Explanation of ear rots and their ability to produce mycotoxins

Alison Robertson
ISU Extension Plant Pathologist
Common Ear Rots of Corn

- Aspergillus
- Diplodia
- Fusarium
- Gibberella
- Penicillium
- Trichoderma
- Nigrospora
- Cladosporium
Favorable conditions

Vary by pathogen but may include:

- Genetics
- Weather conditions
  - hot/cool temperatures
  - dry/wet conditions
- Kernel damage by hail, birds or insects
Ear rots associated with kernel damage

Aspergillus
Fusarium
Gibberella
Penicillium
Trichoderma
Nigrospora
Cladosporium

Does hail increase the risk of ear rots?
Ear rots associated with kernel damage

Does hail increase the risk of ear rots?
Mycotoxins

my·co·tox·in  a chemical produced by a fungus that is toxic to humans and animals

Toxic effects: feed refusal, liver damage, reduced conception, reduced gain and feed efficiency, etc.
Mycotoxins

Produced in **field** (dependent on enviro conditions) or during **storage** (dependent on storage conditions)

Mycotoxin concentration NEVER decreases in storage – increases or stays the same

Contamination determined by sampling and analysis

**Note: mold ≠ mycotoxins**
# Ear rots and associated mycotoxins

<table>
<thead>
<tr>
<th>Fungus</th>
<th>Mycotoxins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspergillus</td>
<td>aflatoxins</td>
</tr>
<tr>
<td>Gibberella</td>
<td>DON (vomitoxin)</td>
</tr>
<tr>
<td></td>
<td>zearalenone</td>
</tr>
<tr>
<td></td>
<td>T-2 toxin</td>
</tr>
<tr>
<td>Fusarium</td>
<td>fumonisins</td>
</tr>
</tbody>
</table>
Aspergillus ear rot

• Gray-green or yellow green powdery mold

• Usually develops around injuries

• Most common in Iowa in hot dry years

• Can grow at
  - temperatures >90
  - moisture < 15%
Optimum conditions for *Aspergillus* growth and aflatoxin production

**Temperature**

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Aspergillus growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>45°F</td>
<td></td>
</tr>
<tr>
<td>120°F</td>
<td></td>
</tr>
</tbody>
</table>

**Moisture**

<table>
<thead>
<tr>
<th>Moisture</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>13%</td>
<td></td>
</tr>
<tr>
<td>30%</td>
<td></td>
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</table>

Grain Quality of Hail Corn Clinic
Callender/Wall Lake - 2009
Optimum conditions for *Aspergillus* growth and aflatoxin production

Temperature

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Aspergillus growth</th>
<th>Aflatoxin production</th>
</tr>
</thead>
<tbody>
<tr>
<td>45F, 55F</td>
<td>13%</td>
<td>17%</td>
</tr>
<tr>
<td>104F, 120F</td>
<td></td>
<td>30%</td>
</tr>
</tbody>
</table>

Moisture

So, the fungus can grow at higher and lower temperatures & moistures and not produce aflatoxin
## Aflatoxin

Levels are regulated by the FDA:

<table>
<thead>
<tr>
<th>Category</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human food</td>
<td>20 ppb</td>
</tr>
<tr>
<td>Feed</td>
<td></td>
</tr>
<tr>
<td>immature livestock and broilers</td>
<td>20 ppb</td>
</tr>
<tr>
<td>breeding cattle or swine; layers</td>
<td>100 ppb</td>
</tr>
<tr>
<td>swine &gt;100lbs</td>
<td>200 ppb</td>
</tr>
<tr>
<td>finishing beef cattle</td>
<td>300 ppb</td>
</tr>
<tr>
<td>Dairy</td>
<td>0.5 ppb</td>
</tr>
</tbody>
</table>

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Gibberella ear rot

- Bright pink mold
- Can cause reddish discoloration of kernels and butt
- Usually begins at the ear tip
- May develop around injuries
- Favored by cool, wet weather
### Optimum conditions for DON and zearalenone production

