

Mycotoxins in Grain

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Agricultural Research Service

US Department of Agriculture



**Agricultural
Research
Service**



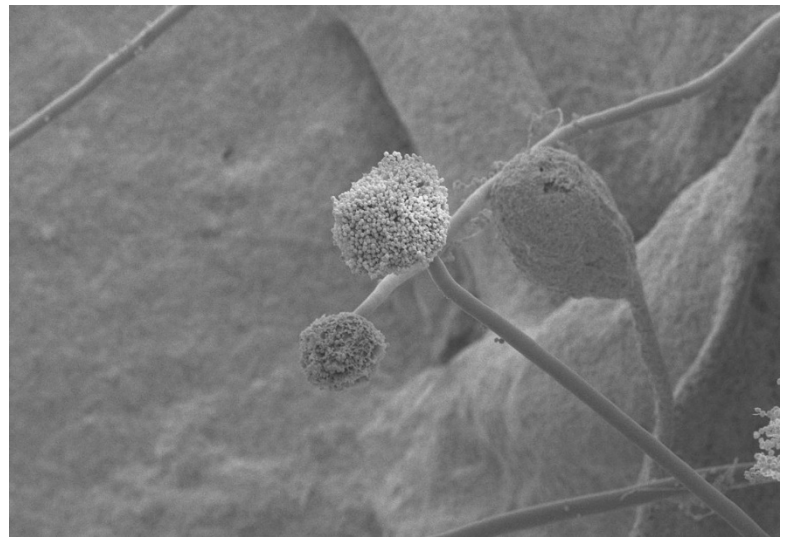
Outline

- What are mycotoxins?
- Why are mycotoxins a concern?
- How do mycotoxins impact the grain processing industry?
- Some of the research being done on mycotoxins.

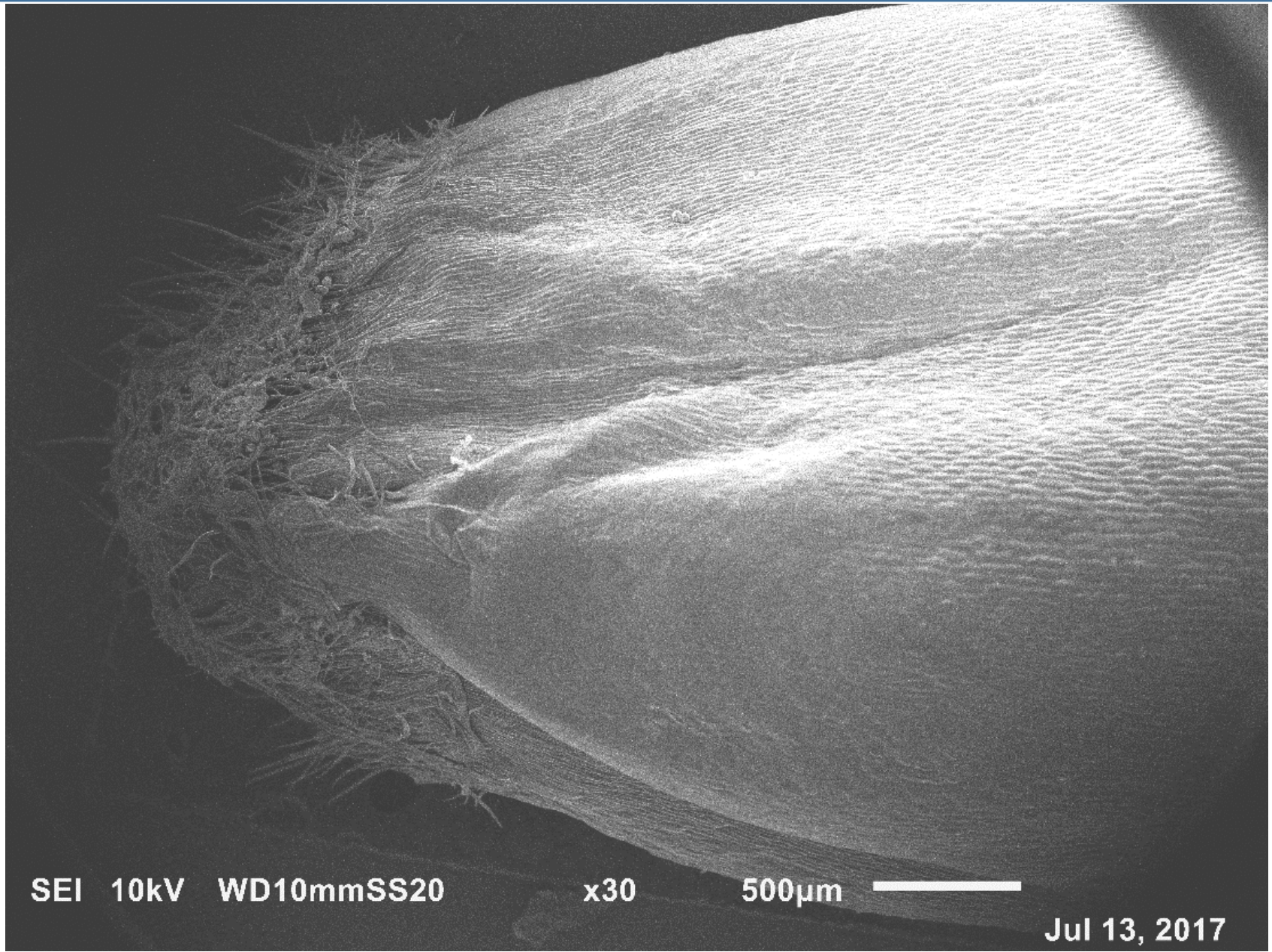


What are mycotoxins?

