ISSUE: 04
JANUARY 2010

SCIENCE in Practice

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Testing for Mycotoxins

Tackling the higher risk for mycotoxin contamination this year begins with testing feeds for these fungal poisons. Here are some things to consider.

Aspergillus, Penicillium, and Fusarium are the three mold genera most often cited for mycotoxin production; but others such as Alternaria, Chaetomium, Myrothecium, and Stachybotrys are also established producers of toxins. And what about molds such as Absidia, which is isolated frequently from stored/ensiled corn and is associated with adverse effects in farm animals although no specific mycotoxin has yet been isolated?

More than 2,500 secondary metabolites of fungi have been cataloged (Cole, Jarvis, and Schweikert [2003]. Handbook of Secondary Fungal Metabolites). Of these only about 400 or so have been studied sufficiently to have a sense of their risk. Of those, about 200 have been characterized toxicologically to the extent that we know their frequency of occurrence and toxicity are sufficient to warrant real concern. About 60 have real data for production livestock. From those, we have fewer than a dozen rapid, economical tests available, and we typically request assays for only two or three.

Neither the mold infection in the field nor in storage is uniform throughout a lot of grain (a field, bin, etc.). Similarly, resultant mycotoxin contamination is not homogeneous. The numbers of molds and mycotoxins and this heterogeneous distribution make valid testing an extremely difficult task.

continued on p. 2

in this issue

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New Corn – What to Do?

Molds are always around, so why is this year so different in terms of grain quality? First, remember that grain and oilseed crops are not sterile; the molds are there. For them to increase above norms and produce large amounts of mycotoxins pre-harvest requires a significant amount of stress on the plants. Late starts in planting, dry spells, weather damage, wet conditions during field drying and harvest, and other factors have all resulted in above average amounts of fungal infection in our crops and much higher concentrations of mycotoxins being produced. Since last October, reports from feed mills and producers are revealing deoxynivalenol (vomitoxin, DON) at levels sometimes exceeding 20 parts per million. Dairy operations are concerned when feed contains around 300-500 parts per billion. 20 parts per million = 20,000 parts per billion!

To make matters worse, many fields had poor yields, higher than normal damaged kernels, low bushel weights, etc. Recently a dairy nutritionist in western Pennsylvania said most of the new silage he's seen is really bad. After a year of disastrous milk prices and pressure to reduce costs on the farm, what could be worse than to find that feeding quality of the 2009 silage is likely going to be way down. So, do we throw up our hands in surrender?

Not yet! Risks are high and the challenge is not going to be easy to meet, but it can be done. This is the time for rational evaluation of the extent of the problem on individual farms, and for using sound judgment in formulating a working plan to combat this situation. The reality is that some action will need to be taken if dairy producers wish to hold production levels and more importantly, preserve the genetic progress and health of their herds. In order to formulate a plan of action good information will be needed.

The process should start with some good-quality tests of feeds and ingredients. Some details about tests and samples can be found in the sidebar. Dairy producers and their consultants (nutritionists, veterinarians, etc.) need to keep in mind that rapid test results are subject to many influences and that pegging all decisions to a fixed, arbitrarily selected 'threshold' value of one mycotoxin or another is not the way to solve these problems. I have suggested in the past that with all the information we have about DON, just for example, it might well be that DON doesn't do all the damage we think it does. But certainly DON in concert with other mycotoxins simultaneously occurring in feeds, and for which we have no rapid tests, does affect cows. So DON serves best as a reference, not an absolute. Pay attention when DON is around the 500 ppb level in the TMR; get real concerned when it reaches a moderate level, e.g., around 1,000 ppb. And don't even think about not taking an affirmative action if your test is pushing or exceeding 3,000 ppb DON. Put your anti-mycotoxin program into full swing.

