

Baleage: Frequently Asked Questions

Jimmy C. Henning, Chris Teutsch, and Ray Smith, Plant and Soil Sciences, University of Kentucky, Brandon Sears, Agriculture and Natural Resources, University of Kentucky, and Lisa Baxter, Crop and Soil Sciences, University of Georgia



Baled silage, or "baleage," allows forage to be harvested at higher whole plant moisture levels than dry hay.

Baled silage, or "baleage," is an excellent method for forage harvest, storage, and feed efficiency. This publication focuses on common questions about baleage. Together with [AGR-173: Baling Forage Crops for Silage](#), this information will help producers better understand the production and use of baleage as livestock feed.

Common Questions about Baleage

Why should I consider making baleage?

Baled silage allows forage to be harvested at higher whole plant moisture levels than required for dry hay. Baleage is ideal for spring cuttings of annual and perennial forages when seasonally frequent rainfall events provide little opportunity for properly drying hay for baling. Many producers have found that they can harvest winter annual forages as baleage in spring to supply all their winter stored feed needs.

What happens during the baleage ensiling process?

When moist forage (40% to 60% moisture) is baled and wrapped in plastic, respiration and microbial activity inside the plastic quickly uses up the available oxygen, creating an anaerobic environment. Anaerobic microorganisms present on the plant surface then ferment some of the carbohydrates in the forage to lactic acid. The accumulation of lactic acid lowers bale pH and inhibits the growth of detrimental microorganisms. Although this process consumes some dry matter and digestible energy (mainly water-soluble carbohydrates), these losses are small compared to dry matter losses that result from raking, tedding, baling, and storing forage as dry hay in round bales.



Making baleage with an inline implement is faster than an individual wrapper and uses less plastic.

What equipment will I need?

A baleage system requires much the same equipment as a conventional hay system, with the addition of a wrapper and plastic. The minimum requirements are a mower, a rake, a baler capable of baling wet forage, a tractor of sufficient horsepower to carry these bales safely, a bale spear, and a wrapper. Some balers have a chopping mechanism that aids in increasing bale density as well as reducing particle size for ease in mixing rations. Cutting the forage with knives theoretically should improve fermentation both from increased density and greater access of microbes to forage carbohydrates. Bale spears are inexpensive ways of moving the bales prior to wrapping and just before feeding. Wrappers range in cost from \$6,000 to \$25,000 or more and differ considerably in labor and equipment requirements. An alternative to purchasing a bale wrapper is to work with a custom operator or rent one locally.

What should I use to mow?

Mower-conditioners are the most popular and easiest-to-use mowing implement for the baleage system. Mower-conditioners crush stems, dry faster, and provide a more conducive environment for microbial growth. The two most common types of conditioners are impellers and rollers or crimpers. Impellers work better for most grasses while crimpers are preferred for legumes and thick-stemmed summer annual grasses.

Although mower-conditioners are ideal, other types of mowers also can be used successfully.

When do I cut?

Cut the forage crop at the maturity stage that combines yields and quality sufficient for your animal requirements. In general, cut legumes at 10% bloom and grasses at the boot stage or just as the head emerges. Rye and triticale should be cut no later than the boot stage. In general, early maturity forage has higher soluble carbohydrate content, essential for proper ensiling. Conversely, overmature forages will not ferment well because they have lower soluble carbohydrate content and their coarse, stemmy nature traps more oxygen in bales.

Can my round baler handle high-moisture hay?

Some modern variable chamber balers can bale wet forage into a dense package. However, special silage models are recommended because they are specifically designed to bale wet forage. Silage balers have modifications, such as scrapers on the belts and rollers to prevent buildup of material, and they have heavy-duty bearings to help handle the increased bale weight. Several baler manufacturers offer "silage kits," which can be added to older balers to enable them to handle wet bales.



Rye forage baled and ready for wrapping. Baleage allows timely cutting because of the shortened amount of good weather required.

When should I bale?

Bale when moisture content reaches 60%. The time required to reach this moisture will vary from hours to more than a day after cutting, depending on drying conditions. Baling at the proper moisture content is a key to success in producing baleage. Baleage can be made at 40% to 60% moisture, but fermentation is best when whole plant moisture is 50% to 60%. Baling above 65% moisture increases the chance of undesirable butyric acid fermentation by clostridial bacteria. Forage with less than 40% moisture will not ferment well but can still be good feed as long as anaerobic conditions are maintained.

