

Mycotoxins in Corn

Creative Component Defense

Justin J. Wilkins

April 9th, 2012

Personal Background

- ▶ Live in Mattoon, IL with my wife Tiffany (45 min. south of Champaign, IL)
- ▶ Originally from Bennett, IA where my family currently farms
- ▶ Enjoy farming, raising cattle, and anything that has to deal with sports.



Personal Background

- ▶ Received bachelor's degree from the University of Northern Iowa in Plant Bioscience and minored in Chemistry
- ▶ Work as an Account Manager for Pioneer Hi-Bred Intl, Inc. since 2008
- ▶ Started the M.S. Agronomy Program in the spring of 2008



PIONEER®
BRAND · PRODUCTS



Why a module on mycotoxins?

- ▶ Concern with ear rots in my territory in 2008 and 2009.
- ▶ Confusion amongst sales representatives and customers on the different ear rots and their association with mycotoxins
- ▶ Involved in livestock, wanted to learn more



Mycotoxins in Corn Module

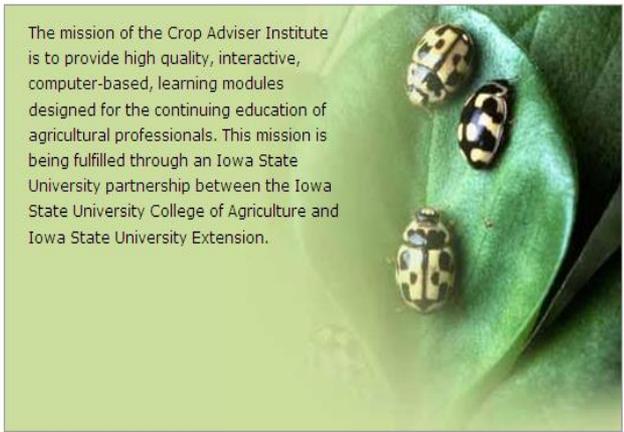


CAI > Home

- Home
- Modules
- My Account
- Resources
- About

Search: Go

- Get CEU courses via streaming media or downloaded .zip files
- Exam access
- Try materials for free!



Welcome

The mission of the Crop Adviser Institute is to provide high quality, interactive, computer-based, learning modules designed for the continuing education of agricultural professionals.

New Modules

Corn Rootworm Biology and Lifecycle

- Created the Module to be utilized as a resource for all agricultural professionals
- General overview of corn ear rots.
- Wanted to provide a clear informative understanding about mycotoxins in corn

Module Introduction

ca Crop Adviser Institute
ModuleMaker Tool Kit

page 2

Introduction

Mycotoxins (from Greek "mukos" fungus and Latin "toxicum" poison) are secondary metabolites or by-products produced by fungi that are capable of causing disease and death in animals. There are more than 250 mycotoxins that have been detected worldwide but few are considered detrimental to animal health. In this learning module we will discuss corn ear molds, the mycotoxins that are associated with them, types of mycotoxins, and their effects on health. We will also look at what control measures can be taken to control the outbreak of mycotoxins.

