Mycotoxin FAQs

1. What are mycotoxins?

Mycotoxins are natural chemicals produced by certain fungi, some of which cause ear rots in corn.

Mycotoxins are nonliving compounds that are byproducts that the fungi produce. Mycotoxins can have detrimental health effects to both humans and animals if they eat contaminated food or feed.

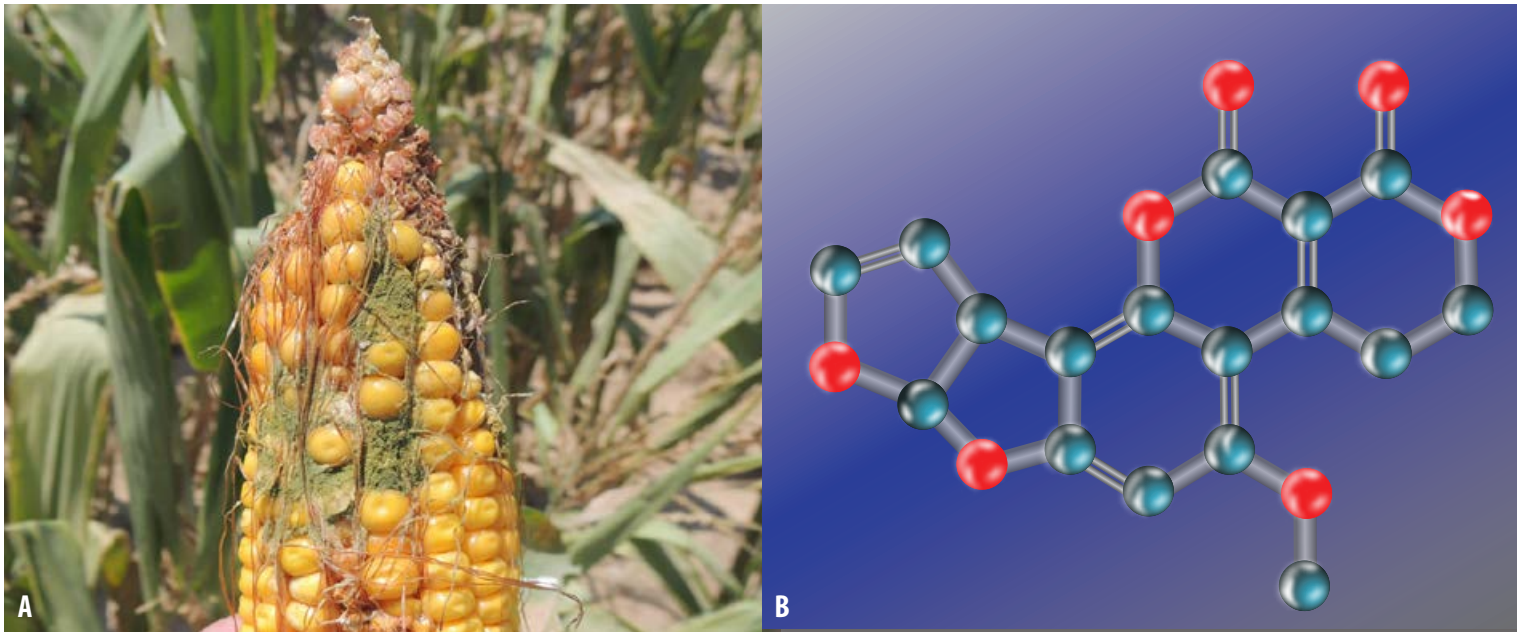

Figure 1. (A) Corn contaminated with *Aspergillus flavus*, the fungus responsible for Aspergillus ear rot. (B) The chemical structure of the mycotoxin aflatoxin.

2. What mycotoxins occur in corn?

There are five major mycotoxins associated with ear rot diseases of corn.

Aflatoxins are found in corn with Aspergillus ear rot (Figure 1).

Deoxynivalenol (DON, sometimes called vomitoxin) and **zearalenone** are found in corn with Gibberella ear rot (Figure 2).

Figure 2. Corn infected with the fungus that causes Gibberella ear rot.

Fumonisins are found in corn with Fusarium ear rot (Figure 3).

Ochratoxin is found in corn infected with *Penicillium verrucosum*, but some *Aspergillus* species also produce this mycotoxin.

3. What are the effects of mycotoxins?

The toxic effects of mycotoxins vary by type, dose, and animal species consuming the toxin.

Aflatoxin can affect the liver (hepatotoxicity), lead to cancer, and suppress the immune system.

Fumonisins can affect the liver (hepatotoxicity), lead to cancer, cause pulmonary edema (fluid in the lungs), and cause leukoencephalomalacia (irreversible, fatal brain damage) in horses and rabbits.