Forage containing more than 65% moisture should not be baled for silage to avoid the chance of undesirable butyric acid fermentation. Forage that is too dry for baleage but too wet for dry hay can be wrapped as baleage, using the proper amount of plastic (at least four layers, preferably six or more). Fermentation in these bales will be limited, but they are stable in storage because the oxygen has been excluded. These bales will begin to heat and mold faster than well fermented forage and are best fed during winter. The cold temperatures will inhibit heating long enough for the dry baleage to be consumed.

How should I make the bales?

A slow ground speed during baling helps make tight, dense bales that are less likely to spoil. Net wrap is helpful in making baleage because it prevents punctures of plastic from stems. Plastic

twine is acceptable but avoid treated sisal twine since the oils applied during the manufacture process often degrade the plastic film and can result in large storage losses.

The most popular bale size is 4 feet wide and 4 to 5 feet in diameter. These bales will weigh 900-1,300 pounds, depending on forage type, bale density, and moisture level. They are best for handling and feeding. Larger bales more than 2,000 pounds require less film per ton but can be hard to handle.

How much plastic needs to be applied?

Six layers of plastic provides adequate oxygen exclusion for baleage and gives protection from punctures. Some producers prefer up to eight layers for large-stemmed forages. Always ensure that the tension of the wrap (tacky side toward bale) is such that film is stretched uniformly on the bales. For an individual bale wrapper, ensure that two layers of wrap are applied during each full rotation of the bale and there is 50% overlapping of successive layers. For an in-line bale wrapper, overlapping layers should be spaced no more than 5 inches apart if using a 30-inch roll (30 in./6 layers = 5 in. between edges of layers). When non-uniform bales are wrapped with an in-line wrapper, it may be helpful to apply extra plastic at the joints. The change in bale size makes it difficult for the plastic to seal, allowing oxygen infiltration and mold growth. Do not apply too little plastic or oxygen will penetrate the bale and cause spoilage, mold growth, and feed losses.



Proper sampling technique for wrapped baleage. Samples should be shipped frozen to laboratories for analysis of forage nutritive quality and fermentation profiles.

How many bales can be wrapped per hour?

Using an individual bale wrapper, experienced workers can wrap 25 or more bales per hour. This number can be doubled with an in-line wrapper.

How much does it cost?

Plastic costs will vary but are generally \$90 to \$100 per roll. Each roll will cover 20 to 25 bales (applying six layers). Therefore, the approximate cost per bale is \$4 to \$5. The total cost of baleage per ton of dry matter (DM) is highly dependent on the type of wrapper used because wrapper cost vary and the type of wrapper determines the amount of labor and plastic that will be required. In-line wrappers are usually less labor intensive and can use less plastic than models that wrap bales individually.

What if I feed a molded bale?

Even in good baleage, some bales develop a surface white mold. This usually occurs on the flat ends of bales of different sizes in

inline-wrapped forage and around previously undetected pinholes in the plastic. This type of mold rarely penetrates more than an inch into the bale and is an indication of some localized oxygen encroachment into the bale. The animal usually eats around or even discards this portion. Even if ingested, this type of mold should not significantly harm the animal. Bales that are molded throughout and have a tobacco-like odor likely never became anaerobic and should not be fed. Moldy baleage can cause abortions due to excessive bacterial and/or fungal growth. Ingesting spoiled or rotten baleage can cause listeriosis, or circling disease.

If red, blue, or green molds are present, exercise caution before feeding. While mold color is not a definite way to identify organisms, some toxic molds have red, blue, or green mycelium and are an indication that fermentation was poor and that bales should not be fed. In these cases, testing for mycotoxins may be needed. Consult your veterinarian or state diagnostic laboratory for more information on testing for mycotoxins.



Patching holes in wrapped baleage.

Should I be concerned with botulism?

