Preventing Contaminated Grain - Ochratoxin A

Preventing Ochratoxin A in Stored Small Grains

Ochratoxin-contaminated grain can lead to down-grading or rejection from the buyer at significant cost to the farmer. This guide, for farmers with on-farm storage bins for small grains such as wheat, oats and barley, outlines why preventing ochratoxin from developing is important and steps to take to prevent its production in their on-farm storage bins.

Ochratoxin A: *What is it?*

Ochratoxin A (OTA) is a mycotoxin produced by the fungus *Penicillium verrucosum*. While some mycotoxins such as deoxynivalenol (also known as DON or vomitoxin) are produced exclusively in the field, other mycotoxins, like OTA are produced only in storage.

In north temperate countries including Canada and the USA, OTA is the most frequently detected storage toxin in small grains. OTA is strictly regulated in Europe but not yet in Canada or the USA. However, OTA is monitored by end users such as food processors, CFIA/Health Canada, and the US Food and Drug Administration because of its potential risk to human health.

- Action is taken on OTA at very low concentrations.
- OTA in raw grain from a bin is difficult to detect because it occurs in small pockets.
- Because OTA can be concentrated in a very few kernels in a load of grain, it is often not detected until after milling.

More small grains destined for human consumption are being stored on farms and for longer periods of time than 10 years ago. It is very important for grain producers and grain storage manufacturers to understand how and when OTA forms during storage so that they can take steps to prevent its formation.

What is the Source of Ochratoxin A in Stored Grain?

Penicillium verrucosum is a naturally occurring soil fungus that can colonize grains. The most common source of spores is from soil particles, last year's stored grain, grain handling equipment, and residues remaining in the bin.

Prevention of even small pockets of OTA-contaminated grains during storage is the only way that it can be managed to protect health and prevent product recalls.

There are no pre-harvest agronomic steps that will prevent the production of OTA in small grains in storage; however, there are several things that can be done to reduce the likelihood of the growth of *Penicillium verrucosum* and its toxin in storage.

Sanitation:

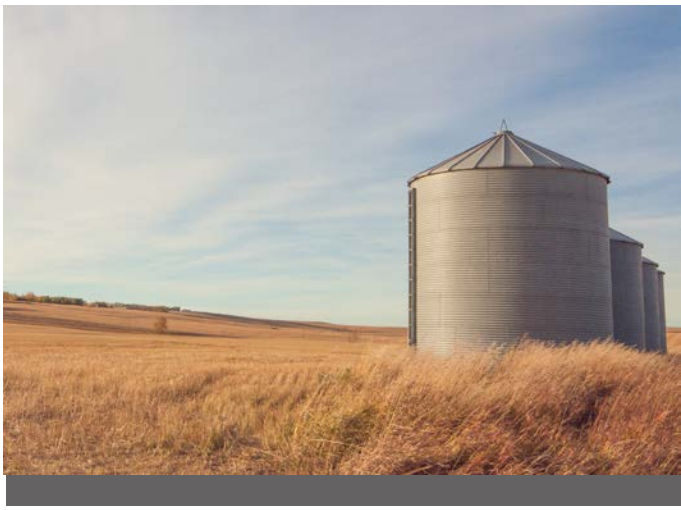
Keeping bins and grain handling equipment clean and a thorough cleaning of dust and debris between grain lots is the first line of defence.

Temperature & Moisture:

Penicillium can grow at temperatures as low as 10°C. Moisture plays the critical role. Fine droplets of water can condense on the grain allowing the fungus to grow. It is important to cool the grain pile to well below 10°C as quickly as possible and keep it cool for as long as possible to minimize the possible production of condensation in the bin.

Even in bins that are generally well managed and properly aerated, *Penicillium* can grow in small pockets if water comes in contact with grain. Warm, moist air may escape through cold pipes such as down-spouts that are used to fill grain bins, allowing water to drip onto the grain pile. Alternatively, the water simply may condense on the cold bin wall in the bin head space when the bin head space is improperly vented. Sometimes this moisture freezes and the grain gets moist later on when the ice melts and the *Penicillium* starts to grow.

A second important source of free moisture is precipitation either in the form of snow or rain getting in through poorly designed or poorly fitting vents. Taking extra care to seal bins, even small holes, to prevent condensation, and encouraging the rapid venting of warm moist air from the bin head space, all reduce the occurrence of free moisture and prevent the growth of *Penicillium*.



- Aerating during early and late winter should be avoided to prevent mixing of warm and cold air leading to condensation.
- Drawing in warm and humid air quickly into a cool grain pile should be avoided as it may encourage condensation at the bottom of the pile, which should also be avoided.
- Check for improper seals around access doors that allow water to run down the bin wall.

