Corn Ear Rots, Mycotoxins and Post-harvest Grain Handling

December 2019

Information Resources

Ear Rots and Mycotoxins

Ear rots of corn annually reduce yields and potentially in the corn belt. Bioaerosol fungal spores and mycotoxins can and are commonly found in corn grain harvested from both corn and sorghum. Mycotoxins can be fatal or cause health risks to humans, livestock, and poultry. The U.S. Environmental Protection Agency (EPA) has established limits for the presence of certain mycotoxins in corn, but these limits are often exceeded. Mycotoxins can be used as a producer of new technologies, which is an area of current research.

Cornmycotoxins.com

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Cornmycotoxins.com
Mycotoxins

- Chemicals produced by fungi
- Accumulate in grains
- Extremely stable
- Toxic if consumed

Deoxynivalenol

Zearalenone

Fumonisin

Aflatoxin
Mycotoxicosis: Common Symptoms

- Reduced feeding
- Poor weight gain
- Vomiting
- Infertility
- Abortion
- Rectal/vaginal prolapse
- Respiratory stress

OUTLINE

1. Preharvest ear rots: the major source of mycotoxins
2. Scouting: staying ahead of problems
3. Storage: maintaining grain quality
Ear Rots in Corn Crop

Gibberella Ear Rot
Fusarium Ear Rot
Aspergillus Ear rot
Diplodia Ear Rot

Gibberella Ear Rot

<table>
<thead>
<tr>
<th>Deoxynivalenol</th>
<th>Gastrointestinal toxicity, inflammation of central nervous system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vomitoxin, DON</td>
<td></td>
</tr>
<tr>
<td>Zearalenone</td>
<td>Infertility, abortions, other reproductive problems</td>
</tr>
</tbody>
</table>
Factors Affecting Gibberella Ear Rot

<table>
<thead>
<tr>
<th>Inoculum Source</th>
<th>Host Resistance</th>
<th>Conducive Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debris</td>
<td>Very Little</td>
<td>Cool &amp; Wet @ Flowering</td>
</tr>
</tbody>
</table>

Vomitoxin, DON

<table>
<thead>
<tr>
<th>Animal</th>
<th>DON Levels</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swine</td>
<td>1-3 ppm</td>
<td>Reduced feed intake</td>
</tr>
<tr>
<td>Feeder pigs</td>
<td>5-10 ppm</td>
<td>50% reduction in feed intake, vomiting</td>
</tr>
<tr>
<td>Feeder pigs</td>
<td>10-40 ppm</td>
<td>Complete feed refusal, vomiting</td>
</tr>
<tr>
<td>Sows</td>
<td>3-5 ppm</td>
<td>Lower fetal weights, or no effect</td>
</tr>
<tr>
<td>Cattle</td>
<td>10 ppm</td>
<td>No effect</td>
</tr>
<tr>
<td>Feeder cattle</td>
<td>6 ppm</td>
<td>No effect or slight reduced feed intake</td>
</tr>
<tr>
<td>Dairy cows</td>
<td>12 ppm</td>
<td>No effect on milk production</td>
</tr>
<tr>
<td>Poultry</td>
<td>50 ppm</td>
<td>No effect</td>
</tr>
<tr>
<td>Broilers, turkeys</td>
<td>50 ppm</td>
<td>No effect</td>
</tr>
</tbody>
</table>
VOMITOXIN

FDA LIMITS

- 1 PPM HUMAN FOOD
- 5 PPM SWINE, < 20% OF DIET
- 10 PPM CATTLE AND CHICKENS, < 50% OF DIET
- 5 PPM ALL OTHER ANIMALS, < 40% OF DIET

2009: Excessive rain and cool temperatures resulted in many reports of DON in North

- Reports of livestock feeding issues
- Issues with dockage due to damage and high levels of DON
- Loads rejected at elevators and refused at ethanol plants
FUSARIUM EAR ROT

| Fumonisins | Hepatotoxicity, cancer, pulmonary edema, leukoencephalomalacia |

J. Tuite, G. Shaner, G. Rambo, J. Foster, and R. Caldwell
Cereal Science Today 1974
Factors Affecting Fusarium Ear Rot

<table>
<thead>
<tr>
<th>Inoculum Source</th>
<th>Host Resistance</th>
<th>Conducive Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil, Debris</td>
<td>Very Little, BT</td>
<td>Heat &amp; Insect Stress</td>
</tr>
</tbody>
</table>

