GMOs And Corn Mycotoxins

DR. PAUL VINCELLI

LEXINGTON, KY.

Corn is a staple crop for human food and livestock feed. Like a number of other crops, corn grain can be naturally contaminated by mycotoxins, natural toxins produced by fungi. The classes of mycotoxins of most likely to cause concern in Kentucky are fumonisins and aflatoxins.

Though most Kentucky corn crops are free of mycotoxins, fumonisins are probably the most common threat. These toxins affect a number of animal species, but horses and pigs are among the most sensitive. Aflatoxins are generally very uncommon in Kentucky, but when they occur, they can cause serious disruption to grain marketing. Both mycotoxin families pose health risks to humans. More information can be found in the two University of Kentucky Extension publications listed under my name in the bibliography below.

Figure 1. Fusarium ear rot of corn, usually associated with fumonisin contamination.

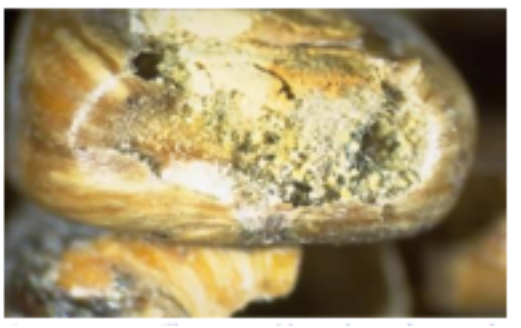

Figure 2. Aspergillus ear and kernel rot of corn, often associated with aflatoxin contamination. The fuzzy appearance inside the kernel is the sporulation of the invading fungus.

Wounding of the corn kernel (Figure 2) makes it easier for the kernels to become infected by the fungi that produce these mycotoxins. European corn borer and other caterpillars commonly produce wounds that favor infection and mycotoxin contamination. That being the case, does the use of genetically modified Bt corn – genetically engineered to provide control of certain insect pests – result in reduced mycotoxin contamination?

To address this question, field studies have been conducted comparing Bt-hybrids to non-Bt hybrids that are otherwise genetically very similar. Thus far, the overall results from this line of research are that meaningful mycotoxin reductions sometimes occur due to the Bt trait. Since (to my knowledge) there is no significant body of peer-reviewed research indicating a food-safety risk from Bt corn, the appropriate use of Bt corn is widely considered to be potentially beneficial both for animal health as well as for safety for human consumption. A more detailed discussion follows.

Fumonisins

Fusarium ear and kernel rot is a disease often associated with fumonisin contamination, and field studies have shown reduced Fusarium ear rot from Bt corn. Not surprisingly, these reductions have been tied to reductions in insect feeding on kernels containing the Bt toxin. Studies in the USA and Europe have also shown that Bt hybrids often produce corn with reduced fumonisin content – with these reductions also being tied to reductions in insect feeding on Bt kernels. In studies where statistically significant reductions in fumonisin concentration occurred, these ranged from 20 percent to over 90 percent, often bringing the grain below concentrations thought to pose risks to humans and the most sensitive animals. It is interesting to note that the application of synthetic insecticides to control kernel-feeding insects on non-Bt plants also sometimes reduces insect feeding and fumonisin contamination. This "opens the door" to an interesting discussion as to which is more sustainable: use of the Bt trait or application of insecticides. Either way, reductions in fumonisin contamination are highly desirable.

Aflatoxins

As with fumonisins, field studies have often documented reductions in aflatoxin contamination due to the Bt trait. Significant reductions were most common when aflatoxin levels were at moderate to high levels in the non-Bt corn. In studies where significant reductions in contamination were documented, these commonly ranged from 50-90 percent. In some cases, the reductions in aflatoxin concentration from the Bt trait were sufficient to bring the corn below 20 parts per billion, an important regulatory threshold for use of the grain in human foods. As with fumonisins, aflatoxin reductions have generally been linked to reductions in kernel injury from insect feeding. In cases where the Bt trait did not result in aflatoxin reductions, other factors – especially drought stress – may have been more important in promoting aflatoxin accumulation than insect damage to kernels.

Caveats

There are several caveats and complicating factors in this line of research, as follows:

• Bt corn isn't a "magic bullet", eliminating all mycotoxin contamination. Indeed, sometimes reductions in mycotoxin contamination do not occur. This is true for both fumonisins and for aflatoxins. However, reductions of fumonisins and aflatoxins have been documented commonly in field studies, especially under conditions moderately to highly favorable for ear rot and mycotoxin contamination. Such reductions occur commonly enough – with no known "downsides" relating to consumption of the grain – that the appropriate use of Bt corn is considered to be beneficial both for food safety as well as for animal health.

• The Bt toxin must be expressed in the corn kernel in order to reduce these mycotoxins, by reducing insect injury. In some Bt corn hybrids, the Bt toxin is not expressed in the kernel. Such hybrids have no protection against wounds created by insect feeding, and therefore fumonisin contamination is not reduced in these hybrids.

• While the Bt trait is important in reducing mycotoxin contamination, the magnitude of mycotoxin reduction can depend on the genetic background of the corn hybrid. In other words, if you compare two hybrids that have the identical Bt trait, one may have less fumonisin than the other, simply because of its genetic background.

• The effectiveness of the Bt trait in reducing mycotoxin contamination depends on the insect pest present. For example, Bt corn is often effective at reducing feeding damage from the European corn borer, but not the corn earworm. Consequently, reductions in fumonisin contamination may occur if the European corn borer is the principal pest in a field, but not if the corn earworm is predominant.

Bottom line

Corn hybrids that express the Bt trait in kernels sometimes exhibit reduced kernel contamination from fumonisins and aflatoxins. This is thought to be due to reduced insect feeding on the kernels. The Bt trait is not a "silver bullet", eliminating all mycotoxin risk. However, reductions occur commonly enough, with no known "downside", that the Bt trait is commonly thought to contribute to food safety and livestock health in both developed and developing countries. While it is well-documented that the Bt trait can reduce mycotoxin contamination, it is best used wisely, and only in fields with a moderate to high risk of damage from the target insect pests.

Acknowledgment

Thanks to Charles Woloshuk (Purdue University) and to Ric Bessin (University of Kentucky) for reviewing a draft of this article.

Relevant Scientific Papers

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DR. PAUL VINCELLI: Extension Professor and Provost's Distinguished Service Professor, University of Kentucky

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