Baled silage: a flexible forage harvest system.

Richard Ehrhardt\textsuperscript{1}, Mike Lauwers\textsuperscript{2} and Eric Wallis\textsuperscript{3}

\textsuperscript{1}Michigan State University Extension; \textsuperscript{2}Lauwer's Alfalfa and Straw Farms, Capac, MI; and \textsuperscript{3}Wallis Family Farm, Rudyard, MI.

Introduction

Baled silage harvest systems offer a flexible forage harvest program well suited to a diversity of farms. This is evident in Michigan where this system allows efficient capture of quality forage in extensive grassland farms in the Upper Peninsula to the thumb region where baled silage offers forage marketing options on high value agricultural land not possible with other harvest systems. Silage harvest systems in general (baled or precision-cut) give a farmer much greater control over the greatest single factor that affects forage quality-cutting date. Dry weather days are typically at a premium in May and early June when optimal harvest windows exist for most perennial forage crops. Silage systems require much smaller dry weather harvest windows than dry hay programs and therefore give a producer much greater control over harvest date. In addition, timely harvest early in the season also sets the stage for quality harvest for the rest of the season in that degree days and moisture are captured as highly digestible vegetative growth instead of lignified, poorly digested dry matter. Harvest and storage losses of baled silage are also considerably less than that of dry hay. Big bale silage systems differ from precision-cut silage program by offering a lower entry level system for farmers along with enhanced opportunities for forage marketing. What follows is a discussion of the big bale silage harvest process, critical control points for quality, considerations of handling and feeding issues and a summary of the pros and cons of this harvest program.

Summary of the baled silage harvest process.

Forage is cut as done in either precision-cut silage or dry hay programs but differs in wilting to a target of 55-65 % moisture. Baling at drier (as low as 35\%) or wetter (up to 75\%) moisture conditions can also work but require special considerations as discussed later. Fast wilting times are ideal as they lessen the chance of mold growth and are accomplished most simply and efficiently by maximizing ground cover at mowing by setting the swath to the widest setting. A variety of balers can be used to create baled silage but they must create a bale of high density (>8.6 lb dry matter /ft\textsuperscript{2} [>430 lb of dry matter in a 4x4 ft bale]) and be capable of handling bales that commonly weigh at least twice as much as dry bales of the same dimensions. Balers designed for large bale silage have heavier chassis and tires and in the case of belt balers, have special scrapers designed to minimize crop build up on belt rollers and create a bale with a dense “hard” core. Fixed chamber, roller-type balers are popular for baled silage because they have fewer clogging issues and high through-put at higher forage moisture levels. Silage balers with
built-in processing capacity have become popular in recent years and allow greater bale density (increases of 10-15%) and make the bales more “TMR friendly” as they are easier to mix in a vertical mixer when creating a total mixed ration (TMR) as compared to long stem baled silage. Bale size in round bale systems is typically minimized to 4x4 ft bales as high moisture bales can be very heavy and therefore create transport issues. Raking systems capable of handling heavy crops and creating a box-shaped swath are ideal in efficient production of even-shaped bales that are easier to wrap. Net wrap systems have advantages over twine systems in terms of tying time, wrapping speed and feeding time (baled can be stripped faster). If twine is used, it must be either polypropylene or non-treated sisal as impregnated sisal twine will degrade the plastic stretch wrap. Polypropylene twine in bright colors can also be problematic as it can encourage bird damage during storage. Ideally bales should be wrapped <4 hours after baling to minimize bale heating and the potential for mold growth. Wrapping systems include in-line wrappers that create a long “tube” of bales wrapped end to end and individual bale wrappers that are further specialized to wrap anything from small square bales (rare in the USA) to both large round and large square bale formats. Individual bale wrappers can either be stationary or mobile with the capacity to self-load bales. Choice of wrapping system is driven by many factors including: labor, cost of plastic, speed of wrapping, bale transport system, risk of plastic perforation, and preferred size of storage area.

Critical control points for quality product

- **Drying speed.** Drying speed can become limiting in heavy crops in the spring and should be maximized in these conditions by increasing swath ground cover. Wide swathing may also have advantages in capturing higher soluble carbohydrate content. To maximize swath ground cover, set mower to maximum swath setting. Further increases in ground cover can be created by tedding if needed. Conversely, ground cover may need to be minimized in light crops under fast drying conditions in order to keep forage in the target moisture range of 55-65%. Under fast and prolonged drying conditions, it usually makes more sense to allow the crop to dry further (<18% moisture) and create dry hay.