- ‘*myco*’ comes from the Greek ‘*mykes*’, meaning *mushroom* or *fungus*.



What are mycotoxins?

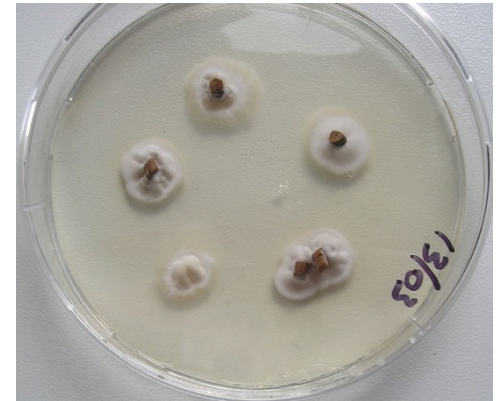
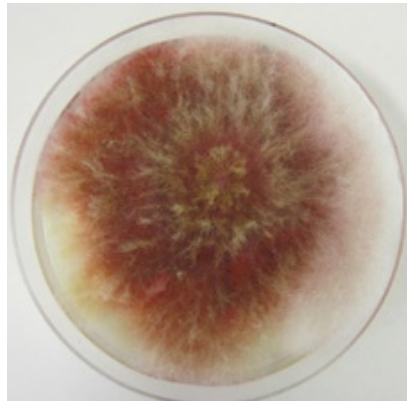
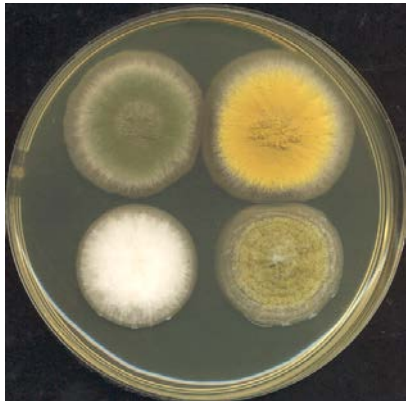
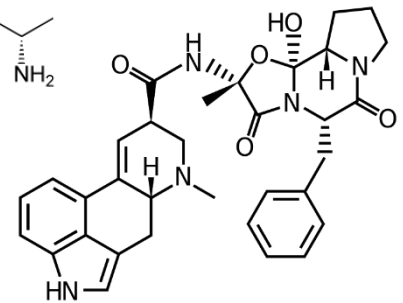
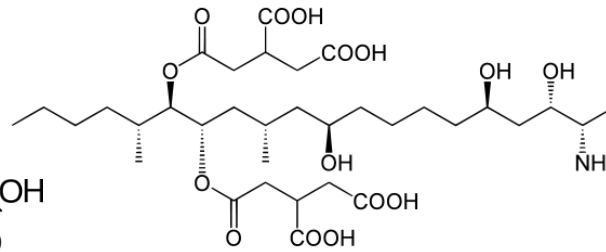
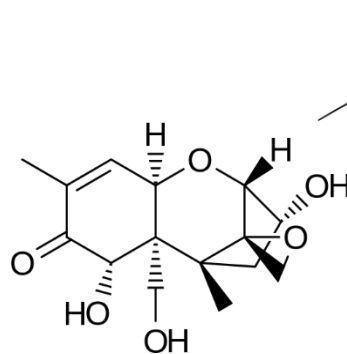
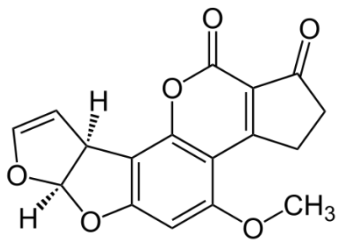


What are mycotoxins?



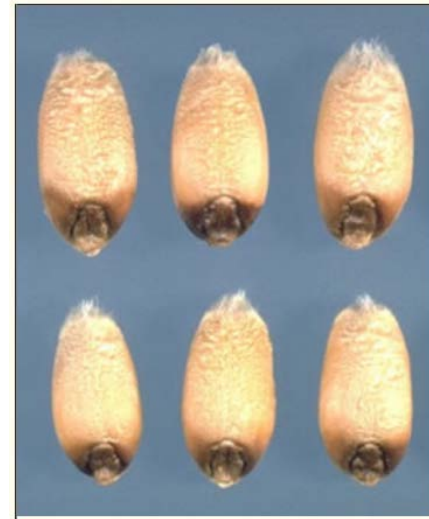
What are mycotoxins?

- Mycotoxins are chemicals produced by fungi, which are toxic to people, animals, and/or plants.
- A variety of chemical, produced by a variety of different fungi, are all referred to as 'mycotoxins'.



