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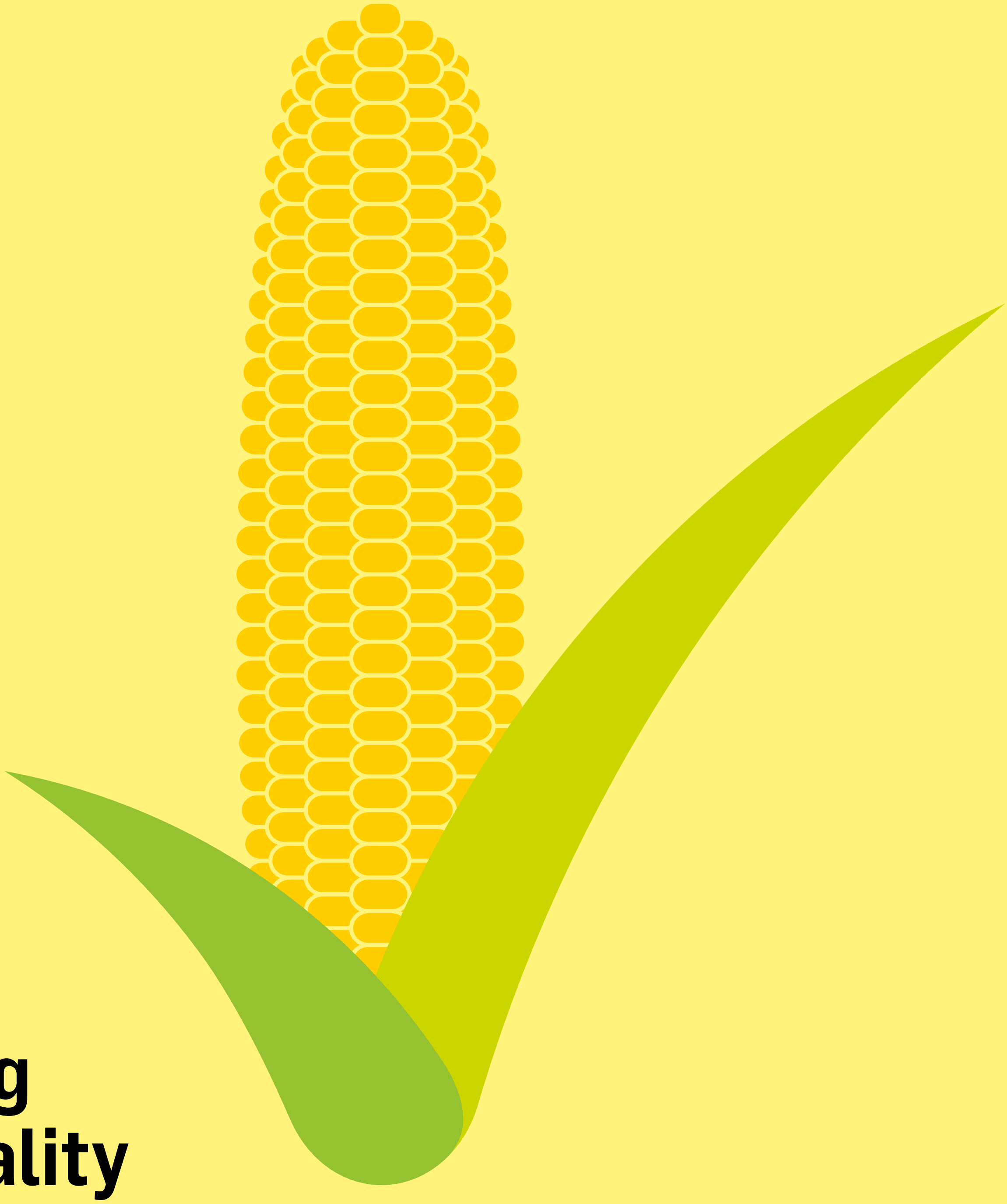
Keeping you naturally informed | Issue 57 | Ruminants

Should we trust our feed to deliver dairy cow performance?

Get more out of your corn silage with BioStabil® Mays

What is wrong with my herd? Part 7



Ensuring high quality corn silage

Are you ready to switch to summer management?

For the majority of people, summer means going on holiday, resting from work and spending time with family and friends.