- **Bale moisture content.** Target values of 55-65% are ideal to promote fermentation while minimizing the problems of high water content silage. Excessive water content (>75%) creates poor fermentation conditions, significant leachate loss, and the potential for frozen bales in cold climates. In general, high water content slows harvest and is costly in terms of transportation expense. In practice, many farmers begin harvest at the upper level of moisture that their balers can function at (70-75%) with drying conditions determining the moisture content of the bulk of the crop. Lower moisture content (down to 35% DM) lessens harvest costs but may increase harvest losses. Low moisture silage is gaining in popularity particularly for late season harvest. Low moisture content silage will have a limited fermentation and will need to be wrapped more extensively, baled at greater density and quality is best assured with addition of silage inoculants to minimize risk of mold growth.
• **Wrapping.** Wrapping should be performed ideally within 4 hours of baling to prevent excessive heating, with 12 h regarded as an upper limit. Bale wrappers dispensing systems typically stretch wrap 1.7 times but stretch extent appears to be far less important than the number of wrap layers. Four layers of wrap has been shown to greatly reduce mold growth with 6 layers of plastic suggested for bales that will be handled more after wrapping and those baled at a low moisture (<50%) and when feeding to animals more sensitive to developing listeriosis (i.e. sheep and goats).

• **Storage.** Holes, even small ones, will create large storage loss so care must be taken to minimize plastic damage. Any holes should immediately be sealed with tape (Tyvek® tape works well) and stored in well drained area and so as to minimize bird and rodent damage. Wrap damage occurring during cold weather in bales fed during the same period is less problematic of course. Wrapped bales can be safely handled using a special squeeze or cradle loader attachment but it is advised to move bales to long term storage within a few days of wrapping to minimize risk of damage. Individually wrapped bales can be stacked (stack layer number [3 layers max.] is dependent on bale dry matter density) to reduce storage area.

**Handling and feeding considerations**

High moisture silage bales can easily weigh over a ton and therefore require careful handling. Bales are typically speared with a conventional spear at feeding time so handling as this point is the same as for dry hay. Feeding baled silage is viewed as a limitation when compared to precision-cut silage because it can be difficult to process long stemmed forage that is tightly packed in a bale. Balers with built-in processing capacity minimize this issue. Baled silage can also be sliced with a hydraulic-activated cutting arm to facilitate feeding or inclusion in a TMR. Bales can also be unrolled as a feeding system using a bale unroller (mechanized cart or equipment attachment) for indoor or outdoor feeding. Bales can also be fed, similarly to dry hay, in bale feeders. Producers who are feeding baled silage on a pen pack or ground more slowly (smaller livestock, bale feeding time >2 days) are finding that leaving the plastic wrap on the ground surface of the bale retards bale heating and spoilage (they remove the plastic after the bale is consumed).

**Advantages of baled silage:**

- Lower capital investment compared to precision-cut silage
- Covered storage not required
- Much greater control over cutting date than dry hay programs
- Mechanized feeding system not an absolute requirement
- Can be of similar quality to precision-cut silage
- Greatly reduced dry matter and quality loss at harvest compared to dry hay
- A complimentary system to a precision-cut silage when silo space is limiting
• Flexibility in harvest options: can make dry hay or silage with same system
• More marketing options than precision-cut silage
• More precise segregation of forage inventory according to quality than in precision-cut
• Can create quality stored fed from variety of forage crops (i.e. small grains, sorghum sudan, kale, etc.)

Disadvantages of baled silage:

• Potential for storage loss due to wrap damage (wildlife, rodents, other)
• Recycling programs for plastic not readily available
• Lower feeding efficiency in large farms compared to precision-cut silage
• Plastic material cost (approx. $2-3 to individually wrap a 4x4 ft bale)
• Generally greater variation in feed value than precision-cut silage
• Poor quality silage (baled or precision-cut) can create animal health issues
• More challenging to incorporate into a TMR than precision-cut silage

Summary

Baled silage forage systems offer a relative low entry investment into silage production with key advantages in flexibility in terms of harvest options, marketing and storage. Baled silage can be a very high quality product when forages are harvested at the optimal stage of maturity but like any other silage system, proper harvest and storage management are essential to assure quality.

Selected References:

McEniry, J., D. Forristal and P. O’Kiely. 2011. Gas composition of baled grass silage as influenced by the amount, stretch, colour and type of plastic stretch-film used to wrap bales and by the frequency of bale handling. Grass and Forage Science 66: 277-289.