What are mycotoxins?

- Not all fungi that grow on grain produce mycotoxins.

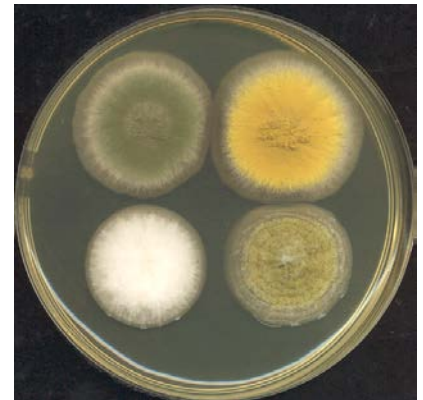
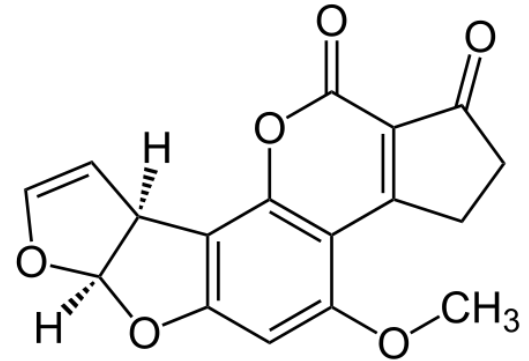


Why are mycotoxins a concern?

- Toxic effects on people and animals.
- Only very small quantities are needed (parts-per-million or parts-per-billion).
- Typically not degraded during food processing.
- ***Heavily contaminated grain should not enter the food or feed supply!***

Why are mycotoxins a concern?

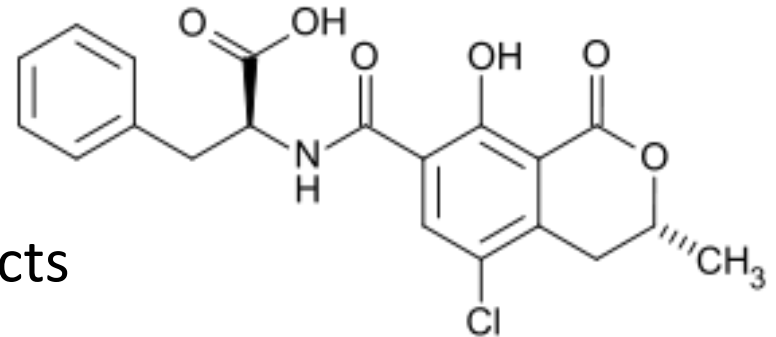
- Aflatoxin
 - A potent liver carcinogen
 - In livestock, lowers breeding efficiency, birth weights, growth rates, egg production
 - Toxin passes into milk



Why are mycotoxins a concern?

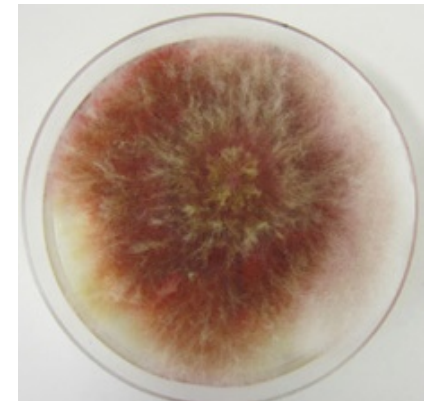
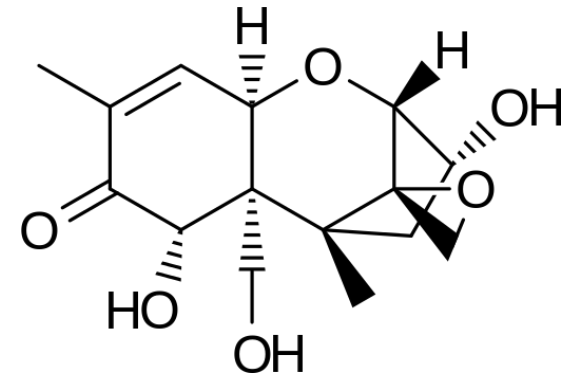
- Ochratoxin

- Damaging to kidneys
- Fat-soluble and not readily excreted
- Among livestock, primarily affects poultry and swine



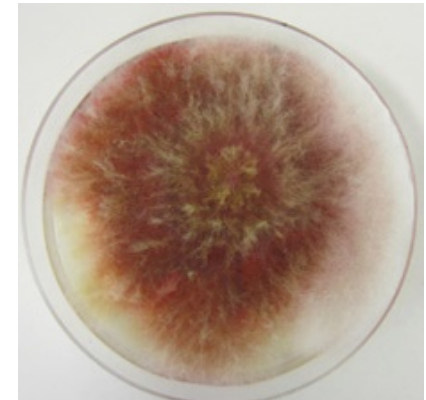
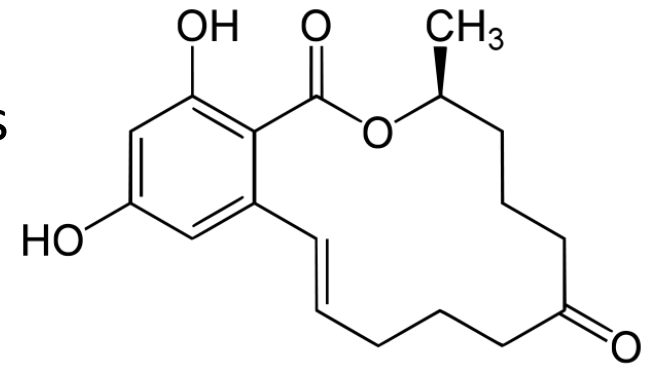
Why are mycotoxins a concern?

