• Major mycotoxin concern when hot, dry
  – Yellow-green or grey green mold

• Produces Aflatoxins

• More of a problem in southeast US than in the traditional Cornbelt

• Pockets can occur in Cornbelt

Aflatoxin

• Very potent mycotoxin
  – ppb vs ppm

• Carcinogen
  – FDA max limits of 20 ppb in grain & feed
  – .5 ppb in milk

• Reduced weight gain
• Impaired immune system
• Death

Fusarium / Gibberella

• G. zeae (F. graminearum) is often red or pink in color
  – may produce abundant mycotoxins
  – vomitoxin=DON, nivalenol, zearalenone

• F. verticilliodes, white, abundant mycelium
  – fumonisins
**Fusarium**

- Deoxynivalenol
- Reduced feed intake, vomiting, & impaired immune system
- Nursery pigs more susceptible (0.5 ppm)
- Mold that produces DON also produces zearalenone so both may be present

**DON or Vomitoxin**

- Deoxynivalenol
- Reduced feed intake, vomiting, & impaired immune system
- Nursery pigs more susceptible (0.5 ppm)
- Mold that produces DON also produces zearalenone so both may be present

**Zearalenone**

- Produces estrogenic-like responses
  - Red, swollen vulvas on pre-pubertal gilts
- Infertility, pseudo-pregnancies, breeding problems, rectal & vaginal prolapses
- May cause boars to become infertile

**Fumonosins**

- B1 most common forms in corn
- Reduced gains & feed efficiency
- Pulmonary edema
- Formation is encouraged by period of drought followed by warm, wet weather

**Diplodia**

- No toxins produced
- Mushroom-like in smell and feel
- May have palatability issues

**Penicillium**

- No specific information provided

**Gibberella**

- No specific information provided
Testing for Mycotoxins

- **Two types of tests**
  - **Quick tests**
    - Commercially available ($10-$50 per sample)
    - Specific mycotoxins
    - Few hours to 1 day
    - Qualitative, not quantitative
  - **Quantitative tests**
    - Can test for multiple mycotoxins
    - Done in a lab with a HPLC
    - $75-$150/sample

- Black light screening only detects live mold, not dead mold or mycotoxins

Ethanol

- **The issue is DDGS**
  - Mycotoxin level in the corn is tripled in the DDGS
  - Ethanol process does NOT inactivate the mycotoxins

- **Receiving plants are testing**
  - Check a plant's testing procedure and rejection standards before buying DDGS

- **Make sure mycotoxin standards & penalties are written into DDGS contracts**

Additives

- **There are NO legally FDA approved mycotoxin binders**

- **Clay binders & anti-caking agents (bentonite, sodium aluminosilicates) will tie up alfatoxins, but ineffective against other mycotoxins like DON, zearalenone, fumonisin**

- **They can also tie-up minerals and antimicrobials**

Feeding Mycotoxin-Contaminated Grains

- **Once the grain is contaminated with mycotoxins, there is NOTHING you can do to remove it!**

- **Drying down the wet grain, adding a mold inhibitor, etc will stop any future mold growth but will not inactivate the mycotoxins already present**

Testing for Mycotoxins

- **Get samples from many different areas of the field since the whole field may not be affected**
  - Use a grain probe to sample throughout the truck
  - Collect samples during the entire unloading process
  - Take at least 10-12 samples

- **Want 10 lbs shelled grain/silage**
  - Send in a cloth or paper bag

- **Needs to be below 18% to test**
  - if wet, may skew the results a bit
  - additional growth/toxin during transit

Diplodia ear mold - white, packed mycelium
no toxins produced, reduces grain weight
• Commercially available additives are not consistently effective against DON, Zearalenone, Fumonosins

• They may lessen the effects of mycotoxins, but won’t totally alleviate the problem

• Might consider adding them as an “Insurance Policy”

• Blend contaminated grain with “clean” grain to get below problem levels
  – Adding 50% corn w/ 1 ppm DON with clean grain will result in a diet with .5 ppm DON

• Screen-clean grain before putting in bins since screening can concentrate mycotoxins

• Wear a N-95 rated mask or respirator when working with moldy grain
  – “Grain Dust Pneumonia”

• Strategically feed contaminated grains
  #1 finishing pigs (120 lbs – mkt) 53% of feed used
  #2 growing pigs (50 – 120 lbs) 22% of feed used
  #3 cull sows

  Keep out of breeding herd & nursery diets
  - Use old crop corn, clean new crop corn, and alternate feedstuffs (barley, milo, etc) in sow and nursery diets

• Feeder Management
  • Data from the Pipestone System
    – Feed taken from feeders in farrowing crates

  • DON Levels
    – Day 4 .8 ppm
    – Day 10 1.0 ppm
    – Day 16 1.8 ppm

  • Feed management is a continual process

• Other Concerns
  • Closely monitor corn in bins early spring when it starts to warm up
    – South side of bin may get enough radiant heat to restart mold growth even with cold air temperatures
    – Continue to aggressively dry grain
    – Consider adding mold inhibitors

  • Mycotoxins will be concentrated in grain screenings, and possibly in the syrup/solubles from ethanol plants so limit their use

  • There may be more than 1 mycotoxin present in a sample, and the effects are additive

  • This summer, re-evaluate operation’s ability to realistically handle & dry today’s larger grain yields in a timely manner

  • Monitor grain throughout the growing season and be prepared before harvest for mycotoxins