Comparison of Hay Preservatives and Additives

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Summary

Organic Acids or Sulphur based preservatives are the best options as Hay preservatives.
Sulphur based preservatives like HayGuard are easier to handle and more economical

Benefits of using hay preservatives are that they:

• allow the safe baling of hay from slightly above target moisture levels up to 25% (or 30%) moisture depending on preservative type
• allow baling after a shorter curing period which reduces risk of rain damage and sun bleaching. It may also allow baling earlier in a season in certain areas, when fodder is less mature and nutritive value higher
• reduce dry matter and nutrient loss caused by leaf loss and shatter, microbial activity and moulds
• enable baling over a longer period each day, resulting in more effective machinery and efficiency of labour usage
• maintain hay colour (due to increased leaf retention) and often smells better
• prevent dry matter and quality loss in storage due to bacterial, yeast and mould activity
• reduce risk of spontaneous combustion
• may increase animal intake
• Animal and human health not affected due to lack of mould spores.

Types of hay preservatives

Four main categories of hay preservatives are available; organic acids and their salts, bacterial inoculants, sulphur-based preservatives (HayGuard) and ammonia-based additives. Some products may also include enzymes, antioxidants and nutrients.

1. Organic acids and their salts

When applied, organic acids act as fungicides by producing an acid environment which is not conducive to mould, yeast or bacterial growth. Two of the main acids used are propionic and acetic and being naturally occurring acids in the rumen, are safe for all types of livestock, including horses. These products are liquid and require spraying equipment to apply the preservative at the hay pick-up area. However, these products are corrosive on machinery and can be dangerous for operators to use in their pure form. To overcome these problems, “buffered” acids, sometimes referred to as “neutralised or pH balanced” acids, have been developed and commonly include salts of propionic, acetic and formic
acids. Their pH is about 5.5 to 6 so they are much less corrosive and safer to use but more expensive. Although slightly less effective than the pure acids there are fewer losses due to volatilisation. More than one buffered acid may be included in product mixes such as propionic + acetic acids. The propionic acid is highly effective against mould growth whilst acetic acid is more effective against bacteria and yeast. They are available in liquid and granular form. To be fully effective the preservative must contact as much of the material as possible. For best results the preservative should be applied across the pick up on the baler, not sprayed onto windrows during raking or conditioning due to the chemical volatilising and consequent reduction in effectiveness. The rate of preservative application varies according to the moisture content of the forage being baled and the type of bale. At a rate of 1.5lt to 8lt this makes it difficult and expensive to apply and labour intensive.

2. Bacterial inoculants

Some silage inoculants developed as fermentation enhancers are also sold as being effective for hay preservation. Most contain lactic acid producing bacteria that compete with yeasts and mould forming organisms aiming to maintain forage quality. Commonly used lactic acid bacteria are Lactobacillus, Pediococcus, Streptococcus and Bacillus. However, most lactic acid producing bacteria require moisture above 30%, anaerobic conditions and acidic conditions (under about pH 5.0) to work at their optimum. This generally makes them not practical for hay preservation.

Aerobic Spoilage Inhibitors

These recently developed inoculants use Lactobacillus buchneri 40788, a group of bacteria which restrict the growth of spoilage type organisms such as yeasts and moulds in silage. Their mode of action is thought to be due to secondary metabolites called “buchnericides” and may reduce the need for paddock curing unless extremely wet. Recent research indicates that they are usually much more effective than the fermentation enhancer group but still require the same conditions as minimum moisture, anaerobic conditions and acetic conditions (low pH) to work effectively and making them not practical for hay preservation.

Antibiotic-producing, bacterial inoculant.

Another group of bacteria selected from the natural Australian environment, Bacillus amyloliquefaciens, was selected to survive desiccation after application to the cut crop and to survive in storage. The use of this product requires specific management to ensure maximum effectiveness. One such requirement is for the product to be applied as the crop is being mowed for hay, the aim being to suppress yeast and mould populations that may increase during hay curing, especially at the bottom of moist windrows and other wet “hot spots”. This makes them not a practical option for hay preservation.

Organic acid or Sulphur preservatives would be much more effective for hay than this class of products.

3. Sulphur based preservatives (HayGuard)

Sulphur based preservatives are another product type that offers control of microbial proliferation. Sulphur compounds are widely used in human and animal food sectors as preservatives and work essentially the same way in hay through their oxygen scavenging mode of action. In fodder, they create an environment within the hay bale that is unconducive to microbial growth stemming mould and yeast development. Sulphur
compounds act not only on the actual surface of the particles within baled fodder, but also in the air spaces within the bale. The application rate at 0.8-1.0 kg or Litres per tonne is much lower than with acids, and complete coverage of all fodder entering the throat of the baler is neither possible nor totally crucial when using this product type. Even and consistent application always remains preferable however. The lower application rate may potentially be an advantage when considering the running time that a tank of product can provide between stops in baling to refill. A lower rate of overall moisture being added into bales could also be a potentially advantage. Sulphur compounds are not acidic, and as such are generally fairly user friendly. The sulphur compounds themselves are salts however and as such, wash down of gear post baling is recommended.

4. Ammonia-based preservatives

Although not commonly used in Australia, anhydrous ammonia, when applied at 1 per cent (dry matter basis) to hay containing up to 30 per cent moisture, has been shown to reduce dry matter losses and prevent heating and moulding. The rate is crucial. Applying, say 0.8 per cent (dry matter basis), is much less effective than the 1 per cent rate. However, it is more commonly used to improve the feeding value of cereal straw, mature grass hay and corn stover when applied at 2 to 4 per cent (dry matter basis). Higher quality forages such as lucerne and leafy ryegrasses should only be treated at the rate needed for preservation (1% of dry matter) due to an unknown toxicity which can cause animal deaths and the toxin is transferred into milk. The major disadvantage of using anhydrous ammonia is that its application is difficult, and it is a hazardous chemical. Equipment has been used to inject the anhydrous ammonia into round bales, but no such equipment is commercially available. Covering bales with plastic and then injecting the appropriate amount of anhydrous ammonia is an option but uniform distribution is difficult, resulting in some spoilage in some areas. Ensuring even distribution in both above techniques would be even more difficult with the very dense nature of the large rectangular bales.

Much of this information is covered in the various documents produced by:

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