- Vomitoxin
 - Also known as deoxynivalenol (DON)
 - Causes loss of appetite, feed refusal and vomiting



Why are mycotoxins a concern?

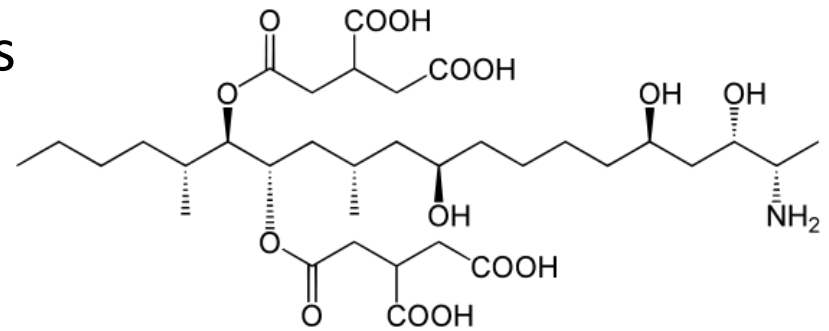
- Zearalenone
 - Mimics the hormone estrogen
 - Causes a variety of health problems related to the reproductive system
 - Swine are particularly sensitive



Why are mycotoxins a concern?

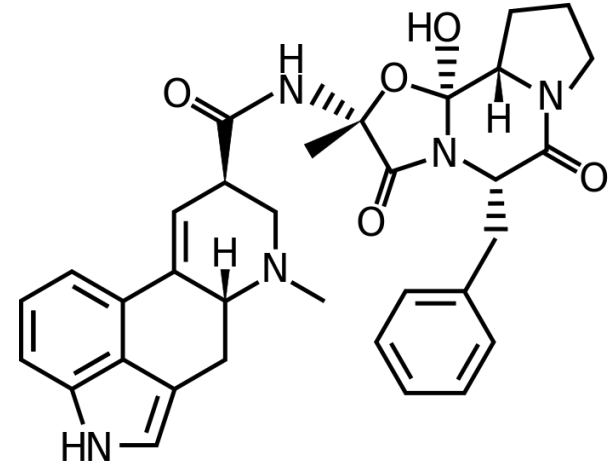
- Fumonisin

- Interferes with biosynthesis of sphingolipids (an important component of the brain and nerves)
- Particularly toxic to horses, causing 'blind staggers' disease



Why are mycotoxins a concern?

- Ergotamine / ergot alkaloids
 - Causes blood vessel constriction, leading to swollen limbs, gangrene, internal bleeding
 - Can lead to abortion
 - Fungal structures mixed with grain, rather than in the grain itself



Why are mycotoxins a concern?

Effects of Mycotoxins

DON – Deoxynivalenol

ZEN – Zearalenone

AFB₁ – Aflatoxin B₁

FUM – Fumonisin

T-2 – T-2 Toxin

HT-2 – HT-2 Toxin

NIV – Nivalenol

DAS – Diacetoxyscirpenol

OTA – Ochratoxin A

Ergots – Ergot Alkaloids

ZEN, DON, T-2, DAS, Ergots

- Decreased hatchability
- Decreased egg production
- Ovarian cysts
- Embryonic loss
- Delayed sexual maturation

OTA

- Kidney damage
- Increased water consumption

AFB₁, FUM, T-2, DON, DAS, NIV, OTA

- Fatty liver
- Immunosuppression
- Inhomogeneous flocks
- Impaired feathering
- Organ damage
- Impaired performance
- Impaired intestinal health

T-2, HT-2, NIV, DAS, DON, AFB₁, Ergots

- Oral and dermal lesions
- Inflammation of mucousmembrane of oral cavity
- Respiratory difficulties

EGG:



AFB₁, OTA, T-2, DON, ZEN

- Residues
- Poor egg shell quality
- Blood and meat spots
- Creamy yolk

T-2, DON

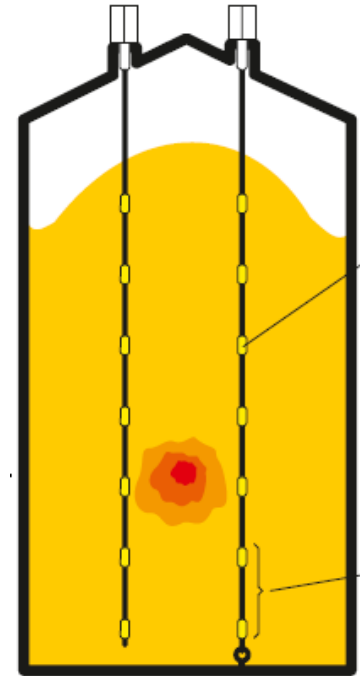
- Gizzard lesions
- Feed refusal
- Decreased feed intake
- Diarrhea
- Vasoconstriction (necrosis)