For dairy farmers, summer is a challenging time with intensification of fieldwork and helping animals overcome the problems associated with heat stress. All farm staff –including the nutritionist, veterinarian and agronomist– are on high alert to manage potential problems. In summer, high-performing animals require more attention.

Over the past two decades, intensive genetic selection to enhance efficiency and milk production has resulted in high-performing dairy cows that require a lot of attention. This is even more necessary with increasing environmental temperatures, often coupled with higher humidity levels.

It is important to avoid mistakes like animal sorting, improper feeding or lack of ventilation. We know that mistakes made in the summer have long-lasting, costly consequences on the health status and performance of animals. The first article in this issue of Science & Solutions offers suggestions on how to support your high-performing herd using proper nutrition.

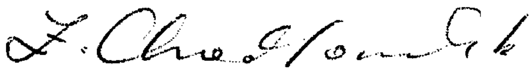
As summer is also a very intensive time for agronomists, this issue will review a number of challenges faced when growing corn for silage in different geographical regions together with some success factors.

You will also learn why it is so important to properly preserve harvested forage material with the use of the unique bacteria strain *L. kefiri* in Biostabil® Mays from BIOMIN.

Finally, Paige Gott gives a short overview of the factors influencing mastitis, which are often related to an increase in environmental temperatures. She offers some practical advice on how to prevent this costly disease.

All of the topics were prepared especially for you so please enjoy reading this issue of Science & Solutions, keeping you naturally informed.

I would like to wish you a happy summer, relaxing with family and friends in a peaceful atmosphere.



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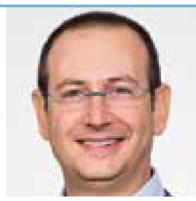
Should We Trust Our Feed To Deliver Dairy Cow Performance?



Paolo Fantinati
Technical Sales Manager

Rising demand for milk and milk products is putting increasing pressure on each individual animal in the dairy herd. Technological and genetic advances have raised potential milk yields, but does our feed help or hinder performance?

Rise in milk production

Cows are genetically selected for efficiency, resulting in modern animals that are highly productive, but at the same time very fragile and demanding. Twenty-five years ago, the average dairy cow produced 6,029 kg of raw milk per year. Twice-a-day milking was the norm, and bovine growth hormones were an emerging topic of debate. Today's modern dairy cow produces an average of 9,681 kg of milk each year, a 61% increase in a quarter of a century. That means the average modern dairy cow weighing 680 kg may produce close to 5% of its body weight in milk per day of lactation. Growth hormones and three-times-a-day milking are major factors in the increase in milk production, as are high-energy feed rations and genetic selection for animals with the highest milk outputs.

There is an increasing global thirst for milk and milk-based products. The forecast is that milk production will increase considerably, driven by consumer demand in emerging markets. The International Farm Comparison Network (IFCN, 2016) forecasted an increase in milk production of 54% in India, 43% in Africa, 27% in China and 43% in Brazil (*Figure 1*).

Meeting this growing demand requires upgrading many aspects of dairy farm management. New feeding strategies have been developed and new additives have become available to effectively increase animal efficiency, control the rumen environment and prevent damage caused by the presence of anti-nutritional factors in the feed.

IN BRIEF

- Increasing demand for milk has fueled technological and genetic improvements in the dairy industry.
- Feed is very variable, making consistent milk production a challenge.
- Forage and grains are key components of the dairy cow diet, but they are also likely to harbor anti-nutritional factors such as mycotoxins.
- Regular feed analysis, adequate storage and a proper mycotoxin mitigation strategy will help reduce the risk of mycotoxins inhibiting the performance of your herd.

Feedstuffs are variable in quality

Dairy cows rely on energy, protein, minerals and vitamins for milk production, making the quality and composition of feedstuffs essential. However, the nutritional composition of cereals and oilseeds is very variable and sometimes inadequate to satisfy a modern cow's requirements, jeopardizing profitability. Variability can occur in protein content, mineral value and amino acid profile.

One of the main protein sources for dairy cows, soybean meal, fluctuates in its nutritional value depending on its source. García-Rebollar *et al.* (2016) tested 500 samples of soybean with three different origins (US, Argentina and Brazil) in a nine-year comprehensive study. As expected, the study showed a huge variation both between samples from the same area and between samples from different origins—a direct consequence of different cultivars, climate conditions and soil characteristics.