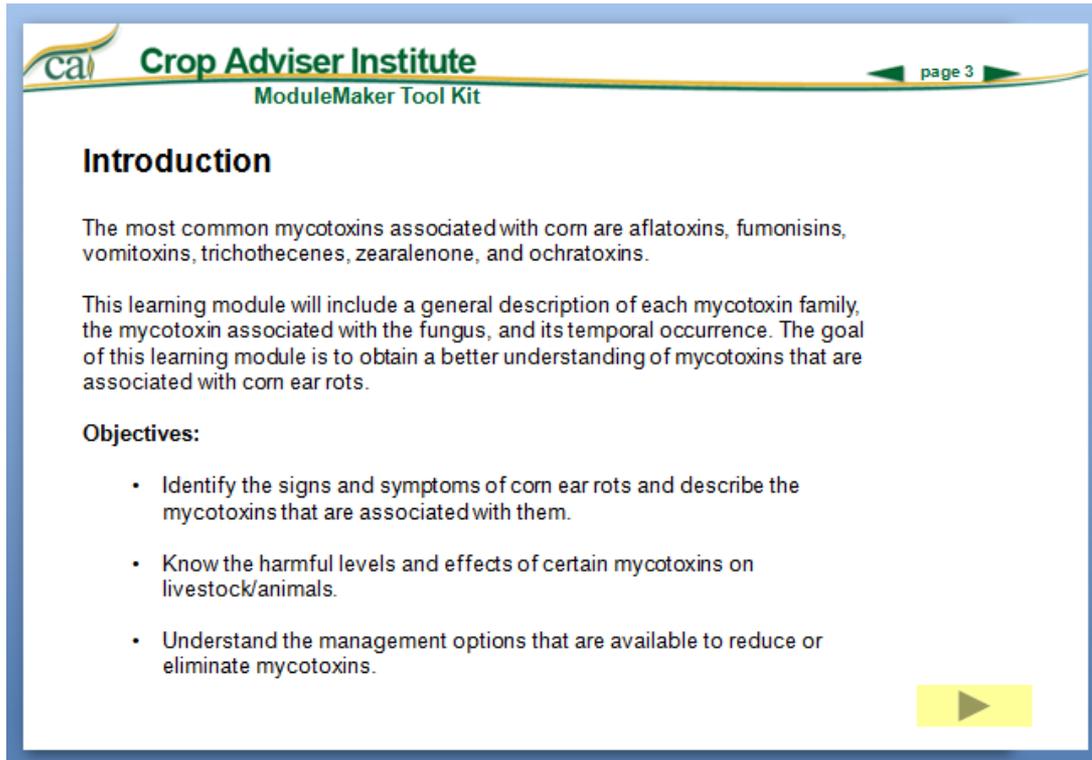


Gibberella Ear Rot caused by *Gibberella zeae*
Source: Pioneer Hi-Bred, Intl

▶

- Definition of mycotoxins
- Corn ear rots and the mycotoxins that are associated with them
- Mycotoxins and their effects on health.
- What control measures can be taken to control outbreak of mycotoxins.

Module Introduction cont...



ca Crop Adviser Institute
ModuleMaker Tool Kit

page 3

Introduction

The most common mycotoxins associated with corn are aflatoxins, fumonisins, vomitoxins, trichothecenes, zearalenone, and ochratoxins.

This learning module will include a general description of each mycotoxin family, the mycotoxin associated with the fungus, and its temporal occurrence. The goal of this learning module is to obtain a better understanding of mycotoxins that are associated with corn ear rots.

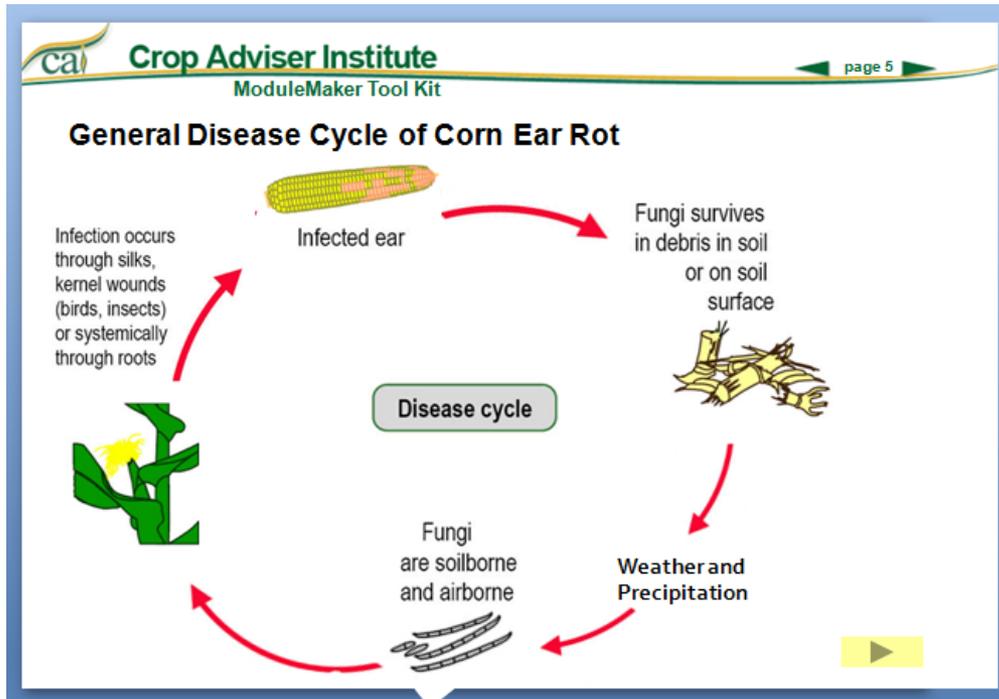
Objectives:

- Identify the signs and symptoms of corn ear rots and describe the mycotoxins that are associated with them.
- Know the harmful levels and effects of certain mycotoxins on livestock/animals.
- Understand the management options that are available to reduce or eliminate mycotoxins.



- Identifying the most common mycotoxins associated with corn
- Identify signs and symptoms of corn ear rots and describe the mycotoxins that are associated with them
- Understand the management options that are available

General Information



➤ Disease Cycle of Corn Ear Rots

➤ Module describes how the general disease cycle works with corn ear rots.

➤ Shows a simple and clear message using images.

