

# THE INTRICATE RELATIONSHIPS BETWEEN MYCOTOXINS, FUNGI AND FARMING SYSTEMS



Mycotoxins cost American agriculture up to \$2.5 billion annually.



Grains pose the most frequent and serious risk.

Fungi are absolutely essential to life on earth. They decompose decaying animals and vegetation, releasing nutrients. In a myriad of ways, fungi make it possible for one generation of life to sustain the next. And without fungi, there would be no Blue cheese, beer or wine.



**However...** some fungi are bad, at least some of the time, like when *Aspergillus* species produce the highly toxic mycotoxin, aflatoxin. Over 300 species of fungi produce byproducts called mycotoxins. Fungi produce mycotoxins in response to stress caused by environmental

extremes, shortage of food, or competition from other microorganisms. Actions taken by farmers can also put fungi under stress and trigger the production of mycotoxins. For example, spraying a fungicide can control some, but stress other fungi.

Millions of times daily around the world mycotoxins find their way into the food chain. In most cases, levels are very low and pose essentially no risk to people or farm animals. But sometimes the levels balloon and become dangerous. This is why mycotoxins are a ubiquitous and worrisome day-to-day food safety risk.

About 25 percent of the world's grain supply is contaminated with mycotoxins according to the UN's Food and Agriculture Organization. It is no surprise, then, that each year there are thousands of mild to serious food poisoning episodes around the world that are traced to mycotoxins. According to studies, health risks from mycotoxins include organ damage,

## MYCOTOXIN MYTHOLOGY

Proponents of conventional agriculture and biotechnology claim organic farming heightens the risk of mycotoxin contamination, citing a small number of cases where organic foods have had elevated levels. Science suggests otherwise. Two core conventional agriculture practices – application of fungicides and high levels of nitrogen fertilizer – clearly triggers mycotoxin contamination in some cropping systems.

# MANAGING MYCOTOXINS

immune system suppression and cancer. In fact, mycotoxins are the likely trigger of 80 percent of liver cancer in many underdeveloped countries, where the poor often have no choice but to consume wet, moldy grain.

People in developed countries with ample food supplies and a wide range of choices often can easily avoid mycotoxins. The presence of mycotoxins on produce and meat is usually easy to spot—where there is mold and rot, or odd smells, mycotoxins are likely present. But mycotoxins also end up “hidden” in processed and baked foods, beverages and dairy products. These toxic substances are even found in human breast milk.

This is why consumers must rely on farmers, the food industry, and government to slam shut, as tightly as possible, the doors allowing mycotoxins to enter the food supply. This can be done by avoiding the environmental conditions that trigger fungal growth and mycotoxin production, both on the farm and after food is harvested and in storage. When



conditions conducive to mycotoxin production arise, food must be tested for the presence of mycotoxins.

Contaminated food must be diverted from the food supply, and not just the human food supply. Dog food contaminated with aflatoxin in the winter of 2005-2006 led to the death of dozens of pets in the United States. Mycotoxin-contaminated corn is sometimes sent to pig farms, where it can cause serious swine reproductive problems.

## ORGANIC FARMING CAN LOWER MYCOTOXIN RISK

Critics of organic farming have asserted that organic food is more likely to contain mycotoxins because organic farmers do not use fungicides. There have been relatively few careful studies comparing mycotoxin levels in conventional and organic foods, but the few that have been published reach the opposite conclusion, or state there appears no major differences between these two systems of farming. Rigorous comparisons of the presence of mycotoxins have been conducted on 24 matched pairs of organic and conventional foods. Mycotoxins were detected in conventional food 50 percent more often than in organic and at average level a little over twice as high, as shown in the Organic Center's 2005 State of Science Review "Breaking the Mold – Impacts of Organic and Conventional Farming Systems on Mycotoxins in Food and Animal Feed."

Research provides two likely explanations. It turns out that many fungicide applications on conventional farms actually increase mycotoxin levels. In some cases, application of a fungicide only partially controls the target fungi pest, placing the organism under stress and triggering its normal defense mechanisms, including production of mycotoxins. In other cases, a fungicide may work well on certain species of fungi, but opens an ecological window for other species of fungi that, in turn, may produce dangerous mycotoxins.



Higher levels of mycotoxins have been reported in multiple studies in wheat and other grains grown under high-yield, chemical-intensive conventional systems, compared to the same grains raised organically. Most of these studies conclude that the high levels of nitrogen fertilizer used on conventional wheat actually stimulates fungal growth, and if weather conditions change and place fungal populations under stress, they begin producing mycotoxins as a part of their survival response.

### Critical Need for Careful, Systematic Monitoring

- Milk, pork and grain-based products
- Wheat, barley and rice-based foods
- Corn meals
- Apple-based products
- Nuts and peanut-based foods

Warranted for both organic and conventional foods.



### Minimizing Mycotoxin Problems

**DIVERSITY** – Organic systems promote greater diversity among fungi. Competing for a common food source lowers the odds that any one strain will dominate, and then perhaps produce dangerous levels of mycotoxin.

**DISEASE-SUPPRESSIVE SOILS** – The use of compost, manure, and planting "cover crops" enhances the diversity of soil microbial communities, which helps keep plant diseases in check.

**HEAT-STRESS RESISTANCE** – Heat-stress increases the risk of mycotoxin production. Soils on organic farms tend to take in and hold more moisture, and typically stay cooler than soils on conventional farms.

Innovation on the farm has great potential to more fully exploit the biological advantages of organic farming systems in preventing mycotoxin production. If we can understand why and how organic farming systems tend to suppress fungal disease and lessen the severity of mycotoxin contamination, all farmers and consumers will reap the benefits.



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For more information on mycotoxins and to view the full scientific report "**Breaking the Mold -- Impacts of Organic and Conventional Farming Systems on Mycotoxins in Food and Livestock Feed,**" visit us at [www.organic-center.org](http://www.organic-center.org).