For further information about mycotoxins please visit

www.mycotoxins.info

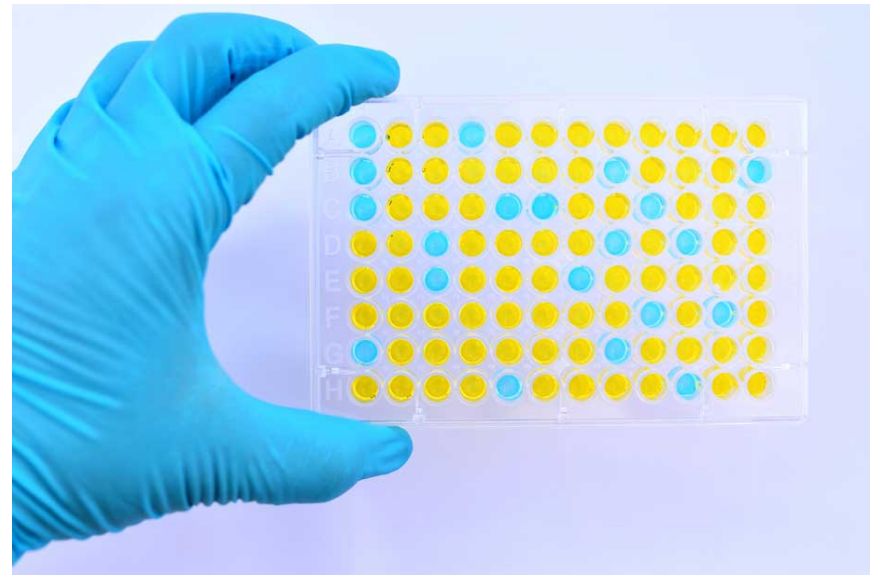
How do mycotoxins impact the grain processing industry?

- Poor storage can exacerbate a mycotoxin problem
- However, accumulation often happens mainly in the field, before harvest



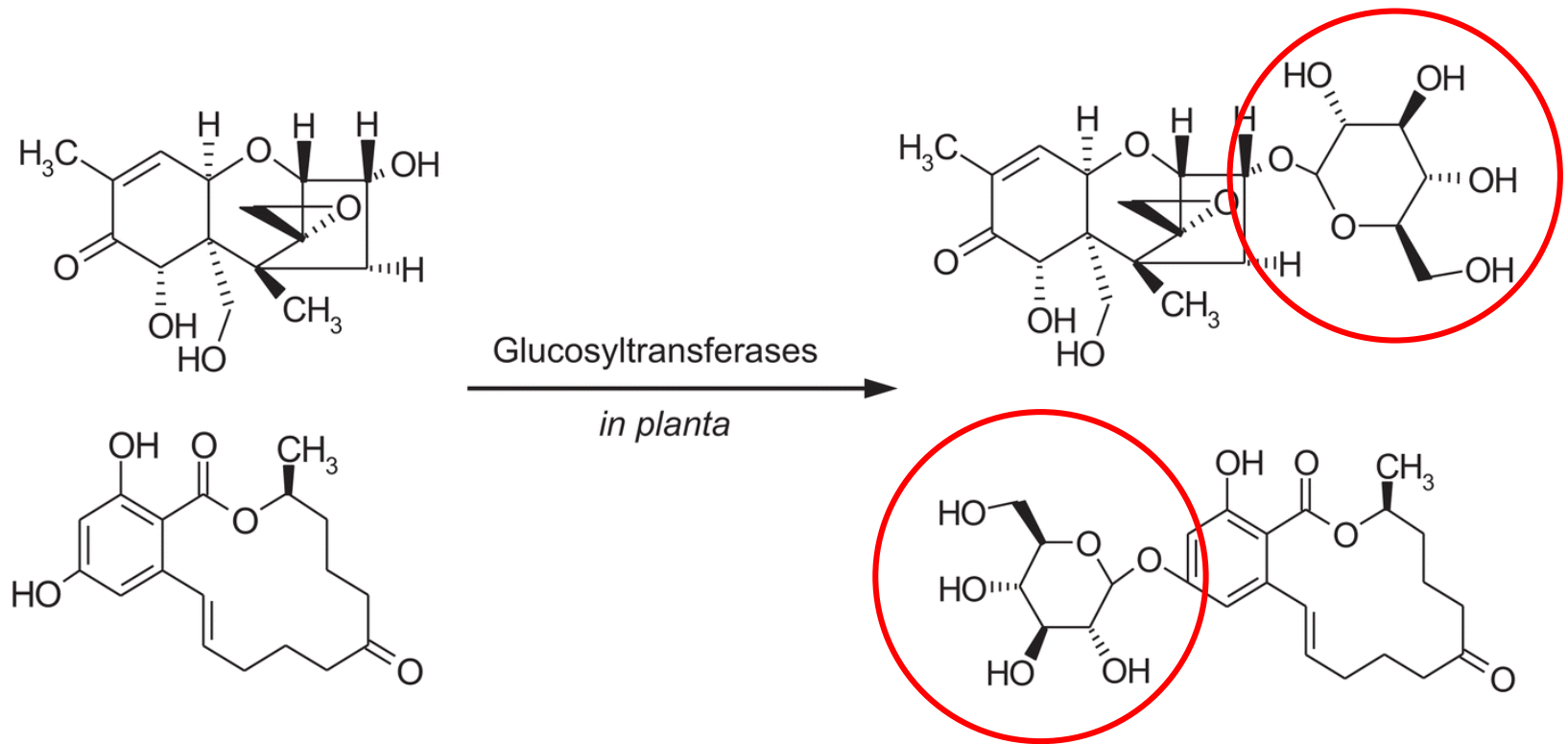
How do mycotoxins impact the grain processing industry?

