Bio-Control Option for Control of Aflatoxin Production in Corn and Assessment of Aspergillus flavus Populations and Distribution (Year 1 of 3)

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Aflatoxin (produced by *Aspergillus flavus*) is the most important disease-related problem of corn in Arkansas, costing growers at least $15,000,000 in 1998 by some estimates. Once corn is contaminated with aflatoxin, there is no easy or practical way to decontaminate the grain. Since the threshold level for aflatoxin is 20 ppb, it only takes a small amount of highly contaminated grain – such as from a small, stressed area within the field – to contaminate an otherwise healthy load of corn. Aflatoxin can reduce the value of corn from 50 – 100%, depending on the supply of corn in the U.S. and market conditions. And, aflatoxin can affect up to 50% of the Arkansas corn acreage in epidemic years like 1998. There are many things that can contribute to aflatoxin development in corn including extreme environmental conditions during the growing season, water stress, low fertility, insect damage, hybrid adaptability, and inoculums levels of *Aspergillus flavus in the soil. The key to minimizing aflatoxin is to understand the effects of these variables on crop production, yield, and the fungus. Our goal is to obtain a better understanding of the environmental and cultural factors influencing aflatoxin outbreaks, and from this information, develop more effective management strategies to minimize the occurrence of aflatoxin in Arkansas.*

One new tool that could immediately help to reduce aflatoxin in Arkansas corn is Afla-Guard, a newly available crop protection product. Afla-Guard is a biological control agent; it contains a naturally occurring, non-toxic strain of *A. flavus* that reduces the ability of aflatoxin-producing isolates to colonize corn and/or produce aflatoxin. Research at other institutions has shown Afla-Guard to be effective in reducing aflatoxin contamination by as much as 85%. Afla-Guard was registered for use on peanut in 2004, and was registered for use in corn in 2009. Although Afla-Guard is now registered for use in corn, little research has been conducted in Arkansas prior to this project regarding the product's effectiveness at reducing aflatoxin development in our environmental conditions, optimum application methods, timing of application, and economical benefit or return.

In 2010, Arkansas experienced the first widespread outbreak of aflatoxin since 1998. A survey of corn in the state revealed that some of the easternmost counties were hardest hit, but that unacceptably high levels of aflatoxin were found in nearly every corn-growing county (Figure 1). Although data from 2011 are still being analyzed, high levels of aflatoxin were predominantly found in the western corn-growing counties in the river valley region; this area suffered record-setting heat as well as drought during the growing season.

Initial Afla-guard tests revealed that the product can provide 60-75% suppression in Arkansas, but does not eliminate the threat of aflatoxin. For example, if aflatoxin levels are at 1000 ppb, even 90% control will only reduce levels to 100 ppb – which is still five times higher than the US FDA action level of 20 ppb. Furthermore, the product will often not be practical or economical for highly productive fields in which fertility and water are not issues. However, Afla-Guard should be considered for fields that are chronically at risk for low levels of aflatoxin (e.g., a history of 20-100 ppb), non-irrigated fields

(especially during years when it is unusually hot and dry immediately before and/or during grain fill), fields that have known fertility and watering issues during extreme years, and fields planted in hybrids that are known to be susceptible to aflatoxin.

Ongoing efforts are focused on refining application guidelines for Afla-Guard in Arkansas, as well as understanding how application of Afla-Guard affects natural populations of the pathogen and whether the inhibition of aflatoxin biosynthesis persists into subsequent growing seasons (even when Afla-Guard is not reapplied). Additionally, numerous hybrids commonly grown in Arkansas are being evaluated to determine levels of susceptibility, which will then be correlated with other parameters such as loose vs. tight shuck cover.

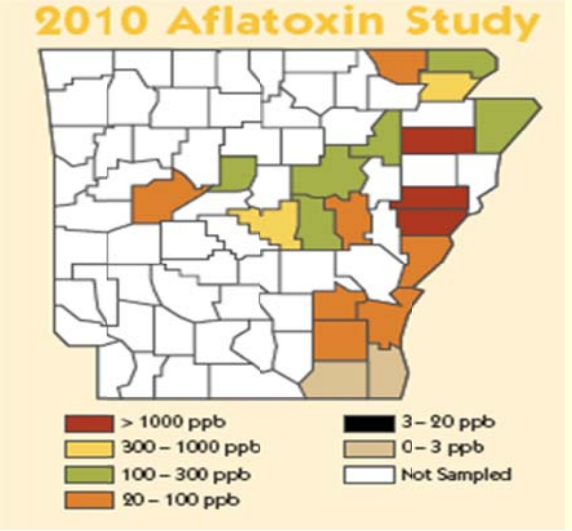

Figure 1. Survey of aflatoxin in Arkansas corn (2010).

Figure 2. Dr. Scott Monfort holds an ear of corn heavily infested with *Aspergillus flavus*. Associated symptoms of drought stress can also be observed (small ear, poor pollination).

Figure 3. Close-up pictures of *A. flavus* during infection of corn. The fungus grows as a velvety, olive green mass in infected kernels (left). When observed under higher magnification, the distinctive spore-bearing structures of *A. flavus* are spherical, with long stems (right).

Figure 4. Dr. Scott Monfort observing corn treated with Afla-Guard. In this field, a significant reduction, although not complete elimination, of aflatoxin was observed in plots treated with Afla-Guard compared to untreated plots.