General Information cont...

ca Crop Adviser Institute
ModuleMaker Tool Kit

page 6

General Information

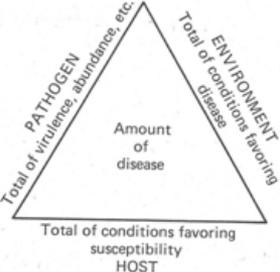
Disease Triangle

While scouting, it is always important to keep the components that make up the disease triangle in mind. Disease such as ear rots that produce mycotoxins, can not be produced if one of these components are missing. Let's review these terms:

"Host" is defined as a plant that is invaded by a parasite and from which the parasite obtains its nutrients.

"Pathogen" is any entity that can incite a disease to occur. All ear rots are caused by fungi.

"Environment" refers to the combination of various conditions that favor the disease such as temperature, moisture, light, etc.



➤ Disease Triangle

➤ Revisits the importance of the “Disease Triangle” and how they correlate

➤ Host

➤ Pathogen

➤ Environment

➤ Scouting is KEY

General Information

ca Crop Adviser Institute
ModuleMaker Tool Kit

page 7

General Information

Favorable Environmental Conditions for Corn Ear Rots

The type of corn ear rot that develops is highly dependent upon the environmental conditions that occur during pollination and early grain development (Table 1.1).

Corn Ear Rots	Favorable Environmental Conditions
Aspergillus	Hot and dry, drought conditions
Diplodia	Cool and wet for up to 3 weeks after silking
Fusarium	Hot and dry at and after flowering
Gibberella	Cool and wet or humid

Table 1.1 – Favorable Environmental Conditions for Corn Ear Rots



➤ Favorable Environmental Conditions for Corn Ear Rots

- Corn ear rots are highly dependent on environmental conditions
- Occur during pollination and early grain development
- Example:
 - Aspergillus occurs in hot and dry, drought conditions

Ear Rots and Their Mycotoxins

▶ Mycotoxins

Zearalenone

Deoxynivalenol (DON)

Fumonisions

Aflatoxins

Ochratoxins

Diplodia Ear Rot

Ear Rot

Gibberella Ear Rot

Gibberella Ear Rot

Fusarium Ear Rot

Aspergillus Ear Rot

Pencillium Ear Rot

Ex: Fusarium Ear Rot

ca Crop Adviser Institute
ModuleMaker Tool Kit

page 14

Ear Molds and Their Mycotoxins

Fusarium ear rot disease cycle and symptoms

Fusarium ear rot is the most common ear disease in the Midwest. It is predominantly caused by the fungus *Fusarium verticillioides*. However, there are numerous *Fusarium* species that cause this ear rot and many produce harmful mycotoxins known as fumonisins.

The fungus usually overwinters in corn residue. Symptoms of this ear disease are white mold and the kernels that are infected are tan or brown. The infected areas are scattered around the ear. The infected kernels may show white streaks, otherwise known as “starburst”. Insect feeding that damages the kernel enhances the susceptibility of the kernel to infection.



Fusarium Ear Rot (photo © Gary Munkvold)

▶

➤ Fungus

➤ *Fusarium verticillioides*

➤ Symptoms

➤ White mold and kernels are infected are tan or brown.

➤ Scattered infection

➤ White streaks or “starburst” kernels.

➤ Mycotoxin

➤ Fumonisins

Favorable Conditions

➤ Favorable Conditions for Fusarium Ear Rot

- Hot, dry at flowering and after
- Temperatures greater than 26°C favor infection
- Damage to kernels
 - Insect, hail, birds, etc.

ca Crop Adviser Institute
ModuleMaker Tool Kit

page 15

Ear Molds and Their Mycotoxins

Favorable conditions for Fusarium ear rot

Environmental conditions that favor the Fusarium ear rot infection are hot dry weather. Infection usually takes place two to three weeks after silking has occurred. Temperatures that are predominantly greater than 26°C favor infection. Drought stress before and after silking increase the likelihood of the infection occurring. Damage to kernels by insect, hail, or birds can lead to fusarium ear rot infection. However, insect feeding is the most important vector for *F. verticilloides*.



Scattered or groups of kernels are typically a sign of Fusarium ear rot.
(Photo Courtesy of Pioneer Hi-Bred, Intl, Inc.)

▶

Fumonisin

ca Crop Adviser Institute
ModuleMaker Tool Kit

page 16

Ear Molds and Their Mycotoxins

Fumonisin

The most common producer of fumonisins is the *Fusarium* species *Fusarium verticillioides*. Fumonisin have been associated with a variety of adverse health effects in livestock and the FDA has provided advisory levels to provide guidelines (Table 3.1).

- Fumonisin are known to cause a fatal disease in horses known as [leukoencephalomalacia](#).
- Swine can develop pulmonary edema (fluid in the lungs) or liver damage.
- Cattle and sheep are resistant to fumonisins with mild liver damage to moderate feed refusal.
- Poultry are more resistant to fumonisins than any other livestock.