Preservation method and microbiological characteristics

Figure 1.
Forecasted increase in milk production around the world

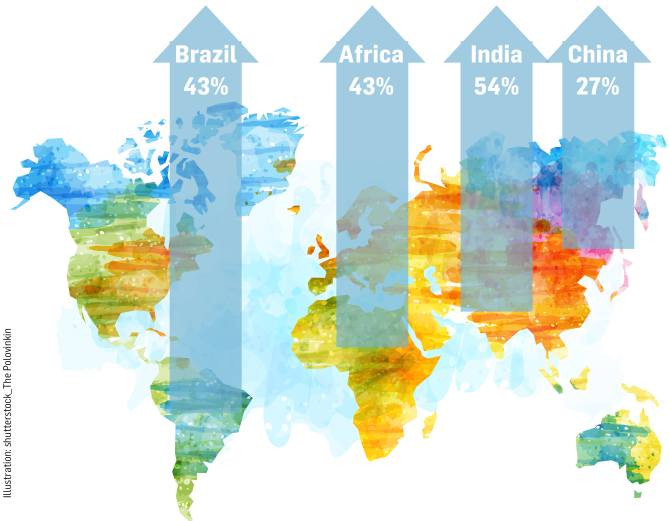


Illustration: shutterstock_The Polovinkin

Source: IFCN, 2016

are important determinants for the nutritional quality of feedstuffs. For example, corn loses some of its nutritional value when infected with mold. The contaminated grains have a lower protein content (falling from 9% to 8%), lower fat content (from 4% to 1.5%) and consequently contain lower levels of energy (Tindall, 1983).

Representative forage sampling is a challenge

Forages are essential feedstuffs for dairy and ruminants in general. Roughage is a necessary component of the ruminant diet to maintain good rumen health and efficiency. Forages are much more variable than cereals, not only in their chemical composition, but also in terms of digestibility and their ability to stimulate rumination. However, forage sampling is complicated due to the inhomogeneous distribution of nutrients.

Given the double function of forage (nutritional and mechanical), mistakes in evaluating forage quality can have severe consequences. The dry matter of corn and grass silage varies considerably over time. Wet forage should be analyzed each week to prevent overestimation of dry matter intake. However, this analysis is often overlooked and, considering the high inclusion levels of wet silage in dairy rations, the risk of energy deficiency and lack of effective fiber can be severe, quickly compromising animal performance and health, and predisposing animals to ketosis and other metabolic diseases.

The evaluation of neutral detergent fiber (NDF) and its digestibility can be crucial. Overestimating the NDF content can increase the risk of sub-acute ruminal acidosis (SARA) in high-producing and fresh cows, while underestimation can slow down the transit time of forage in the rumen and consequently limit feed intake. In this situation, the dairy cow will be at risk of falling into a negative energy balance.

SARA is a pathology that can negatively influence production and health. It stems from an excess of fast fermenting carbohydrates in the diet, a common feeding technique to meet the high energy demands of modern lactating animals. Increasing chewing activity by providing effective sources of fiber is one of the most reliable strategies to control SARA. In this regard, wheat straw is a good and economically effective fiber source that is often widely available at farm level. Unfortunately, wheat straw is one of the forages more likely to be contaminated with mycotoxins (*Figure 2*).

The threat from anti-nutritional factors

Grains and forages are not only a source of nutrients; they can also hide many threats such as naturally occurring anti-nutritional factors. Some can be mitigated with technological treatments (e.g. antitrypsin factors) but some can persist or even increase during storage. Mycotoxins, secondary metabolites from fungi and molds, are one example of anti-nutritional factors that can survive storage and cause problems to animals.

A recent survey showed that the majority of the 170,000 known natural metabolites have fungal origins (Gruber-Dorninger *et al.*, 2016). Some fungal metabolites have pharmaceutical uses like penicillin. Other components, such as ergot alkaloids, have both poisonous and pharmaceutical properties. Some mycotoxins, such as aflatoxins and trichothecenes, are potent poisons for dairy cows.

A wide range of grain and forages can be contaminated by mycotoxins, of which more than 400 strains have been identified to date. The 2017 BIOMIN World Mycotoxin Survey, the broadest and most comprehensive analysis of global mycotoxin occurrence, showed that the risk of mycotoxin contamination remains high for fumonisins, with deoxynivalenol and other trichothecenes being the most commonly occurring mycotoxins globally.

