**Mycotoxin Matters Podcast ep 3 Climate Change and Mycotoxins Part 2**

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Female: Welcome to the Mycotoxin Matters Podcast from Alltech Mycotoxin Management. As mycotoxins present an ever-increasing threat to livestock production, join us as we discuss these impacts and potential solutions, sustainable farming, and our vision for a planet of plenty.

Nick: Hi. Welcome to Mycotoxin Matters. My name is Nick Adams and I'm the Global Director for Alltech's Mycotoxin Management Program. I'm delighted to be joined today by Dr. Radka Borutova. Radka is a veterinarian who also studied for a PhD in the impact of mycotoxins within broilers, and joined Alltech in June of 2020 after spending a number of years providing mycotoxin management support within the feed industry. Radka is focused in providing mycotoxin management support across Europe. Radka, welcome to Mycotoxin Matters.

Radka: Thanks, Nick. Glad to be here.

Nick: In today's episode, we are going to take a deeper dive into the area of climate change and maybe pick up on some of the themes that we talked about in our opening episode with Dr. Mark Lyons, and explore exactly how climate change will affect mycotoxins in feed and food. Maybe, Radka, you can begin by telling us how you would see the relationship between climate conditions and mold.

Radka: Yeah. It's a very simple answer because the climate conditions can affect the growth, distribution, proliferation, and also mycotoxin production of fungi or molds. Actually, the molds or fungus, which are growing in the fields or which are produced during storage, they will be very much influenced by climate conditions which are surrounding them.

Nick: So can climate change have an impact on mycotoxin production?

Radka: Yes, definitely. Changes in climatic conditions have a potential to increase risks that mycotoxigenic fungi pose to food and feed safety. But before that, we really have to understand what those climate changes are. In my opinion, the climate changes, what's happening now is the concentrations of methane, carbon dioxide, nitrous oxide in the atmosphere are increasing that's resulting in environmental warming. And that's resulting in greater precipitation, or on the other side, drought and all of those changes. So increased concentrations of those air gases, global warming, and also changes in precipitation are going to have an impact on the behavior of fungi.

Nick: So then if we pick up on one of those things, Radka, clearly what you're saying is our planet is warming. So with that in mind, what are the predictions concerning temperature on the pre-harvest crops with regards to mycotoxin production?

Radka: That's a good question. The IPCC report from 2007 says or states that the temperature will rise in approximately four degrees Celsius in the next 100 years. What is that going to mean when we talk about mycotoxins? When we talk about mycotoxins, we will have two different regions created. We have them now as well, but at this moment, we have cool regions and we have warm regions. The cool regions, they are going to warm up. The warm regions are going to warm up even more and they are going to be very dry as well. So if we talk about those cool regions, because they are going to warm up, more crops or greater yields will be seen in those regions, which is going to result in higher mass of mycotoxins produced because if we have more crops, we'll also have more mycotoxins.

 The overall quality of the crops may be worse than before in terms of mycotoxins per unit weight of crop. Those regions, because the temperature is going to rise, the storage conditions are going to change, but that was not your question because you're asking about the pre-harvest. If you talk about the warmer regions then fewer crop yields will occur as a result of climate change, and crops will be of lower quality because of the stress. We will expect lower mass of mycotoxins produced because if we have more crops, also less mycotoxins will be produced in that mass of the crops.

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 But nevertheless, that lower mass of the crops will be contaminated with high concentrations of mycotoxins. Why? Because the drought is a huge stress for the plants. And if the plants are in distress, they are less resistant against pests and molds and mycotoxins consequently. Of course, dry conditions, they might be on either side favorable for the storage conditions. The storage in those warmer regions should improve a little bit. That's how I would see the difference of temperatures on the mycotoxin production.

Nick: So very much the temperature side of things, from what you're saying, is split into two, obviously the effects on the cooler areas of the world and the effects on the warmer areas of the world. What's the situation when we think about precipitation and the impact of precipitation on mycotoxin development in the future?

Radka: Yes. Heavy precipitation is very likely in some regions, while drought, which is the opposite of heavy precipitation, is likely in the others. The plants are going to be stressed from both conditions. Heavy precipitation is stressing the plants. It's also having an impact on the soil erosion and inability to cultivate some lands, and drought is doing the same. Also, when we talk about soil erosion, that allows nutrients to flow away from the plant and that's going to decrease the plant's resistance against fungal infections and will result in more mycotoxin production. So definitely, if we talk about precipitation then definitely higher precipitation or drought, both are going to lead to a huge stress for the plants. And when the plants are stressed, they are more vulnerable to fungi or fungal infections. So in both cases, higher mycotoxin production is predicted for the next years.