- Mycotoxin content is a component of grain quality
 - Assessed by testing
 - Sampling methods
 - Measurement methods



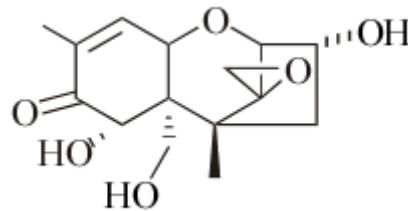
How do mycotoxins impact the grain processing industry?

- Several mycotoxins exist in a range of chemical variants
 - Implications for testing

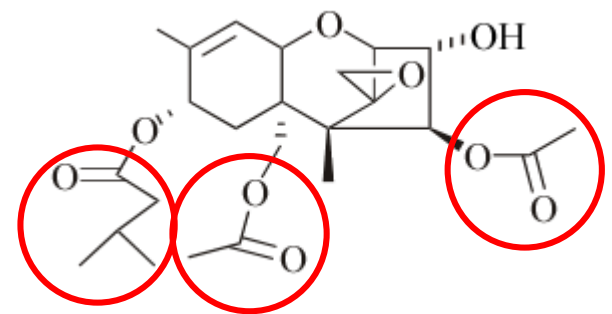
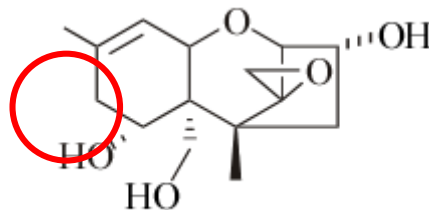
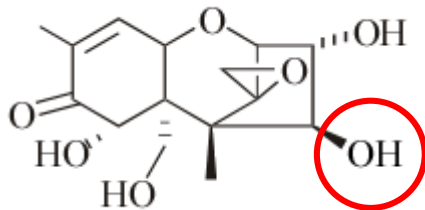


How do mycotoxins impact the grain processing industry?

- Several mycotoxins exist in a range of chemical variants
 - Profile of mycotoxins present in a region can change over time (e.g., with introduction of foreign fungi)



vomitoxin



How do mycotoxins impact the grain processing industry?

- Mycotoxin content is a component of grain quality
 - Which downstream customers and processes are concerned with this aspect of grain quality?
 - Different customers may have more or less stringent requirements for tolerable mycotoxin concentrations



How do mycotoxins impact the grain processing industry?

- Food and Drug Administration ***advisory*** levels for ***vomitoxin***:
 - 1 ppm:
immature animals, dairy animals, or destination unknown
 - 5 ppm:
breeding cattle/swine, or mature poultry
 - 10 ppm:
finishing swine > 100 pounds



How do mycotoxins impact the grain processing industry?

- Food and Drug Administration ***action*** levels for ***aflatoxin***:
 - 20 ppb:
immature animals, dairy animals, or destination unknown
 - 100 ppb:
breeding cattle/swine, or mature poultry
 - 200 ppb:
finishing swine > 100 pounds
 - 300 ppb:
finishing beef cattle



How do mycotoxins impact the grain processing industry?

- Weather conditions can strongly influence mycotoxin levels across an entire region... but different conditions are required for different toxins
 - Vomitoxin is a larger problem when conditions are humid and wet during flowering & grain fill
 - Aflatoxin and fumonisins will be a larger problem when conditions are hot and dry during grain fill



How do mycotoxins impact the grain processing industry?

- Early alert to potential mycotoxin issues
 - Communication with other grain handlers in the region
 - Routine monitoring of incoming loads



How do mycotoxins impact the grain processing industry?

- Cleaning grain may be possible & effective in some cases



Infected

Healthy



How do mycotoxins impact the grain processing industry?

- Blending is sometimes used to reduce mycotoxin concentrations below tolerable maximums
 - Blending is generally not permitted for aflatoxin



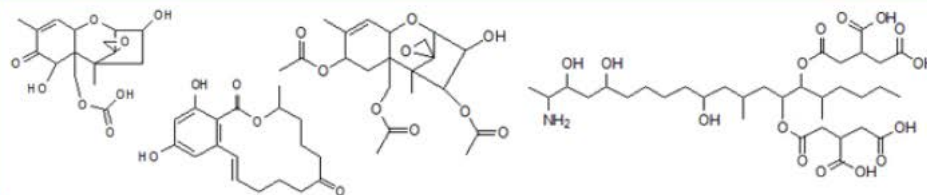
What research is being done on mycotoxins?