Detecting mycotoxins

The presence of mold on feedstuffs does not indicate mycotoxin contamination, but it does indicate that the potential for contamination exists. On the contrary, the risk of contamination in feedstuffs that appear clean or mold-free cannot be excluded. Mycotoxins themselves are invisible to the naked eye so visual detection is not possible.

The risk of contamination in feedstuffs that appear clean or mold-free cannot be excluded as visual detection of mycotoxins is not possible.

The economic effects of mycotoxins on animal performance are clear. The rumen is the most important organ in dairy cow digestion, and the composition of feedstuffs affects its function and metabolic activity. The liver is another important organ for cow nutrition, and its efficiency and health can affect performance. Mycotoxins are perhaps the main anti-nutritional factors, having a direct negative effect on both the rumen and the liver as well as many other organs (*Figure 3*).

Many scientific articles have shown that mycotoxins pose a real risk. For example, Abeni *et al.*, (2014) showed that a combination of aflatoxins and fumonisins was able to reduce the growth rate and increase the age of the first estrus in heifers. This delay was due to chronic liver toxicity, which reduced the liver's ability to produce glucose.

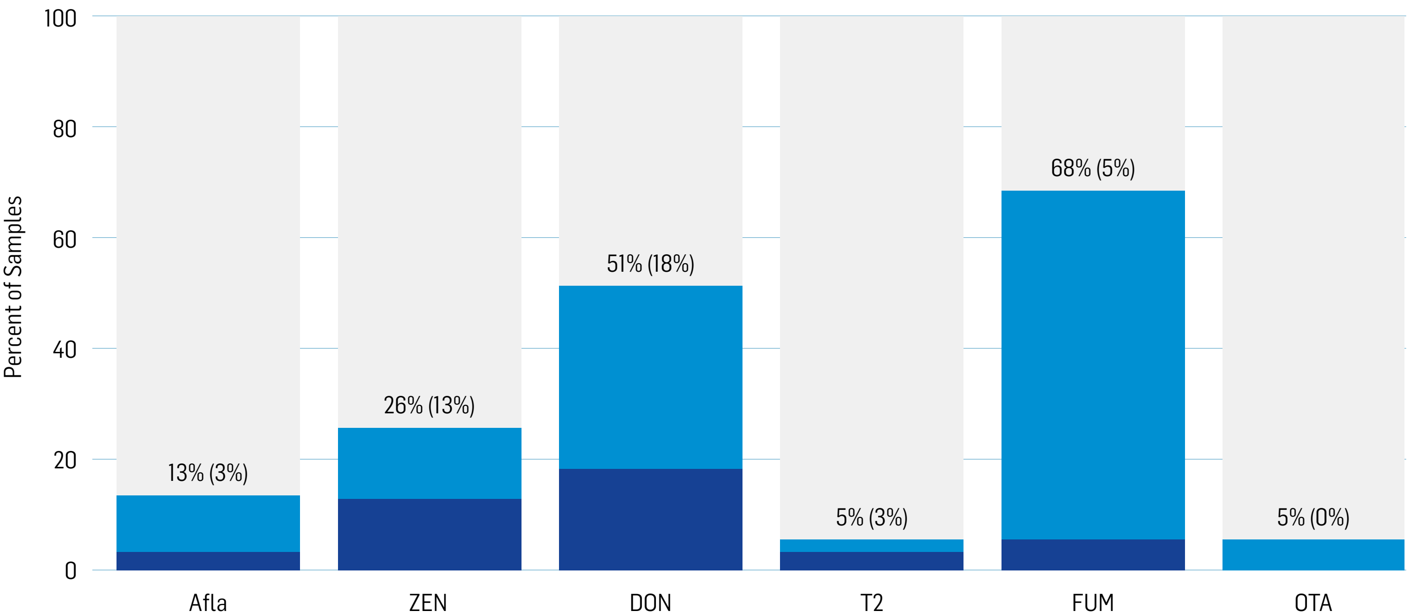
Deoxynivalenol, the most frequently occurring mycotoxin worldwide, can reduce rumen function, microbial production, metabolizable protein availability and flux of essential amino acids to the intestine (Danicke *et al.*, 2005). Therefore, in case of the presence of trichothecenes in feedstuffs, nutritionists seem obliged to increase protein levels in the diet in order to maintain milk production levels, which is an expensive proposition.