Nick: It's so interesting that you've chatted there, Radka, around the pre-harvest mycotoxin production and the fact that in all likelihood, as the climate changes, we will see more likely increased risk from mycotoxins pre-harvest. So if we then turn our attention to the other side of the fence, as it were, where we talk about the post-harvest mycotoxins or storage mycotoxin, what about their production as a result of climate change?

Radka: When we talk about the storage or the impact of climate change on the post-harvest production of mycotoxins, definitely storage will be difficult in cases where climate change results in high moisture levels because that's going to lead to problems with drying of the crops. That is going to happen more in those cooler regions. On the other side, we have those warmer regions, which are going to be drier as well. In that case, definitely dry conditions are not suitable for mold. Mold, they like high moisture, high humidity, high temperatures, and hot and dry weather is not favorable. The crop is going to be dry itself, which is actually not a favorable condition for the mold growth and mycotoxin production. So we should see in which region we are, and depending on that, we will see what is going to be the climate change impact on the storage conditions and mycotoxin production.

Nick: So actually then, the concept is that in certain scenarios that warmer, drier climate will actually potentially help the storage side of things when it comes to mycotoxins.

Radka: Yeah, that's possible.

Nick: So let's maybe pick up on the gas side of things. You've mentioned concentration of methane and carbon dioxide, nitrous oxide in the atmosphere. When we think about increasing concentrations of carbon dioxide in the atmosphere, what impact on mold growth and mycotoxin production will that have?

Radka: Yeah, you're right. That's what I said. Actually, the atmospheric concentrations of CO2 are expected to double or triple in the next 25 to 50 years. If you talk about different regions in Europe, for example, those are going to be impacted by increased temperatures, around two to five degrees Celsius, and that's going to be coupled with elevated CO2 concentrations and the drought episodes, and that's a mortal combination for the plants.

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 If we talk about CO2 itself then those slightly elevated CO2 concentration and interaction with the temperature and water availability, that may stimulate the growth in some mycotoxigenic specie especially under the water stress. It means some molds might benefit from this condition because increased CO2 concentrations mean there will be also higher temperature. There will be probably in some regions, as I said, higher drought where some molds will favor from this, and the others, not. So it will really have an impact on what kind of mold we will see. And probably the composition or the mold species are going to change from region to region. They are going to shift, I would say. So the molds, which we see in some regions now, they will most probably disappear from there and they will just appear somewhere else. That's how I would see that.

 If you talk about the plants themselves, we know the plants are breathing the CO2 during the day. That's very important because increased concentrations of CO2 are going to have an impact on the metabolism of crops. The crops, we can predict the highest CO2 in the atmosphere will increase or will have an impact on the increase or higher yields of the crops. When we look at the plant itself, when the plant is infected by fungi and mycotoxins, they are all over the plant. They are on the leaves. They are on the kernels, on the crops, whatever. If there are going to be higher temperature results of increased CO2 concentrations in the atmosphere then there's also going to be increased temperature on the leaves of those plants. As the molds are living on those leaves, of course that's going to have an impact on what kind of molds are growing because every mold has a different temperature optimizer. There's always a range. Some molds like lower temperatures. Some molds like higher temperatures. But if the leaves are going to be warmer, that's going to have an impact on what kind of molds are going to appear on those plants.

 Again, as I said, probably the molds and the mold species are going to shift from one region to another one depending on the temperatures, which are a consequence of the CO2 concentrations in the air. Higher CO2, a warmer climate is probably what we will see.

Nick: Yeah. It's interesting, isn't it? Obviously, we think about climate change on a very big scale, but there you are talking really about the microclimate in and around the leaf and the temperature and the impacts of all of these changes on those microcosms. What about the concept of UV and mycotoxins? You talked about carbon dioxide. What does UV do in this equation as it were?

Radka: That's a good question because we know that many mycotoxins are orthogenic and are well-known as a source of mutation in the environment. But the increase in UV radiation from climate change-related temperatures, that's going to increase the number of mutations as well. Mycotoxins and UV radiation, both are causing mutations in nature.

 I don't know what is going to be the impact of the UV radiation on the mycotoxin production. It probably might have a direct impact on molds as well because if we have high UV radiation, that's going to cause increased number of mutations in nature, including the molds. The more I would see that, those two will work in synergy. So if fungi and mycotoxins are producing more mutations in nature and UV radiation is doing the same, we can expect more mutations in nature in the future, and we know that mutations might be very dangerous.

Nick: Radka, given the comments around climate change and some of the different elements that you've talked about, what are some of the potential options and opportunities within the feed chain to reduce mycotoxins given this changing landscape?