FUMONISIN

- Decreased performance
- Immune suppression
- Neurotoxicity
- Hepatotoxicity
- Nephrotoxicity
- PPE - Porcine pulmonary edema
- Carcinogenicity
- ELEM - Equine leukoencephalomalacia
Fumonisin: FDA Advisory

Food 2-4 ppm
Equids 5 ppm, < 20% of diet
Swine 20 ppm, < 50% of diet
Ruminants 30-60 ppm, < 50% of diet
Poultry 100 ppm, < 50% of diet
ASPERGILLUS EAR ROT

Aflatoxins  | Hepatotoxicity, cancer, immunosuppression

Factors affecting Aspergillus Ear Rot

<table>
<thead>
<tr>
<th>Inoculum Source</th>
<th>Host Resistance</th>
<th>Conducive Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil, Debris</td>
<td>Very Little</td>
<td>Drought &amp; Heat Stress</td>
</tr>
</tbody>
</table>
2012: Drought and heat resulted in many reports of aflatoxin

AFLATOXIN

FDA ACTION LIMITS

- 0.5 PPB  MILK
- 20 PPB  GRAIN FOR INTERSTATE TRADE
- 20 PPB  HUMAN FOOD & DAIRY CATTLE
- 100 PPB  BREEDING CATTLE & SWINE
- 100 PPB  MATURE POULTRY
- 200 PPB  FINISHING CATTLE & SWINE (over 100 lb)
Diplodia Ear Rot

Factors Affecting Diplodia Ear Rot

<table>
<thead>
<tr>
<th>Inoculum Source</th>
<th>Host Resistance</th>
<th>Conducive Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debris</td>
<td>Some hybrids less susceptible</td>
<td>Wet @ Flowering</td>
</tr>
</tbody>
</table>
Diplodiatoxin

- Outbreaks of diplodiosis have been reported in South Africa and Argentina
  - Cattle and Sheep
- Symptoms
  - Loss of coordination
  - Paralysis
  - Liver damage

In U.S., strains produce toxin in culture. Only trace in field

Russia

The Russian Ministry of Agriculture approved the List of Pests of Quarantine Concern for the Russian Federation. The List is approved by the Ministry’s Order No. 501 of December 15, 2014

Quarantine pests that are absent on the territory of the Russian Federation

Stenocarpella macrospora
Stenocarpella maydis
Trichoderma Ear Rot

PREHARVEST Ear Rot Diseases

Weather Extremes
Drought
Rain
Temperature
Insect Damage

DON/Zearalenone

Fumonisin

Aflatoxin

Gib ear rot

Fusarium ear rot

Aspergillus ear rot

Diplodia ear rot
Hurricane Season

Assessing Ear Rot Severity

- Difficult to see symptoms and signs of ear rots until nearing harvest
- Important to scout fields right before or at harvest to determine ear rot incidence
Why Scout?

• Be aware of ear rot problems BEFORE harvest
  • Prioritize harvest and designate storage
  • Determine if grain needs to be tested for mycotoxin levels
  • Avoid feeding damaged grain to livestock
  • Crop insurance claims

Corn Mycotoxins

Mycotoxins are natural chemicals produced as by-products by fungi. In general, mycotoxins are extremely stable, and dry heat and freezing will not significantly degrade them. Exposure to mycotoxins, especially through consumption of contaminated food, can have detrimental health effects to both humans and animals. This poisoning, called mycotoxicosis, manifests many symptoms, including reduced weight gain, cancer, or death. In many cases, the immune system is impacted by the mycotoxin, which complicates symptom diagnosis.

Testing for mycotoxins

Mycotoxins can be assessed by using several different chemical and immunoassay technologies, but analyzing mycotoxins can be a challenge due to their complex nature. It is important to not rely solely on visual methods, such as the blacklight test, for confirmation of mycotoxins. In fact, in some states it is illegal to use the blacklight to reject corn. Visual test results can be inconsistent, and therefore samples should be sent to professional laboratories for analysis.

