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Five Common Silage Sins

The following article is based on a paper delivered by Professor Keith Bolsen several years ago in both Australia and New Zealand. Keith Bolsen, recently retired, was Professor of Animal Sciences, Ruminant Nutrition and Forage Preservation at Kansas State University for 30 years. He is credited with probably conducting more research and trial work into silage, and particularly silage inoculants, than any other institution worldwide.

Keith addresses silage making factors, which he has observed, that receive insufficient attention in order of which they occur. I will follow his order.

Inoculating silage crops. Keith commits half his paper to silage inoculants alone, an issue he credits with major implications. Effective bacterial inoculants promote faster and more efficient fermentation of the ensiled crop with the impact of both increasing quality and quantity of silage. The key to bacterial silage inoculant effectiveness is to produce a very rapid drop in pH of the ensiled crop.

Once pH has reached 4.5 (5 in wetter crops) the silage is stable, and due to acidic conditions no further fermentation should take place. Bacteria and enzymes cannot work in low pH. Rapidly stabilised silage retains more energy, protein and dry matter.

Bacterial inoculants have inherent advantages over other additives including safety, low cost, low application rates, no residues or environmental problems. In fact they contribute to reducing the environmental problems of silage effluent, ethanol and ammonia nitrogen, and have higher digestible protein benefiting both cow nutrition and milk production, and reducing soil nitrogen compounds from manure.

Extensive research at Kansas State University showed in a summary of results from over 200 laboratory-scale studies involving nearly 1,000 silages and 25,000 storage situations, indicated bacterial inoculants were beneficial in over 90% of comparisons.

Quality inoculants contain strains of lactic acid bacteria isolated from silage samples, cultured to commercial quantities for their ability to ferment sugars predominantly to lactic acid and not a whole series of other less useful substances. They must grow rapidly under a wide range of temperature and moisture conditions.

During Keith's time in New Zealand he studied the economics of using silage inoculant on various crops and concluded, depending on the crop, you could expect between $3 and $6 return in more dry matter retained and better animal performance for every $1 invested in a good silage inoculant.

In concluding his section on inoculants, Keith described his recommendation for selecting a bacterial inoculant. An inoculant should provide at least 100,000, but preferably 200,000 colony forming units (CFU) per gram of silage. They should produce lactic acid as the sole end product; be able to grow over a wide range of temperature and moisture conditions; and ferment a wide range of plant sugars. In low sugar/high calcium crops (pasture and legumes), enzymes are essential for breaking down indigestible fibre converting it to sugars for bacteria to convert to lactic acid.

The second issue Keith addresses is density. Density, or lack of it, manifests itself in high dry matter losses due to ongoing fermentation from poor exclusion of air. Mould is often associated with drier silages either not reaching a stable pH, or taking a long time to achieve stability. Generally, baled silage does not have a great deal of difficulty reaching a density of 200 – 250 kgs DM/cubic meter with modern balers at 65% moisture. Last season many silages were baled at 50% moisture and lower, leaving them very prone to both mould and dry matter losses. Bulk silage density is very dependant on stack-rolling tractor weight and rolling time. Again, in both issues of density and drier silages are helped by inoculant's capacity to drop pH quickly.

The third issue is protecting silage from air and water penetration after covering. With most silage in dairying areas being baled, this simply becomes an issue of adequate layers of quality plastic. In the case of pits/stacks, Keith observed in Aust & NZ, plastic covering was adequate, but weighting down with tyres was frequently lacking.

Fourthly, feed-out face, although not an issue in baled silage, it certainly is a real problem in bulk silage. Pit/stack design (width) must meet the criteria of removing 15 to 30 cm/day (30 to 40 cm in warm weather). Obviously this is driven by herd size.

Finally, the feeding of spoiled silage, or more so, the consequences. A recent study at Kansas State University showed that feeding surface-spoiled silage had large negative effects on DM intake due to palatability of not just the spoiled silage, but from contamination of good silage. Rumen function was also affected negatively from intake of microtoxins. The subject of microtoxin implications on rumen function and efficiency is receiving considerable research attention now as its impacts have only recently become more understood. The first increment of spoilage had the greatest negative impact. Keith's message: don't feed it, discard into a compost heap.

Although Keith only touches on the subject of palatability in his section on return on investment in quality inoculant, it has proven a major issue in our dairying system. Summer feed intake needs every possible assistance we can give it, and a good "lactic acid" fermentation has significant impact on feed intake through very palatable silage. I have a client who operates a large dairy and has told me he would inoculate his silage on palatability alone, all other science is secondary to cow's taste preference.

Silage is a major fraction of summer feeding, particularly in dryland dairying. It demands our utmost attention and planning from both the nutritional aspect of feeding cows to sustain milk production over summer, but also as described in last month's article, it has major impacts on farm profitability due to total dry matter harvested.

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