Radka: Definitely. Climate change has started many years ago when we were already doing that. It's definitely good agricultural practice and good manufacturing practice. So the pre-harvest and the post-harvest methods help reduce mycotoxins in the crops, and then also how to reduce the concentrations of mycotoxins which are fed to the animals.

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 Definitely from the wider perspective, we can see also the strategies of countries or regions to reduce climate change. For example, Europe, which just recently launched the Green Deal. What the Green Deal means is that Europe wants to make its economy more sustainable. The goal is to become climate-neutral by 2050. That's, I would say, a wider perspective, but it's going to have an impact on the agriculture. It's going to have an impact on all of us.

Nick: Radka, it is a fascinating area, so many different things that are playing into this bigger picture. Obviously, we've got the European Green Deal now coming in and people are really trying to get their heads around what that means in terms of how we can try and hit the sustainability targets and some of the requirements around the different types of agricultural practices, reduce pesticide use, et cetera, that will go into those things. Certainly, moving forward, the future is going to be an interesting one. When you look at it from an Alltech standpoint, how do you think Alltech can contribute to successful mycotoxin risk management in times when the environment is changing so dramatically?

Radka: That's a good question, Nick. That's why we are here. In my opinion, Alltech has many possibilities, how we can operate or how we can help the agriculture to decrease the impact of climate change. For example, the Alltech Crop Science products, they offer producers free chemical alternatives in improving the crop's health and resistance. That's what I was talking in the previous part. Every time the crops or the plants are in stress, they are more vulnerable to the molds and fungi. If we improve the health and resistance of plants, we can pretty much decrease the mycotoxin contamination. If we talk about the post-harvest strategies then Alltech Mycosorb product range offers to producers different solutions for the management of mycotoxins.

 What I forgot to mention is when the climate is changing and those regions are shifting and we have cooler and warmer regions, we need to analyze or test for mycotoxins more often, and that's what Alltech is doing. We provide our customers with services, which we call Alltech 37+ where we can help them to analyze mycotoxins. Also, Alltech recently launched the RAPIREAD analytical programs where again we help the farmers and the feed users to analyze mycotoxins in raw materials. Just one example, if we, for example, use the Mycosorb in 100,000 layers, we can help to improve their performance, which could be somehow impaired by mycotoxins. By improved performance, we could reduce the overall carbon footprint by 3.76% based on our meta-analytical data. That's equal to the impact of removing 124 cars on the road or planting 190 trees. That's one feed additive.

 What if the layer producer would apply several feed additives, which could increase the performance and reduce the carbon footprint? How many cars could be removed from the road if we do that? How many trees could be plant if we do that? There are so many feed additives especially from Alltech, which have the ability to reduce the carbon footprint. That's a question which we have to ask ourselves, is how agriculture can contribute to climate change or reduction of the impact of climate change. That would be the question I would ask definitely.

Nick: Radka, when we think then about Mycosorb, one of the things that we know about mycotoxins is that they will typically reduce the performance efficiency and the total production of livestock and poultry. What can we learn from research in these situations to say, well, okay, what does that do for carbon footprint? Can we offset some of that carbon footprint if we're using products like this? What do we know?

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Radka: Yeah. That's a good question, Nick. Definitely, we have a scientific animal data, which are published in peer-reviewed journals. When we take all of those data, when we make the meta-analysis, we can look at the impact of Mycosorb on the animals. In this case, we are looking at the impact of Mycosorb on the layers and the performance of layers when they were challenged with mycotoxins and treated with Mycosorb. We could see that there was clear performance impact of mycotoxins, and this performance impact was that the performance of layers was decreased. But when Mycosorb was applied, the performance was protected or increased, which consequently reduced the carbon footprint of that layer production of those 100,000 layers, let's say, if we want to bring it back to the numbers. So basically, we talk about scientific data put into the meta-analyses and evaluating those results and changing all of those data on the impact of Mycosorb on the carbon footprint in layers.

Nick: Thanks very much, Radka, great insights there in and around the whole concept of climate change and how that will impact molds and mycotoxins.

Radka: Thank you.

Nick: If you'd like to find out more on this topic, you can head over to our blog on knowmycotoxins.com. That's knowmycotoxins.com. Look out for the blog titled "Climate Change and Mycotoxin Risk: Analyzing an Evolving Problem." We look forward to catching up with you next time on Mycotoxin Matters.

Female: We hope you enjoyed listening today and we look forward to you joining us next time on the Mycotoxin Matters Podcast. For more information on the topics discussed, please visit knowmycotoxins.com. That's knowmycotoxins.com.

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