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Hay Preservatives

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Rainfall on mown hay will significantly lower forage nutrient content. Shortening the field curing time frequently reduces the risk from precipitation. Mechanical conditioning of freshly cut forage now is widely utilized to hasten field drying. Two additional approaches also can be considered to further reduce hay curing time. These are: treatment of legume forages with drying agents as discussed in Agronomy Fact Sheet AGF-011 (Chemical Drying Agents in Harvesting Legume Hay) and the use of a hay preservative as described in this Agronomy Fact Sheet. Unlike drying agents, hay preservatives are not restricted to legume forage; they also can be used on grass and grass-legume mixtures.

Preservatives work by inhibiting or reducing the growth of aerobic microbes in moist hay. Without microbial growth, heating and the subsequent depression in digestibility does not occur. Most hay preservatives do not improve nutritional quality of the forage, but merely prevent the decline in quality caused by heat buildup from excessive aerobic microbial action.

Generally hay with a moisture content of 20% or less will not spoil during storage. Large round bales should contain hay that is slightly drier (approximately 18%). If hay is baled with more than 22-25% moisture, often it will become moldy and much of the feeding value will be lost. Hay with a moisture content of about 25% provides an excellent environment for growth of aerobic microorganisms. These microbes rapidly break down the nutrients in the forage resulting in a large increase in microbial populations. The resultant heat buildup causes a reaction to occur between proteins and carbohydrates which renders both fractions less digestible. Protein digestibility can be reduced to almost zero with severe heating. The amount of heat necessary to produce the reaction depends on several factors. Generally bale temperatures less than 100 deg. F cause no problems, but bale temperatures above 150 deg. F almost always severely reduce protein and carbohydrate digestibility. When bale temperatures remain between 100 and 150 deg. F, the length of elevated temperature determines the amount of nutrient loss. Damage occurs more rapidly at higher temperatures.

Chemicals and Application Procedures

Hay preservatives can be grouped into three categories; organic acids and their salts, ammonia-based, and microbial additives. Propionic acid is the most effective and most tested preservative available presently. It is a liquid, so tanks and a spray application system must be added to your baler. Spray nozzles must be spaced so that the chemical is distributed over all forage as it enters the baling chamber. The amount of active ingredient that must be applied depends upon the moisture content of the hay. Small bales with 20-25% moisture should be treated with about 0.5% propionic acid (as baled basis). Application rate should be increased to 1% for hay with 25-30% moisture. No consistent response to any preservative has been observed with hay containing more

than about 30% moisture. For adequate coverage, it is best to use a 50% solution and apply twice as much of the diluted acid so that the correct amount of active ingredient is applied. The main disadvantages of propionic acid is its corrosiveness and the cost of the equipment necessary to apply the liquid to hay. Estimated cost of adding spraying equipment to a baler is $1,000 - $1,500. Buffered acids and salts of acids have been developed to overcome the corrosion problem. These products have not been tested as extensively as propionic acid. Buffered acid applied at about 1% (as baled basis) was as effective as 1% propionic when applied to alfalfa hay baled with 30% moisture (results from one study only). If buffered acids continue to prove to be as effective as propionic acid, then producers will have to balance the added cost of buffered acids with the reduced wear they cause on equipment. Salts are granular and need less expensive application equipment. Salts include sodium diacetate and sodium metabisulfite. These compounds have proven less effective than propionic acid. Application rates of 0.1 to 0.2% (as baled basis) are usually used. Results from a limited number of studies indicate that this type of preservative is effective on hay containing no more than approximately 25% moisture.

Ammonia is toxic to many microbes and can be a very effective preservative for moist hay (up to 30% moisture) when applied at 1% (dry matter basis). Fact Sheet AGF-015 describes how lower quality straw, mature grass hay and corn stover can be ammoniated to 2-4% of the dry matter and be fed safely to ruminants. Higher quality forages such as alfalfa, immature grasses and cereal grain hay should only be treated with ammonia at the rate needed for preservation (1% of dry matter) because of the toxicity risk. The major disadvantage of using anhydrous ammonia as a preservative is that application is difficult. Devices have been made to inject anhydrous ammonia into large round bales, but these are not yet sold commercially. The recommended means of treating moist hay with anhydrous ammonia is to cover the bales with plastic and then inject the appropriate amount of ammonia. The ammonia may not become distributed uniformly throughout the moist hay; therefore, portions of the stack may spoil. Urea can be converted to ammonia by bacteria normally found on the hay. Application of urea is much simpler than using anhydrous ammonia gas. Researchers have found that relatively large amounts of pelleted urea (5-7%, as baled weight basis) applied during baling can be an effective preservative for hay containing up to 30% moisture. Urea is only effective however if the hay is stored shortly after baling and covered tightly with plastic sheeting.

Applying the proper amount of ammonia is extremely important. Application rates below about .8% (dry matter basis) are much less effective than the 1% rate. Applying more than 1% ammonia to high quality forages can result in the formation of an unknown toxic compound. Animals consuming ammoniated high quality forage often exhibit hyperexcitability followed by death. The toxin is transferred into milk, so nursing calves and lambs also are susceptible to the toxin. **HIGH QUALITY HAY MUST NOT BE TREATED WITH MORE THAN 1% AMMONIA (DRY MATTER BASIS).**

Many types of microbial products have been promoted recently for use as hay preservatives, but very little positive value has been demonstrated with these products. Nebraska researchers found that inoculating either large round bales or small square bales of alfalfa with 200,000 colony forming units of lactic acid producing bacteria per gram of dry forage had little effect on hay quality and preservation over a wide range of moisture concentrations. Other types of bacterial inoculants (non lactic acid producers)

have been tested with little beneficial results. Certain types of nonlactic acid bacteria have increased the visual quality of moist hay (up to 25% water), but quantitative data on improved feed value are lacking. In general, the microbial products used as hay preservatives do no harm but have shown few benefits.

Advantages of Using Hay Preservatives

1. Preservatives allow hay to be baled at a higher moisture content which reduces the length of time hay lays in the field and lowers the risk of rain damage.
2. Baling at a higher moisture content reduces dry matter and nutrient losses during baling caused by leaf shatter.
3. Preservatives lengthen the potential baling period. Hay can be baled during early morning and late evening hours if dew does not raise moisture level above 25-30%.

Disadvantages of Using Hay Preservatives

1. Propionic acid is corrosive and can damage machines and injure workers.
2. Anhydrous ammonia is difficult to apply and is a hazardous chemical.
3. Effectiveness of many hay preservatives available currently has not been tested thoroughly and may not work under many conditions.

Summary

1. Propionic acid and anhydrous ammonia (application rates of about 1% of wet forage weight) are the only preservatives that consistently are effective on hay containing 25-30% moisture.
2. Other preservatives may be effective on hay containing 20-25% moisture (follow manufacture directions), but many have not been scientifically tested.
3. Preservatives other than ammonia and urea do not improve feeding value, but can reduce storage losses.
4. It is essential that the moisture content of the hay be known. Hay containing more than 30% moisture should not be baled even with a preservative. Application rates of other preserva-tives should be modified according to moisture content of the hay.

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