• Click here to view a video on the blacklight test for aflatoxin detection
• Click here for approved Midwest testing facilities for aflatoxin
<table>
<thead>
<tr>
<th>Laboratory Name</th>
<th>Location</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairyland Laboratories</td>
<td>Memphis, TN</td>
<td><a href="http://www.balabs.com">www.balabs.com</a></td>
</tr>
<tr>
<td>Barrow-Agee Laboratories</td>
<td>Millersburg, OH</td>
<td><a href="http://www.holmeslab.com">www.holmeslab.com</a></td>
</tr>
<tr>
<td>Holmes Laboratory, Inc.</td>
<td>New Ulm, MN 56073-0249</td>
<td><a href="http://www.mvtl.com">www.mvtl.com</a></td>
</tr>
<tr>
<td>Indiana Animal Disease Diagnostic Laboratory (ADDL)</td>
<td>West Lafayette, Ind.</td>
<td><a href="https://www.addl.purdue.edu">https://www.addl.purdue.edu</a></td>
</tr>
<tr>
<td>Titus Grain Inspection, Inc.</td>
<td>West Lafayette, IN</td>
<td><a href="mailto:titusgraininsp@aol.com">titusgraininsp@aol.com</a></td>
</tr>
<tr>
<td>Indiana Crop Improvement Association</td>
<td>Lafayette, IN</td>
<td><a href="http://www.indianacrop.org">www.indianacrop.org</a></td>
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### Strip Readers

- **EnviroLogix**
- **Charm Science**
- **Neogen Corporation**
- **Vicam**
Managing Harvested Grain

- Harvest the diseased fields as soon as possible
  - Test for mycotoxin levels
  - Store separately
- Dry grain without delay
  - 14.5% is safe for storage
- Cool grain
  - Low temperature will slow pathogen growth

Leakage

Poor Storage Conditions
Blue Eye Damage

Moldy Grain Attracts Mold-Feeding Insects
Conditions that Contribute to Spoilage of Grain

- **Moisture** content of the grain
- **Temperature** of the grain
- Amount of broken kernels and foreign material
- How much preharvest disease

Storage Molds

Each fungal species has its own moisture preference

- **Field Fungi**
  - Grow best under **high moisture** conditions
  - Do not grow well or compete well under dry storage conditions
- **Storage Fungi**
  - Adapted to grow under **low moisture** conditions
  - Normally invade kernels after harvest
  - Generate heat and moisture as they grow
### Effect of Moisture and Temperature

<table>
<thead>
<tr>
<th>Moisture</th>
<th>Eurotium spp. Storage Mold</th>
<th>Fusarium graminearum Field Mold</th>
<th>Aspergillus flavus Field/Storage Mold</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td><img src="image1" alt="Image of Eurotium spp." /></td>
<td><img src="image2" alt="Image of Fusarium graminearum" /></td>
<td><img src="image3" alt="Image of Aspergillus flavus" /></td>
</tr>
<tr>
<td>Low</td>
<td><img src="image1" alt="Image of Eurotium spp." /></td>
<td><img src="image2" alt="Image of Fusarium graminearum" /></td>
<td><img src="image3" alt="Image of Aspergillus flavus" /></td>
</tr>
<tr>
<td>Very Low</td>
<td><img src="image1" alt="Image of Eurotium spp." /></td>
<td><img src="image2" alt="Image of Fusarium graminearum" /></td>
<td><img src="image3" alt="Image of Aspergillus flavus" /></td>
</tr>
</tbody>
</table>

**Effect of Moisture and Temperature**

- **14%**
- **18%**
- **20%**
- **24%**
AFTER 7 DAYS @ 80 F

AFTER 21 DAYS @ 80 F
Storage Management Goals

- Dry grain (Corn)
  - Below 14.5 % for fall to spring
  - Below 13.5 % for summer storage
- Cool grain
- Remove fines and foreign material.
  - These restrict air flow and lead to hot spots
- Core bins if necessary
Thank You