What have we learned about forage quality and mycotoxins?

Forages have long been the standard feedstuff for ruminant livestock production. The use of higher forage content total mixed ration (TMR) has increased in recent years, creating the need for greater monitoring of the quality of high-inclusion feedstuff(s).

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Major forage crops include corn silage, grass silages, haylages and small grain silages.

These, individually and in combination, will represent most of the TMR, and their quality is a determining factor in efficient production and animal health.

Weather stresses can greatly influence forage crop quality. These stresses can include drought, excess moisture, wind, hail and combinations of these factors. The stress will make the plant more susceptible to mould infestation.

These soil-borne moulds include Aspergillus, Fusarium and Penicilliums that can produce secondary metabolites called mycotoxins. In addition to the challenge posed by these individual mycotoxin types, there is also potential for additive and synergistic toxin effects to be considered.

The associated environmental stresses and some of the mycotoxins produced from these moulds are:

- Aspergillus (warm and dry environment): aflatoxin, gliotoxin, sterigmatocystin and verruculogen.
- Fusarium (moderate temperature and moist): trichothecenes, fusaric acid, emerging mycotoxins, fumonisin and zearalenone.
- Penicillium (drier, less densely packed forage clamps that allow oxygen penetration): mycophenolic acid, penicillic acid, roquefortine C and patulin.

Table 1. Mycotoxin occurrence in samples analysed during the Alltech 2020 North American Summer Harvest Survey.

Mycotoxin	Mycotoxin occurrence (%)
Fusaric acid	94.44
Type B trichothecenes	80.90
Emerging mycotoxins	70.83
Fumonisins	63.54
Other Aspergillus	11.46
Type A trichothecenes	4.51
Zearalenone	3.47
Ergot toxins	3.13
Aflatoxins, total	2.78
Other Penicilliums	2.78
Aflaxtoxin B1	1.04
Ochratoxins/Citrinin	1.04

Factors influencing mycotoxin production

The climatic factors that can affect forage quality and mycotoxins may range from a high impact incident in a day or two to longer-term seasonal effects. The timing of these events in terms of plant maturity is important as to which mycotoxin(s) may be produced. Most of this relates to pre- and post-flowering and pollination.

This critical phase is also when the plant is susceptible to climatic, disease and insect challenges that can further increase plant damage and subsequent mould infestation and mycotoxin challenges. Crucial to the success of a mycotoxin management programme is effective mycotoxin analysis.

Identifying multiple-mycotoxin contamination using tests such as Alltech 37+ is a more accurate risk assessment of feeds. However, producers should not discount the value of a rapid mycotoxin test such as Alltech's RAPIREAD, which can provide results in minutes for individual mycotoxins.

The sample itself must be collected while considering the amount of variation in the total inventory. It has been shown that silage cannot be regarded as a homogeneous mixture due to variation within a field, plant maturity and dry matter, time to harvest and fill, delays due to weather and breakdowns and filling and packing methods. Therefore, it is important to utilise multiple samples from throughout the silage pile to build a pooled sample that attempts to develop a homogenous selection of the available inventory.

The mycotoxin impact on ruminant animals

The greatest mycotoxin challenge in corn silage typically derives from the Fusarium mould, while the most prominent mycotoxins are type B trichothecenes, fumonisin, fusaric acid and emerging mycotoxins.

In Alltech's 2020 North American Summer Harvest Survey (Table 1), almost 95% of the 288 samples analysed contained fusaric acid, over 80% contained type B trichothecenes and over 70% of samples were contaminated with emerging mycotoxins. These mycotoxins in feeds can lead to issues with dry matter intake, milk production, average daily gain (ADG), digestion, gut health, liver function, respiratory health, conception rate, liver function and immune response.

Mycotoxins can be present at high risk levels at harvest, and the trend is that they can increase over time in storage. The exact nature of this increase in risk is dependent on the individual situation. Vandicke et al. (2021) suggested that some field-produced mycotoxins may be reduced during storage.

Still, if silages are poorly made, this effect is lost through the production of storage mycotoxins, increasing the overall risk. This trend has been seen in recent years based on submissions to the Alltech 37+ mycotoxin analysis laboratory. Corn silage data collected in Alltech's US Harvest Analysis over a three-year period, 2018-2020, shows an increase in Fusarium mycotoxins over time from harvest until winter and spring feed-out. Deoxynivalenol, one of the most occurring mycotoxins, has a consistent year-on-year increase during this period.

There are some key steps in the management of forage during harvest

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and ensiling that producers can take to minimise this risk, including ensiling forages between 32-36% dry matter content, tightly packing and sealing the clamp and proper clamp face management during feed-out to minimise oxygen penetration.

Penicillium can present a major challenge in grass silage and haylages. Penicilliums are normally viewed as storage mycotoxins, and dry, poorly packed silages and haylages can allow greater oxygen penetration, providing the conditions for micro-aerobic mould to flourish.

The levels of Penicilliums can increase greatly from harvest through feed-out. Small grain silages can have an array of mycotoxins present, but typically Fusarium and Penicilliums occur the most. Zearalenone tends to be more present in cooler and wetter growing seasons, with subsequent negative effects on reproduction performance when ingested by animals.

The actual mycotoxin risk can range from low to high. It can be the result of an individual mycotoxin at lower or higher risk or multiple mycotoxins that generate additive and/or synergistic interactions. The multiple-mycotoxin challenge is demonstrated in Fig. 1.

An effective mycotoxin control programme must be able to manage all situations. A higher risk situation was studied across three separate dairy farms. In this study, a multiple-mycotoxin challenge resulted in decreased milk production and increased somatic cell count (SCC) across all three farms.

When a glucomannan mycotoxin adsorbent (GMA) was added to the diet, milk production increased by 6.1kg/cow/day, SCC decreased by 62% and Trolox equivalent antioxidant capacity (TEAC) was improved over an eight-week period. Lower-risk challenges are often considered as non-challenging to cow health and performance.

Hulik (2014) demonstrated that multiple mycotoxins at low risk did not significantly impact milk production. However, when a GMA was included in the control programme, the pregnancy rate was improved by 19.3%.

Fig. 1. Key results from the Alltech 2020 North American Summer Harvest Survey.

Mitigating the mycotoxin threat

The climate impact on crop quality and subsequent mycotoxin contamination poses a continuous risk to healthy and efficient ruminant production.

This mycotoxin risk can be further increased by less-than-ideal harvest and storage conditions.

Although mycotoxins are an unavoidable problem, some key management practices can help reduce the risk attached to forages and ruminant feeds.

Alltech believes that effective mycotoxin management is about seeing the whole challenge, from the farm to the feed mill and from risk assessment to feed management.

To effectively manage the inevitability of feed mycotoxin contamination, it is crucial to understand the level of mycotoxin challenges so that the right steps can be taken to mitigate any adverse effects on animal performance, production efficiency and food safety.

Using a combination of modern management tools, the Alltech Mycotoxin Management Program provides a complete holistic solution to help producers take control of mycotoxin contamination and protect their businesses.

The programme is built around next-generation risk identification technology, data analysis and insights and mycotoxin binder solutions designed to reduce the damaging effects of mycotoxins on animal health and production potential. ■

References are available from the author on request