<table>
<thead>
<tr>
<th></th>
<th>Optimum Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>DON production</td>
<td>72-82°F</td>
</tr>
<tr>
<td>Zearalenone production</td>
<td>82°F/54°F</td>
</tr>
<tr>
<td>Category</td>
<td>FDA Recommendation</td>
</tr>
<tr>
<td>---------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Cattle/chickens</td>
<td>5 ppm in diet</td>
</tr>
<tr>
<td>Swine</td>
<td>1 ppm in diet</td>
</tr>
<tr>
<td>All other animals</td>
<td>2 ppm in diet</td>
</tr>
<tr>
<td>Human food</td>
<td>1 ppm</td>
</tr>
</tbody>
</table>
Fusarium ear rot

White mold, tan or brown colored kernels, or white streaks
Infection via insects, wind blown spores onto silks or systemically through root infection
Favored by hot (80-100 F), dry weather
Optimum conditions for fumonisin production

Marin et al, 1999
Fumonis in

FDA recommendations for total feed levels:

Horses and rabbits 1 ppm
Swine and catfish 10 ppm
All other species livestock and pets 5 ppm
Preliminary analysis of ears from hail damaged fields

- Sooty molds
- Gibberella
- Fusarium
- Penecillium
- Trichoderma

Grain Quality of Hail Corn Clinic
Callender/Wall Lake - 2009
## Weather conditions August – Sept 12, 2009

<table>
<thead>
<tr>
<th>Location</th>
<th>Mean Temperature</th>
<th>Rainfall</th>
<th>Av RH%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>Castana</td>
<td>77.2</td>
<td>58.3</td>
<td>0.6</td>
</tr>
<tr>
<td>Kanawha</td>
<td>76.9</td>
<td>55.1</td>
<td>1.4</td>
</tr>
<tr>
<td>Sutherland</td>
<td>76.8</td>
<td>54.1</td>
<td>2.3</td>
</tr>
</tbody>
</table>
Harvesting recommendations for moldy grain

Harvest

If >10% ears in a field have more than 10-20% mold – harvest a.s.a.p.

Adjust combine for minimal kernel damage and maximum cleaning

Thoroughly clean grain before storage to remove chaff, foreign material and cracked/broken kernels

Immediately dry grain

short term storage – dry to 15% moisture
longer term storage – dry to 13-14% moisture
Mycotoxin testing

Various procedures available: Qualitative and quantitative

**Thin layer chromatography**

**ELISA**

**Dipstick**

**Gas chromatography**
Mycotoxin testing

**Sampling**
Contamination can vary widely within a field / storage facility

- **Moving grain stream:**
  Take a composite sample of 10-lb

- **Grain cart/truck:**
  Take multiple probes for a composite 10-lb sample
Mycotoxin testing

Testing

• Private Labs

• ISU Veterinary Diagnostic Lab
  1600 South 16th St
  Ames, IA 50011-1250
  Telephone: 515-294-1950
  E-mail: isuvdlv@iastate.edu
Summary

1. Corn is susceptible to numerous ear rots

2. Some fungi that cause ear rots also produce mycotoxins

3. The affect of hail damage on ear rot and mycotoxin contamination is unknown
Summary

4. Scout to determine how much and what ear rots are present. If >10% of ears have ear rot – harvest a.s.a.p.

5. Presence of mold ≠ mycotoxin

6. Feed grain should be tested for mycotoxins
Thank You
Toxigenic fungi, their toxins and target effects

<table>
<thead>
<tr>
<th>Grain Mold Fungus</th>
<th>Toxin produced</th>
<th>Toxic effect</th>
<th>Species affected</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Aspergillus flavus</em></td>
<td>aflatoxin</td>
<td>Reduce feed efficiency, Liver cancer, Immune suppression</td>
<td>Many Humans, Humans, animals</td>
</tr>
</tbody>
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## Toxigenic fungi, their toxins and target effects

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<tr>
<td><em>Fusarium verticilliodes</em></td>
<td>fumonisin</td>
<td>Blind staggers, Pulmonary edema, Esophageal cancer</td>
<td>Horses, Swine, Humans</td>
</tr>
<tr>
<td><em>Gibberella zeae</em></td>
<td>vomitoxin (DON), zearalenone</td>
<td>Feed refusal, Reprod. dysfunction</td>
<td>many, Swine</td>
</tr>
</tbody>
</table>