Fumonisin	FDA Advisory Level
Humans – Dry Milled Corn Products with fat content	2 ppm <2.25% dry wt. basis 4 ppm >2.25% dry wt. basis
Horses	5 ppm, not to exceed 20% of diet
Cattle	60 ppm, not to exceed 50% of diet
Swine	20 ppm not to exceed 50% of diet
Poultry	100 ppm, not to exceed 50% of diet

Table 3.1 – FDA Fumonisin Level Guidelines

- **FDA Advisory Levels**
 - Ppm different depending on final destination
- **Health Effects**
 - Liver damage
 - Pulmonary edema
 - Weight Loss

Review Section

Crop Adviser Institute
ModuleMaker Tool Kit

Lets Review!

Deoxynivalenol (DON) or Vomitoxins
Associated with the fungus *Gibberella zeae graminearum* which causes Gibberella ear rot. It is the most common encountered mycotoxin in feed and food that can be harmful to both humans and animals. General rule not to feed grain with >5% moldy kernels. Swine particularly sensitive to DON

Zearalenone
Commonly associated with Gibberella Ear Rot and has negative estrogenic activity on certain animals. Swine should not exceed feed rations that exceed 0.5 ppm and dairy 12.5 ppm. Cool, wet weather with high humidity can increase colonization of the ear by the fungal pathogens

Fumonisin
Fumonisin are a mycotoxin that are produced by the fungus *Fusarium verticillioides* that causes Fusarium ear rot. Warm, dry weather with insect feeding favor development of this ear rot. Horses are the most susceptible to harmful effects such as [leucoencephalomalacia](#).

➤ Review Section on the different mycotoxins

- DON or Vomitoxins
- Zearalenone
- Fumonisin
- Aflatoxins
- Ochratoxins

Management of Mold Infection

ca Crop Adviser Institute
ModuleMaker Tool Kit page 29

Management of Mold Infection cont...

- Control insect damage.
- Ensure all storage facilities are clean before filling. Old corn, if contaminated can infect new corn crop.
- Mold inhibitors such as propionic acid can slow mold growth, but will not destroy mycotoxins if already present. If treated with propionic acid, corn can only be fed to animals.
- Ensure all fines from the corn are removed. Broken kernels are 3-4 times more likely to mold growth.



Grain handling facility
(Photo: Courtesy of Justin Wilkins)

▶

➤ Options available

- Harvest quick as possible
- Dry to 13% moisture
- Control insect damage
- Clean storage facilities

➤ Scouting is critical

- Early detection

What to do if mycotoxins are present?

 **Crop Adviser Institute**
ModuleMaker Tool Kit

◀ page 32 ▶

What do I do with corn that has mycotoxins present?

Once a grower has discovered that they have corn that is contaminated with mycotoxin it can be extremely frustrating. Here are some suggestions for the use of infected corn:

- Sell contaminated corn to ethanol production plants
- Analyze the mycotoxin that is present in the sample, and dilute it with clean non-contaminated corn. Blending is intended for **ONLY** for on-farm use. It is important to know what mycotoxin is present if you plan on feeding it. These tests are able to be done at the location of where the corn is being stored.
- Clean the corn to remove any fines that may be in the infected sample. This should remove fines and breaks where mycotoxins tend to be the highest.
- Depending on particular mycotoxin present and levels, grain may be fed to animals that are more immune to the particular mycotoxin.



➤ **Provide helpful suggestions**

➤ **Contaminated Corn**

- Sell to ethanol production plants
- Blending, **ONLY** for on-farm use
- Clean the corn to remove fines
- Animal feed, dependent on which mycotoxin is present

Summary

ca Crop Adviser Institute
ModuleMaker Tool Kit

page 33

Summary

Corn ear rots can be a problem in corn fields every year. The type of ear rot that may develop will depend on the environmental conditions and the amount of pathogen present in the field.

It is important to scout fields throughout the grain fill period and know how to correctly identify the particular ear mold that may be present. By learning the favorable conditions and symptoms of each corn ear rot, you should have a better understanding of which mycotoxins are associated with each corn ear rot.

This learning module, should of given you a good idea of the potential harmful effects certain mycotoxins have on animals and humans. You should also be able to know what control measures and management decisions should be made if mycotoxins are present.

➤ **Corn Ear Rots can be a problem every year**

- Scouting is important
- Depend on environmental conditions and pathogen present

➤ **Certain mycotoxins can potentially have harmful effects on health**

➤ **Control Measures**

➤ **Management of Mold Infection**

Acknowledgements

- ▶ Dr. Alison Robertson
 - ▶ My Family and Friends
 - ▶ ISU Faculty
 - ▶ Pioneer Leadership
- 