Botulism poisoning of cattle from baleage is not common and can be prevented. Botulism toxicity is caused by the excessive growth of *Clostridium botulinum* bacteria in haylage that has been baled too wet (> 60% MC) and whose pH is not low enough to prevent clostridial growth. A baleage pH of 5.0 or below indicates good fermentation and low probability of clostridial growth. Clostridium bacteria is common in soil, manure, and in the carcasses of decaying animals. Clostridial fermentation and production of butyrate is not proof of botulism, as there are several strains other than *C. botulinum*. Forage can become contaminated during raking and baling, from manure applications close to harvest and from dead animals that get trapped in the baled forage. The risk of botulism toxicity from baleage is minimized by baling at 60% moisture or less, using six or more layers of plastic, and preventing puncture damage to plastic during storage. Baleage that has undergone a clostridial fermentation will have high moisture (usually above 70%), high ammonia content (> 15% of total N), elevated butyric acid (> 1% of DM) and usually elevated ash content from soil contamination (>11%). Failure to maintain anaerobic conditions has also been associated with botulism in actual case studies. To determine if clostridial fermentation has occurred, analyze a sample of the forage to determine the moisture, ash content, pH, concentrations of lactic and butyric acid and ammonia-N at a certified laboratory.

Should I apply additives?

Commercial additives for baleage vary widely in their composition, but generally contain enzymes and inoculants to assist in fermentation. Inoculants containing live bacteria provide insurance that adequate microbial numbers are present on the moist forage at baling. Additives and/or inoculants are not required to make acceptable baleage in Kentucky but may help fermentation in certain circumstances. Inoculants may be especially helpful with early spring and late fall baleage when cool temperatures limit the number of natural fermenters present on forage surfaces. Inoculants contain lactic acid bacteria (LAB) that may be homofermenters (produce only lactic acid) or heterofermenters (produce lactic plus acetic acid). Lactic acid-formers increase the speed of fermentation by supporting higher lactic acid formation. The production of acetic acid by heterofermenters improves the stability of silage during feedout. Inoculants are best applied in liquid form, usually by applicators mounted on the baler.

How soon should I wrap the bales?

Ideally, wrap forage immediately or within 24 hours of baling. Delays between baling and wrapping lowers feed quality by allowing undesirable microbial activity and excessive heating due to aerobic bacteria.



Uneven bales puts stress on the plastic at the joint and may split. This baleage was a total loss.

Where should I wrap?

Wrapping at the storage site minimizes handling of wrapped bales and reduces the potential for damaging plastic. Store bales on a well-drained sod and away from trees or weeds that might harbor rodents and insects that attract birds and lead to plastic damage. Avoid locations with excessively coarse stubble that may cause small punctures. Using six layers of plastic will help protect the baleage from punctures. Patch small holes in the bale's plastic using a repair tape treated to resist degradation from UV light.

What kind of wrap should be used?

The plastic wrap used in making baleage is a polyethylene plastic film that is pre-stretched 50% to 70% by the wrapper as it is applied to the bale. The plastic must be able to withstand the local environmental conditions such as UV radiation and changes in ambient air temperature. Tear strength and tack (stickiness) may also vary among brands of wrap. Plastic film may be white or black. White plastic is most common in this region since it reflects sunlight better and reduces solar heating of the plastic.

What type of wrapper is best?

Three major types of wrappers are available, and all can produce good baleage. The main types are:

1. Platform
2. Swinging arm
3. In-line

Platform wrappers simultaneously rotate and revolve the bale on a platform to feed plastic from a stationary roll. Swinging arm wrappers have rollers that open to enclose and pick up the bale before wrapping. The plastic roll swings around the bale on an arm. More recently, integrated baler-wrapper designs have become available that wrap the bale just after it is formed. In-line wrappers place bales end-to-end in a row while dispensing plastic from rollers that travel around the bale.

In-line wrappers are popular due to quick wrapping rates, reduced plastic consumption, and ease of use. Many in-line wrappers have automatic wrapping features with remote control options that allow the producer to operate the machine from the tractor, thereby reducing labor requirements.

Is baleage higher in quality?

When comparing properly ensiled baleage to properly cured dry hay, forage quality of the baleage is usually higher due to decreased losses from harvest and storage. The process of ensiling also will metabolize a portion of excess nitrate, lessening the chance for toxicity. In addition, research has shown that 80% of the toxins associated with buttercup (*Ranunculus* spp.) are metabolized after three days of ensiling. Ultimately, stage of maturity at harvest determines forage quality. Therefore, the quality of forage when cut is the greatest determining factor on the baleage quality.



Uniform bales place less stress at the junction between bales for inline-wrapped forage.

How soon after wrapping can I feed baleage?

Waiting eight weeks after wrapping will ensure complete ensiling. Fully ensiled forage will be slow to deteriorate or heat when fed. Forage baled in the proper moisture range and wrapped with the correct amount of plastic will undergo the full fermentation process within six to eight weeks and usually in less than four weeks. Cool temperatures, mature forage, and insufficient forage moisture levels will reduce fermentation rate.