Mycotoxin management in three simple steps

Feedstuffs can sustain milk production and provide nutrients. However, feedstuffs have two main drawbacks: variability and high mycotoxin contamination. While it is not possible to eliminate either, these steps can help reduce the risks:

Figure 2.

Mycotoxin contamination in straw. The dark blue shading indicates the proportion of samples for which the mycotoxin level exceeded the risk threshold for ruminants (% value given in brackets).

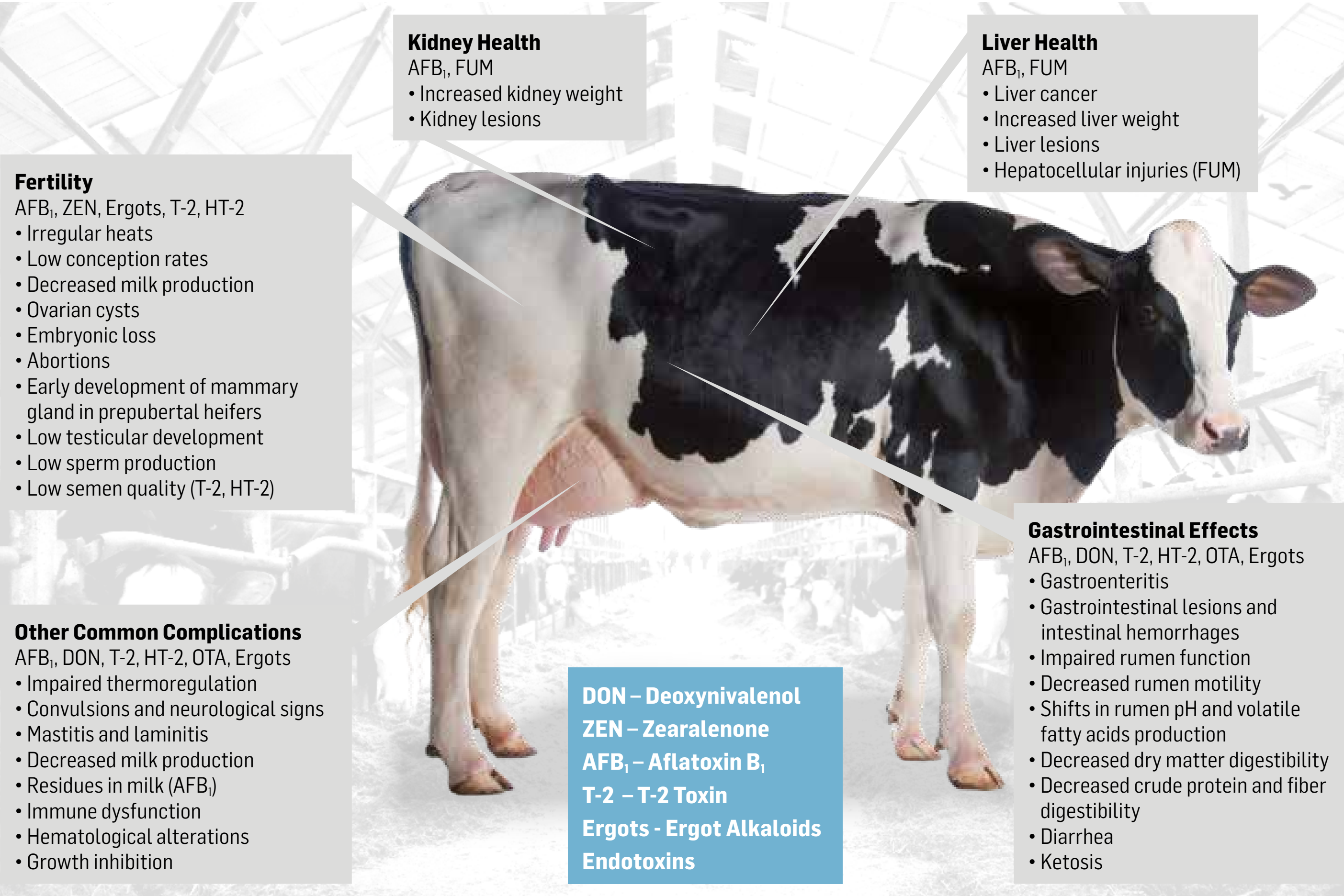


Alfa - Aflatoxins, ZEN - Zearalenone, DON - Deoxynivalenol, T2 - T2 toxin, FUM - Fumonisin, OTA - Ochratoxin A

Source: BIOMIN Mycotoxin Survey, 2017

Figure 3.