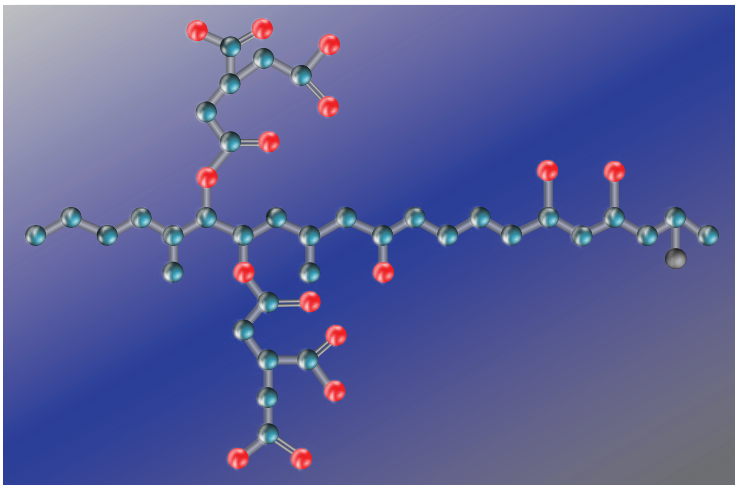

Figure 3. The chemical structure of a fumonisin molecule.

DON affects the gastrointestinal tract (which often makes animals vomit and refuse to feed) and can inflame the central nervous system.

Zearalenone can cause hyperestrogenism (estrogen overload), a condition that is particularly dangerous for female breeding animals.

Ochratoxin can cause cancer and is toxic to the kidneys.

4. What levels of mycotoxins are safe in food and feed?

The United States Food and Drug Administration (FDA) and Health Canada have issued **action levels** (legally allowed amounts) for aflatoxin and **advisory levels** (cautionary levels) for fumonisins and DON. The concentrations vary by mycotoxin and the intended use of the final corn products.

If grain or end products contain mycotoxin concentrations that exceed an action level, then the law may require the grain or products to be destroyed. Acceptable mycotoxin concentrations are most often set at the point of sale and in contract specifications. Corn for export must meet the limits set by each country, which are often more stringent that the United States.

Specific information about action and advisory levels are available from CornMycotoxins.com and the Canadian Food Inspection Agency, www.inspection.gc.ca/animals/feeds/regulatory-guidance/rg-8/eng/1347383943203/1347384015909?chap=1.

5. When should I test for mycotoxins?

If you have a field that has any ear rot problem, test the grain for mycotoxins. Testing for aflatoxin is recommended for corn that is severely drought stressed (Figure 4).

Figure 4. This corn is drought stressed, which can make it more prone to infection by the fungus that causes Aspergillus ear rot.

More information about grain sampling and mycotoxin testing is available in *Corn Disease Management: Grain Sampling and Mycotoxin Testing* (CPN-2003), available from the Crop Protection Network, CropProtectionNetwork.org.

6. How do I scout for potential problems?

Scout Fields Before Harvest

Scout fields for ear rot diseases at kernel maturity (black layer) and just before harvest.

Pay close attention to areas where the crop may have been stressed, damaged, or exposed to extreme environmental conditions. These areas include hillsides where drought stress may be more severe (for Fusarium and Aspergillus ear rots) and low areas where moisture from fog or high-dew conditions prevail (for Gibberella ear rot).

When you scout, randomly select plants and pull back the husks to examine the ears (Figure 5). A quick method is to select 100 plants across the field (20 ears each from five different areas). If you find a diseased ear, examine another 10 ears from adjacent plants.

Figure 5. Pull back the husk on corn ears to look for signs and symptoms of corn ear rots.

During your examination, ask three questions:

1. What ear rot disease is present?
2. How much of the ear is affected by ear rot (what is the severity of the disease)?
3. What proportion of the crop is affected?

Once you answer these questions, determine your next steps (see below).

More information about identifying ears rots is available in *Corn Disease Management: Ear Rots* (CPN-2001), available from the Crop Protection Network, CropProtectionNetwork.org.

Know When to Test for Mycotoxins

The risk of mycotoxins in harvested grain increases with the number of infected kernels on an ear. You should assume that diseased kernels contain mycotoxins.

However, mycotoxin levels may vary among diseased ears. Additionally, corn that appears to have a mild ear rot may still have very high mycotoxin levels. This makes the decision to test for mycotoxins difficult.

The threshold for aflatoxin should be very low. If you find any ears with Aspergillus ear rot, test the harvested grain for aflatoxin.

For DON and fumonisins, the threshold is flexible. If 30 percent of the ears you examine in a field have Gibberella or Fusarium ear rots, test for DON and fumonisins. You should also test your corn if you observe severe symptoms (more than 50 percent of the ear covered with mold) of either disease on multiple ears.