When high toxin levels start showing up, what actions are open to you? We have four strategies that have been in use over the years. Good feed equipment hygiene helps to reduce post-harvest mold infestation but won't address the problem of the mycotoxins that are already present. Mold inhibitors (feed preservatives) are much the same and are not amenable to post-ensiling treatments. Third in line are the myriad of products which claim to bind mycotoxins. These materials, either clay or yeast based, work by attaching toxin molecules and keeping them from being absorbed by the animal. Unfortunately while several such products are well proven to do a good job with aflatoxin, only one or two show any kind of measurable response against Fusarium toxins such as DON and zearalenone. Many university research trials have shown the efficacy of some binders against aflatoxin; I'm not aware of any that demonstrate equivalent action against DON under real-world conditions. And, if some do exist, the amounts that would have to be included to off-set this year's above average DON levels would compromise the nutritional status of the cow! Effects of mycotoxins have always been shown to be worse when the animal's plane of nutrition is lowered. That leaves application of L-Form Lactobacillus products, such as Select DTX™ and Select BioCycle Plus™. These have been demonstrated in university trials to work and they are not dependent on a particular toxin chemistry.

Make your plan now. Talk with your Select Sires technician or sales representative about the L-Form products and how to use them. Cost will be a factor – pick your time and approach properly to ensure your herd is protected when it is most vulnerable (e.g., transition cows). ✤

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Testing for Mycotoxins, continued from p. 1, sidebar

Testing and Interpretation

Mycotoxin tests should begin with a valid sample and proceed through the sampling process, mycotoxin extraction, detection, and quantification.

Sample. A truly valid sample represents the entire original lot of material that is being evaluated. To obtain a valid sample requires obtaining multiple small increments of material, combining and mixing them, and then dividing it to provide for a reasonable but sufficient quantity of sample that is representative of the starting material. Consider the amount of feed or ingredient that is typically taken for a "sample" and, as importantly, how it was taken. It is not unusual for one to 'grab' a few handfuls of feed without regard to representation nor amount and submit it for analysis.

Testing. For animal producers, the costs of assays usually result in decisions to use the less expensive, antibody-based tests. These are economical, rapid, and require fairly minimal technical expertise to perform. Some are available for use on the farm with essentially no lab equipment involved; others, for real quantization, are best done in the lab. For the most part, such tests are fairly accurate and can be quite precise. The major limit is the quality of the sample, itself, followed by differences in affinities and cross-reactivities for the antibody used in a particular test. For example, the outcome is influenced if Company A's antibody is highly specific for DON and does not cross-react with 15-acetyl-DON while Company B's will detect about 35 percent of the 15-acetyl-DON in a sample. Both tests will report out as ppb of DON, but one will seem quite inflated. Which is the best result? If 15-acetyl-DON were innocuous, then A's test would be preferred while B's would give a gross over-estimation. But 15-acetyl-DON is not without toxicity. So, perhaps, one might rather have this related compound included in the analytical result? There are other factors which can impede extraction or interfere with proper detection.

The alternative is full scale chemical testing with some fairly exhaustive extractions and clean-up steps followed by analysis via high-end instrumental means (HPLC, GC-MS, etc.) or with thin-layer chromatography.

Interpretation

Interactions. Apart from the shear numbers of molds and mycotoxins possible and the high probability of multiple toxin contamination of feedstuffs for livestock, even suggesting some limits above which animals are at risk and below which they are "safe" is not possible due to the myriad of possible interactions that can occur. Interaction(s) occurs by one of three ways. 1) additive – in which the final effect can be predicted by summing the effects of the individual interactants; 2) antagonism (or sparing effect) – in which the final effect on the animal is, or at least seems to be, less than could be predicted by adding the known effects of the individual interactants; and 3) synergism (or potentiation) – in which the final effect may be significantly greater than the sum of the individual effects. Mycotoxins typically interact synergistically with many kinds of other stressors, including other mycotoxins, temperature stresses (heat or cold), social stresses (movement of dairy cows into new groups), diseases, nutritional problems (marginal nutrient or excess nutrient), etc. For these reasons it is imperative that producers and advisors not use a specific test result number as the basis for decision on remedial approach.

Ranges. Given the issues related to testing and the very few toxins for which tests are requested, it is more prudent to first accept that any positive test result confirms the activity of molds and the formation of mycotoxins. If one Fusarium toxin is present, odds are great that several other Fusarium toxins are also present; a high or low value for the tested toxin does not predict the extent of contamination by toxins not included in the testing. For best response decisions, it is better to categorize test results within approximate ranges suggesting low, medium, or high contamination rates. From that starting point one can begin making a logical, pro-active plan to combat these challenges to cow health, performance, and reproductive capacity.

Interested in learning more about mycotoxin management? Visit www.agrarianmarketing.com or contact Agrarian Marketing Corporation® at (888) 254-1482. ✤