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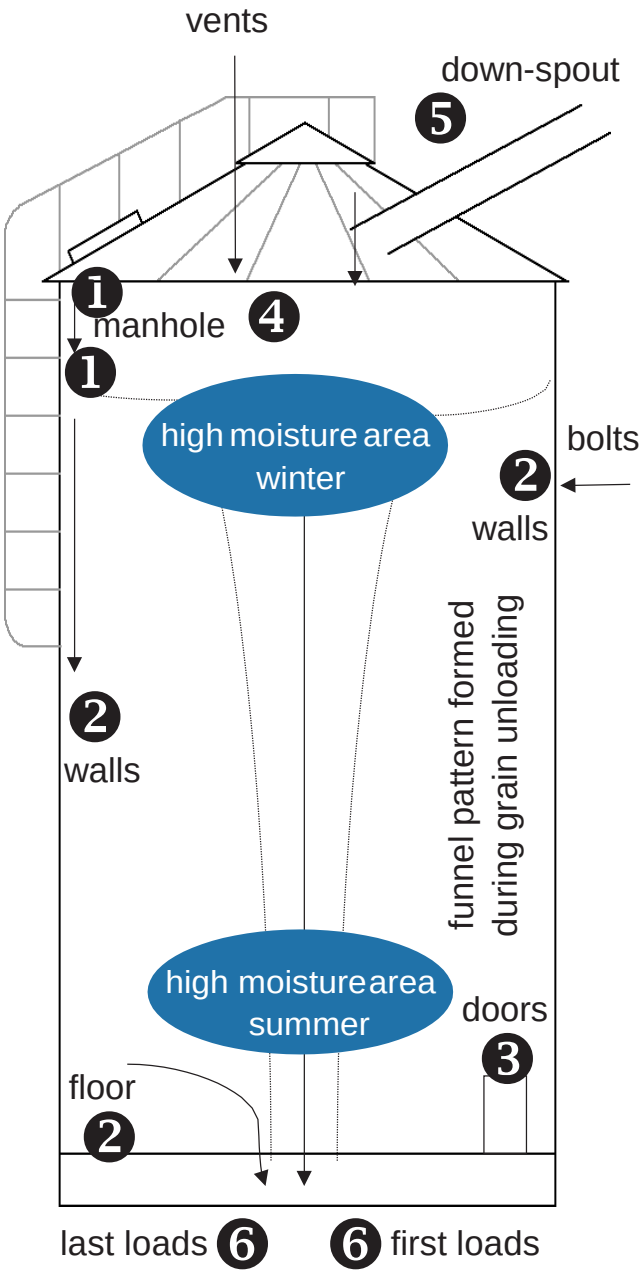
Reference: Limay-Rios V, Miller JD, Schaafsma AW (2017) Occurrence of Penicillium verrucosum, ochratoxin A, ochratoxin B and citrinin in on-farm stored winter wheat from the Canadian Great Lakes Region. PLoS ONE 12(7): e0181239. https://doi.org/10.1371/journal.pone.0181239

Critical Point Sources of Ochratoxin A Contamination



- **Clean bins and grain handling equipment** from dust, debris and old grain before storing new grain. Pay special attention to leg and auger bottoms and bin floors in the corners where walls and floors meet.

- **Make sure bins are properly sealed** and vents are designed and installed so that no rain or snow can get into bin, especially not on the grain pile. A missing bolt on a rain exposed side of the bin can be enough to get an infected clump started. Manhole openings are particularly vulnerable and must be fully sealed to keep warm and cold air from clashing and condensation forming, and to keep precipitation out.

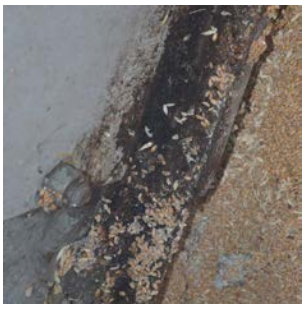
- **Avoid any sort of condensation** from getting into contact with grain. Do not let moist warm air from the grain pile escape through openings like down-spouts that will allow condensation to drip onto grain pile. Install fittings that can close down-spouts. When aerating bins in winter consider a design that quickly removes moisture-laden warm air from bin head space.

- **Careful aeration.** Avoid dramatic mixing of warm moisture-laden air with cold air or cold surfaces when aerating; this leads to condensation. BinCast® *(http://www.weathercentral.ca/bincast.cfm)* is a useful tool to help prevent aeration under conditions which could lead to condensation.

Critical Point Sources of Ochratoxin A Contamination

1. Grain clumps around or under manhole openings:


2. Crusted grain hang-ups and clumps from missing bolts or grain debris left on the floor and augers:




3. Grain clumps on side doors or on the holes of the bin walls:


4. Surface bridging in high moisture migration areas:

5. Moisture below dripping down spouts or vents from snow or rain:


6. Grain samples from the first or last loads.

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