Effects of mycotoxins in ruminants



Step 1. Analyze feed regularly. It is important to understand the risk associated with each feedstuff, and to assess them for anti-nutritional factors. Analysis of feedstuffs for the presence of mycotoxins is common practice and a high priority, especially in view of the worldwide prevalence of fungal metabolites.

Step 2. Store feed properly. Ensure proper preservation of feedstuffs to achieve a more stable nutritional composition over time. It will also reduce the growth of storage mycotoxins.

Step 3. Apply a multi-strategy mycotoxin deactivation product. Mycofix® counteracts a broad spectrum of mycotoxins, offering the most comprehensive method of mycotoxin control.

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Get More Out of Your Corn Silage with BioStabil® Mays

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Ruminant Technical Manager

Corn silage is successfully grown around the world in most climates, but timely harvesting and correct ensiling procedures are required to ensure the highest quality is achieved. Adding BioStabil® Mays to harvested material will ensure protection against a wide range of pathogens, maintaining forage quality and delivering animal performance.

On most dairy and beef farms today, we see corn silage in the ration. Why is corn silage so popular in milk and meat production?
In many different geographical regions around the world, corn silage is the main ingredient of cattle diets. It provides an excellent source of energy along with fiber to stimulate chewing activity. It has a high value not only from the animal's perspective in terms of a high nutrient content to support production, but also from the profitability and economic point of view of the farmer, as it is able to improve feed efficiency and achieve high levels of animal performance.

The maize plant, although originally from Central Mexico, has adapted and grows well in a wide range of climates and on many different types of soil. Even in regions with unpredictable rainfall, corn for ensiling grows and remains a more reliable source of nutrients than other forages. However, in order to become a valuable and palatable diet ingredient, it must be harvested in a timely manner and preserved appropriately. If the ensiling process of a very good corn crop is poorly executed, problems will arise for the farm manager and the animals at feed-out.

IN BRIEF

- Corn silage is used in ruminant diets globally as an excellent source of energy and fiber.
- While corn is able to grow in many climates, the quality of corn silage is greatly affected by time of harvest and the ensiling procedures used.
- The silage harvest typically occurs when either plant condition or harvesting conditions are compromised, increasing the likelihood of the silage being contaminated with pathogens.
- Adding BioStabil® Mays to harvested material will protect against pathogens before ensiling, ensuring that silage quality and subsequent animal performance are as high as possible.

What could farmers do better when managing corn plants for silage?
The best methods for growing corn and preserving silage come from the very good farms. However, in practice, crop management looks very different from farm to farm.

Some farms manage silage perfectly well and others not so well. It often happens that a good crop brought in from the field dramatically loses its nutritional value during storage in pits and silo bunkers, and during feeding out. Heating of the silage in storage and on the feeding table is very common. Small changes due to improper management of the fermentation stage happen very often, leading to complaints about reduced feed intakes.

Why is harvest time so important in silage production?
In practice, the maize harvest for silage takes place in one of two ways. It either falls in the very busy time of late summer, when there is increased workload and a shortage of time, machinery and people due to all the other necessary work that must be carried out, resulting in the maize harvest being delayed. Alternatively, harvest falls in early autumn as one of the last fieldwork tasks of the year, in the period of lower

temperatures, shortening days and frequent rainfall, which hinder or prevent the entry of machines into fields. Neither of these situations is ideal.

If late summer harvesting happens in southern countries, the undesired drying of leaves, stems and kernels promotes the development of fungi and other harmful microorganisms. These are then transported with the plants and stored in the silo. Over time, starch in the kernels changes into a less available form. The dried leaves and stalks become less digestible for the animals and more difficult to cut down into short pieces for proper compaction. There is likely to be a high level of mycotoxin contamination, causing further problems when the contaminated silage is fed.

With early autumn harvesting more popular in cooler regions located further north, maize has a very slow start after planting due to the reduced soil temperature. In many cases, the corn must be harvested before the grain is fully matured, due to the high risk of early frost. In those regions with prolonged periods of coolness accompanied by abundant, long-lasting rains, the harvest of immature plants is further hindered by poor field conditions, preventing the use of harvesting machines. Both scenarios cause further problems with ensiling and feeding out.