Mycotoxin Prevention and Applied Microbiology Research: Peoria, IL

[Research](#) ▾ [People](#) ▾ [MPM Home](#)

Mycotoxins are toxins produced by molds (fungi) and can accumulate in crops, where they pose health hazards to humans and animals. Mycotoxins are estimated to affect 25% of the world's crops and cost US agriculture approximately \$1 billion each year.

[more about mycotoxins](#)



Mycotoxin Prevention and Applied Microbiology (MPM) Research

- [Mission Statement](#)
- [Strategic Goals](#)
- [Major Accomplishments](#)

MPM NEWS

Dr. Martha Vaughan Speaks about Women in Science

[ARS Culture Collection: A Valuable Resource](#)

[Dr. Martha Vaughan is a 2017 USDA, ARS Scientist of the Year](#)

[Dr. Cletus Kurtzman is inducted into the ARS Science Hall of Fame](#)

[NCAUR celebrates it's 75th Anniversary](#)

The Mycotoxin Prevention and Applied Microbiology Research is located in Peoria, IL and is part of the [Midwest Area](#).
The Research Leader is Todd Ward.

Email: Todd.Ward@ars.usda.gov

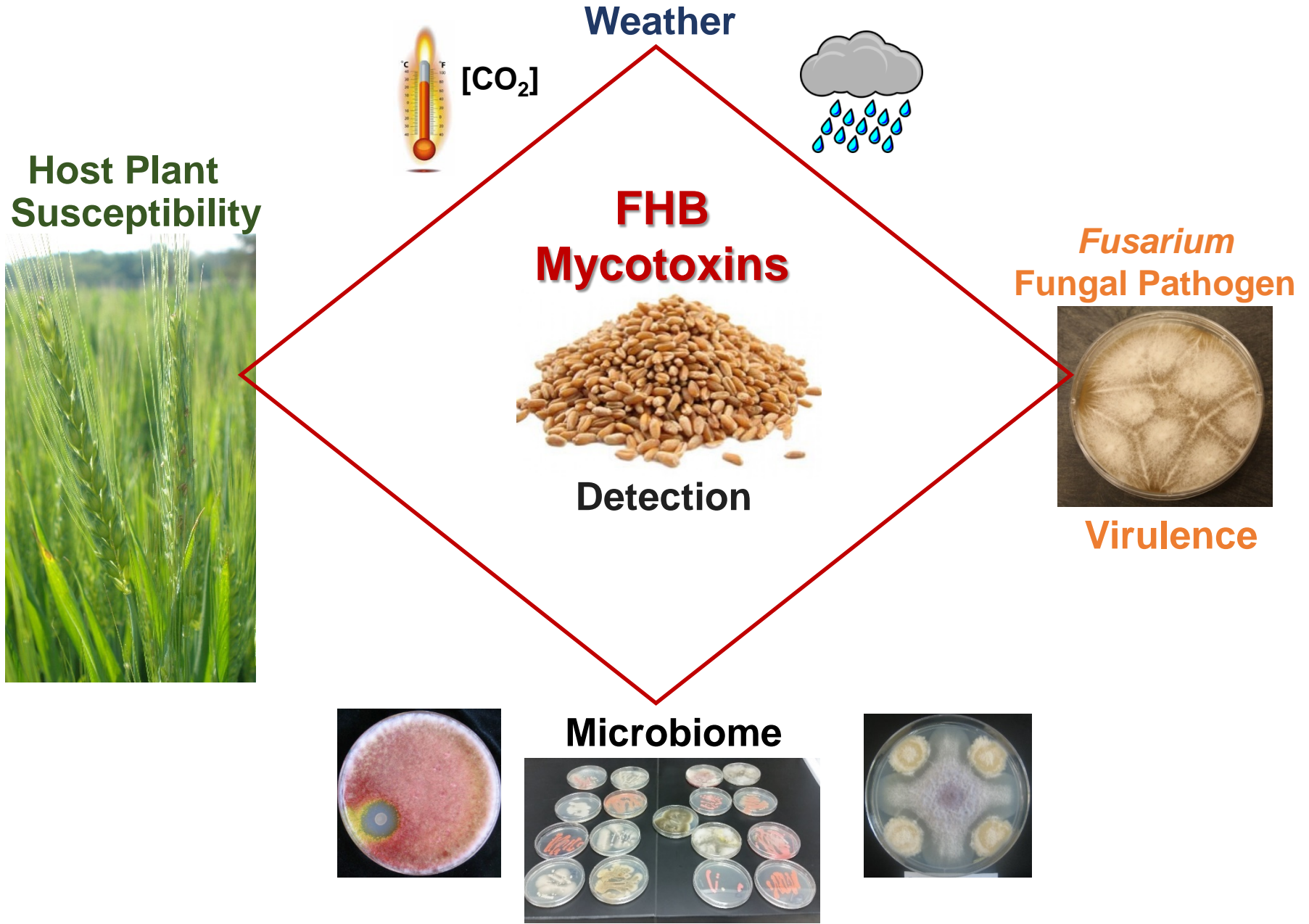
What research is being done on mycotoxins?