Baleage made with in-line wrappers needs the full eight weeks to ensile because feeding out these bales exposes the next bales to oxygen and increases the risk of spoilage. However, if there is a dire need to feed out the baleage before ensiling is complete, make sure that the baleage is completely consumed in less than 24 hours.

How long can baleage be stored before feeding?

In general, forages baled at 40% to 60% moisture will maintain feed value for about 12 months if the integrity of the plastic is maintained. However, even where the forage was baled at the appropriate moisture level and the plastic is intact, it is good practice to feed baleage bales within nine months.

What kind of feeding system do I need to minimize losses?

Use a ring feeder, cone-type ring feeder or elevated bale wagon to minimize losses during feeding. Losses can reach 50% when feeding without using one of these devices. When feeding whole baleage packages to any species, it is best to consume the entire

bale within two days. Baleage also may be integrated into rations by grinding and mixing.

To what can I feed baleage?

Traditionally, baleage has been fed to beef and dairy cattle. Baleage can be fed to sheep and goats, but it is extremely important that bales be consumed quickly to minimize the chance that animals will consume rotten silage. Sheep and goats that consume spoiled silage are at high risk for listeriosis. Baleage is generally not recommended for horses in Kentucky and other states because of surface molding and especially their sensitivity to clostridium bacteria that causes botulism poisoning.

To ensure the most efficient use of the quality in a baleage bale, it is important to match the bale's quality to the animals' nutritional needs at a given stage of production. Baleage can and should be tested for nutrient levels in the same manner as dry hay.

What should I do with the used plastic?

Because the plastic can be used for making baleage only once, plastic must be disposed properly to avoid an environmental problem. There are no standard policies for collection and disposal of used baleage plastic beyond deposition in landfills. There are no active recyclers of baleage plastic in Kentucky. In the future, used plastic might be collected for recycling. Check with your local government or division of solid waste on applicable statutes in your area for disposal or recycling.

Can I wrap dry hay as an alternative to inside storage?

Some producers who have limited inside space for storing dry hay rolls have successfully wrapped dry hay for outside storage. Typically, only enough plastic to cover the bale is needed. Use at least two layers to help prevent punctures. For best results, allow hay to go through the sweat period (typically one to two weeks) before wrapping.

How do I determine the proper moisture content of my forage?

- “Dish rag” test. Take a handful of forage and wring it out as one would wring out a dishrag. If moisture can be expressed from the forage, it is generally above the 65% moisture range.
- Commercially available moisture probes are an option but are less accurate than forced air dryer or microwave methods. Windrow moisture testers are much less accurate than bale probes. Make sure you use a moisture tester calibrated for the high moisture levels in baleage.
- Koster moisture testers are heated, forced-air dryers that are used in silage production to dry down the forage. The Koster system has a scale to measure weights, but it takes longer than a microwave moisture test.
- Some silage balers can be equipped with sensors that provide a continuous readout of moisture content while the bale is formed.
- A microwave may also be used to accurately measure moisture content.

MEASURING THE MOISTURE CONTENT OF FORAGE USING A MICROWAVE OVEN

(Adapted from Southern Forages, 4th Edition, Page 303)

- Chop fresh forage into short lengths (< 1 inch) for ease of handling and uniform drying.
- Weigh out at least 100 grams (3.5 ounces) of chopped forage. You will need scales capable of measuring small quantities, such as postal scales (available at office supply stores).
- Spread forage thinly on a microwave-safe dish and place into microwave. (A cup of water placed in the microwave beside the sample will help prevent the sample from igniting once dry.)
- Heat for 1-2 minutes and reweigh.
 - ◊ If forage is not completely dry, shake and redistribute the sample, and repeat the heating cycle until the sample reaches a stable weight. (Microwaves vary considerably in drying capacity. It is better to dry for short intervals and reweigh until the last two weights are constant, than to overdry and run the risk of burning and damage to oven.) If charring occurs, use the previous weight.
- Calculate moisture content using the following equation:

Moisture Content =

$$\left(\frac{\text{Initial Weight} - \text{Final Weight}}{\text{Initial Weight}} \right) \times 100$$

Dry matter (DM) is the percentage of forage that is not water. DM equals 100% minus the % Moisture Content.