What kind of problems can we expect with delayed harvest or harvest of immature plants?

Any delay to the silage harvest will increase the risk of contamination with fungi, molds and yeast. This causes both aerobic and anaerobic instability of the ensiled material, leading to a significant reduction of nutrients.

Dried plants are more difficult to cut and many leaves are left uncut, having slipped through the knives of the harvester, making them resistant to compaction. Proper compaction of such a material is almost impossible; a lot of oxygen will remain hidden in the stems, which will cause further problems with yeast activity and a general instability of the ensiled material due to heating.

Plants harvested with a relatively low dry matter content in rainy, wet conditions are exposed to significant soil pollution with high risk of *Clostridia*, *Listeria* and *Enterobacteriaceae* contamination.

All pathogens that are present on plants will also be present in the storage silo, competing for nutrients including carbohydrates and proteins. During their growth, microorganisms will also carry out their own fermentation. For example, the presence of *Clostridia* leads to higher levels of butyric acid, and alcohol is a result of yeast fermentation in the silage. The result is not only a significant reduction in the nutrient content of the stored material but also poor palatability. *Listeria* is responsible for abortion and mastitis problems on farms. *Enterobacteriaceae*, which is very common in wet silage, converts plant sugars into acetic acid, ethanol and CO_2 with high nutrient loses, a bad smell and compromised palatability.

Is there a method to prevent these undesirable microorganisms from getting into the ensiled material or to kill them before storage?

Unfortunately, there is no such method. We cannot shake or wash them out of the plants prior to ensiling. Nor can we use a chemical treatment as the forage needs to be safe and palatable for the high-producing animals it is being fed to.

The only way to reduce the microorganism content is by creating conditions in the ensiled material that will quickly stop or at least limit their growth. Unfortunately, this is not an easy task. When the growth of *Clostridia* and *Enterobacteriaceae* limit the rapid reduction in pH, yeast and *Listeria* can still cope with only slightly acidic conditions. Compaction and elimination of oxygen will also not always work as yeast and *Clostridia* are not affected by oxygen reduction. Yeast can survive under both aerobic and anaerobic conditions and *Clostridia* needs anaerobic

Forage is the main component of the ration. In order to reduce costs on farm, forage quality needs to be high.

Table 1.
Control of harmful microorganisms present in silages

Parameter	Microorganisms				
	Listeria monocytogenes	*Clostridia*	*Enterobacteriaceae*	Yeast	Molds
Anaerobiosis Compaction	+++	—	+++	+++/-	+++
pH *L. brevis* *L. plantarum*	+++	+++	+++	—	—
Lactic acid* (fermentation) *L. brevis* *L. plantarum*	+++	+++	+++	—	—
Acetic acid* (Feed out) *L. kefiri* *L. brevis*	+	+	++	+++	+++

— Low inhibition + High inhibition * Factors influenced by inoculants

conditions for growth and reproduction. *Table 1* shows some methods of controlling microorganisms.

Is there a method that will limit the growth of harmful microorganisms in such a complicated situation?
BioStabil® Mays from BIOMIN is a new solution for ensiling corn with such a wide range of pathogens. BioStabil® Mays is an inoculant with a broad spectrum of protection covering a wide range of harvested corn dry matter contents. BioStabil® Mays contains a unique combination of the strains that effectively fight the pathogens during the ensiling process of maize plants (*Table 1*).

This unique combination of strains includes:

- *L. kefiri,* a novel hetero-fermentative bacterial strain that works very efficiently against aerobic yeast, causing secondary fermentation in high dry matter silages.
- *L. brevis*, also a hetero-fermentative strain that works very effectively in low dry matter silages, with strong pH reduction and high efficiency in reducing *Clostridia* and *Listeria* in ensiled materials.
- *L. plantarum*, a strong homo-fermentative strain leading the fermentation process, limiting *Enterobacteriaceae* and other coliforms.

Does using Biostabil® Mays on silage guarantee the best quality corn silage for efficient milk and meat production?
In the past, different methods have been tried with varying results. The search for even better results is still ongoing but today, BioStabil® Mays offers the best solution for silage production.

Forage is the main component of the ration. In order to reduce costs on farm, forage quality needs to be high. With high-quality, well-preserved forage, we can expect high dry matter intakes and better digestibility of nutrients, followed by enhanced feed conversion, and ultimately higher farm profitability.