- Current research in the Mycotoxin Prevention & Applied Microbiology research unit:
 - Faster/cheaper/better methods for detecting mycotoxins
 - How and why do different species and strains of fungi vary in their capacity to produce mycotoxins?
 - How do environmental factors impact mycotoxin accumulation?
 - Can other microorganisms be used to reduce mycotoxin contamination?

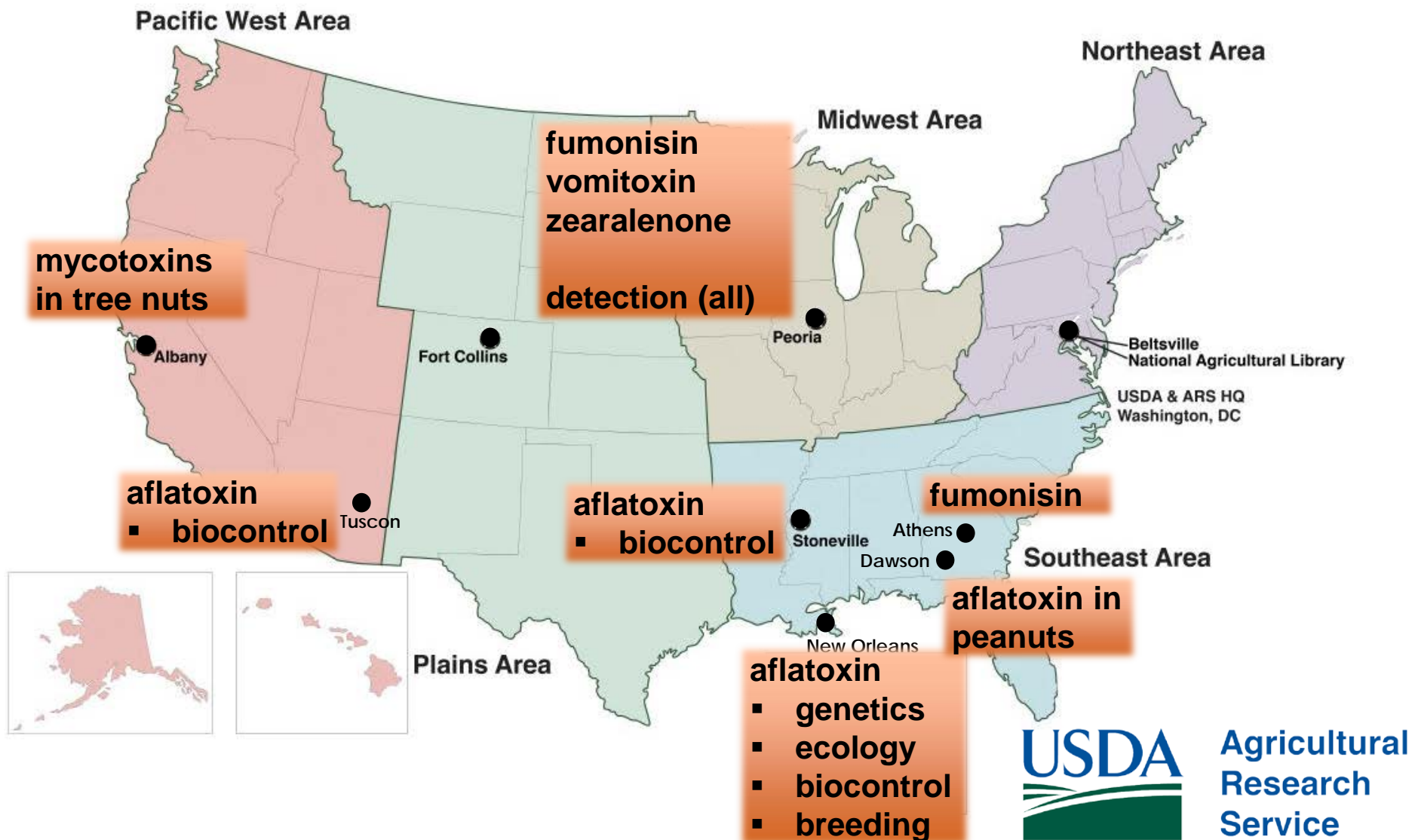
What research is being done on mycotoxins?

- Because many mycotoxin issues arise in-field, the grain processing industry benefits from research targeting the production setting

Mycotoxin Prevention and Applied Microbiology Unit



USDA Agricultural Research Service locations performing research related to mycotoxins



For more information:

- Federal Grain Inspection Service
 - Performance verified testing kits
 - (Government reorganization recently moved them into the Agricultural Marketing Service)



Grain Inspection,
Packers and Stockyards
Administration

Federal Grain
Inspection
Service

Washington, D.C.

September 2006

A large, light blue, semi-transparent microscopic image of grain fungal structures, possibly hyphae or spores, serves as a background for the title text.

**Grain
Fungal Diseases
and
Mycotoxin
Reference**

Questions?

We'd love to hear from you Re: research directions that would be the most impactful for your industry!

Matthew Bakker, Ph.D.

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