7. What are the mycotoxin testing options?

Mycotoxins are complex chemical compounds, which makes them difficult to quantify. However, several technologies can assess mycotoxin concentrations in corn grain.

For this reason, you should never rely solely on visual methods to confirm the presence of mycotoxins. A common visual test — the black light test — can indicate the presence of the fungus *Aspergillus flavus*, but it does not detect the aflatoxin it produces (Figure 6).

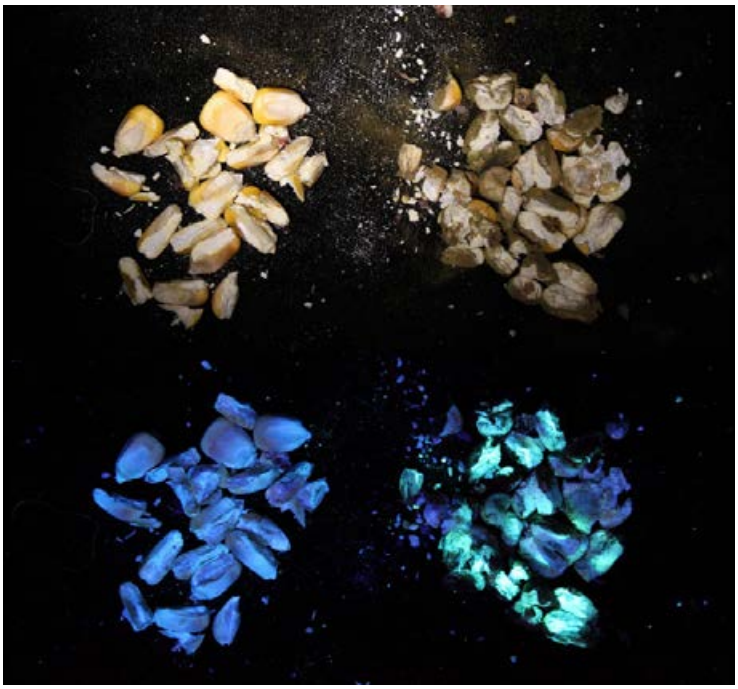

Figure 6. When crushed corn grain (top) is exposed to a black light, it can fluoresce (glow) if kojic acid is present (bottom right). *A. flavus* often produces kojic acid, but a black light test is not a reliable method for detecting aflatoxin.

For an accurate assessment, send grain samples to a professional laboratory for analysis (Figure 7). Local laboratories and grain inspection services may test individual corn samples for mycotoxins; however, sample testing can be expensive. Check with your local extension personnel for a more complete list of grain testing facilities in your area. The cost and submission procedures will vary by provider.

See *Corn Disease Management: Grain Sampling and Mycotoxin Testing* (CPN-2003) for more information.

Figure 7. Sample corn to send out for laboratory testing.

8. Will drying, heating, freezing, or applying chemicals reduce mycotoxins in grain?

No. Mycotoxins are extremely stable and heating, freezing, roasting, or treating with chemicals cannot reliably reduce mycotoxin levels within kernels. In some cases, you can reduce the overall mycotoxin concentration in the grain by removing broken grain (fines), foreign materials, and lightweight moldy kernels.

You can greatly reduce the further accumulation of mycotoxins in harvested grain by properly drying corn to less than 15 percent moisture. Dry grain to 13 percent for long-term storage.

When grain moisture levels are greater than 16 percent, the risk of aflatoxin and ochratoxin accumulation increases. Moisture greater than 18 percent elevates the risk of DON, zearalenone, and fumonisins. Warm conditions will accelerate the rates of spoilage and mycotoxin accumulation. There is no evidence that mycotoxin levels will increase in grain stored at an appropriately low moisture (Figure 8).

Figure 8. Healthy corn in a grain wagon.

It's important to point out that while high-temperature drying will stop mold growth and mycotoxin production, it will not reduce the level of mycotoxins already present. Quick drying is preferred over low-heat drying. Be wary of low-temperature, in-bin dryers for moldy corn, and be sure to meet proper ventilation requirements for dry corn storage.

More information about proper grain storage is available in *Corn Disease Management: Storing Mycotoxin-affected Grain* (CPN-2004), available from the Crop Protection Network, CropProtectionNetwork.org.

Find Out More

The Crop Protection Network (CPN) is a multi-state and international collaboration of university and provincial extension specialists, and public and private professionals who provide unbiased, research-based information to farmers and agricultural personnel. Our goal is to communicate relevant information that will help professionals identify and manage field crop diseases.

Find more crop disease resources at CropProtectionNetwork.org.

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