Proper silage management consists of:

1. Proper harvest and timely storage of the harvested material
2. Adequate cutting length of the material with crushing of the kernels
3. Uniform application of BioStabil® Mays on harvested material
4. Compaction, compaction, compaction
5. Timely covering of the compacted material
6. Ongoing silage face management

What's Wrong With My Herd?
Part 7 – Mycotoxins and mastitis

Paige Gott PhD
Ruminant Technical Manager

Mastitis, a costly disease affecting the dairy industry worldwide, is a complex disease with many factors influencing its occurrence. Mycotoxins can increase the risk of mastitis and negatively impact milk production and milk quality.

Mastitis is an inflammation of the mammary gland, typically caused by an intramammary infection. Bacteria are the most common cause of mastitis in dairy cows, but other microorganisms have been isolated from the milk of quarters with mastitis including yeast, fungi, mycoplasmas, algae, and viruses. Physical trauma or chemical irritation can also cause mastitis.

There are multiple ways to classify cases of mastitis. The first major classification is the source of the pathogen (*Table 1*). Major contagious pathogens include *Staphylococcus aureus*, *Streptococcus agalactiae*, and *Mycoplasma* spp. Common environmental pathogens include *Escherichia coli* and *Klebsiella* spp. as well as environmental *Streptococci* including *S. uberis* and *S. dysgalactiae*. A third group exists, 'skin flora opportunists', which consists of the coagulase negative *Staphylococci* (CNS) species that colonize healthy teat skin.

The second classification of clinical vs. subclinical mastitis deals with the presentation of the disease. Clinical cases result in visible abnormalities of the milk and/or quarter, and range from mild to severe. Subclinical infections do not cause overt changes in the milk or quarter. Both mastitis types cause increases in somatic cell count (SCC). An elevated SCC often signals subclinical mastitis.

A third classification is acute vs. chronic mastitis. This has to do with the timing and duration of the disease. Acute cases are characterized by their sudden onset, but are often quickly resolved. Chronic cases continue over a longer period of time.

Table 1.
Contagious and environmental mastitis

	Contagious mastitis	Environmental mastitis
Reservoir	Infected mammary glands	The cow's environment including bedding/stalls/soil, manure, water and feedstuffs
Exposure	Spread from cow-to-cow via milking equipment, milkers' hands or towels, flies and other vectors	Constant exposure exacerbated by heat and humidity

Costs

Economic losses stem from reduced milk production and decreased milk quality. Farmers must discard milk from cows with clinical cases of mastitis and from cows undergoing antibiotic treatment (according to withdrawal periods). Treatment and veterinary costs rise, as do labor costs.

Mycotoxins

Some of the main consequences of mycotoxin contamination in dairy cows in relation to udder health and milk production are:

- Reduced milk yield and quality
- Toxic contaminants in milk, especially Aflatoxin M_1
- Increased risk of intramammary infections and mastitis
- Altered milk composition

Reduced milk yield results from several factors, including a decrease in feed intake or feed refusal associated with certain mycotoxin contamination of the feed. Additionally, mycotoxins can alter rumen function, reducing nutrient absorption and impairing metabolism, which ultimately leads to reduced availability of the precursors needed for milk synthesis.

Addressing predisposing factors

Proper milking parlour management and milking routines are essential to limiting the risk of mastitis in a herd. The milking system must be well maintained, ensuring that properly functioning, clean equipment is used to harvest milk.

Good hygiene is critical. Clean sand is considered the gold standard bedding material, as inorganic materials do not support the growth of pathogens. The environment also influences mammary health as increased temperature and humidity better support pathogen growth in the cow's surroundings. Additionally, heat stress reduces the cow's resistance to infection.

Cows in negative energy balance, especially transition cows, are more susceptible to infection. Diets must meet vitamin and mineral requirements to support proper immune function. Coordinating the delivery of fresh feed while cows are in the parlour will entice cows to eat once they return to the pen after milking. This provides time for the teat ends to close while the cows remain standing at the feed bunk and limits exposure to pathogens following milking. Finally, feed should be monitored for the presence of mycotoxins and an effective mycotoxin-counteracting product should be incorporated into the feed.

Many factors influence the development of mastitis, making mastitis control and prevention a constant challenge for dairy producers striving to produce high quality milk for consumers.

For more information, visit www.mycotoxins.info

References are available on request