SILAGE FOR BEEF CATTLE
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THE VALUE OF SILAGE IN BACKGROUNDING RATIONS

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A native of southwest Nebraska, Dr. Jason Warner was raised on his family's cow-calf and diversified dryland farming operation, and enjoys working with producers in all facets of the beef industry. Jason earned bachelor's degrees in Animal Science and Grazing Livestock Systems, followed by a master's in Animal Science from the University of Nebraska-Lincoln. He completed his Ph.D. in ruminant nutrition at UNL while researching alternative (intensified) cow-calf systems. While cow-calf nutrition and management has been Jason's primary research focus, he has research and practical experience in reproductive management, heifer development, and growing/finishing nutrition and management as well. Jason's objective is to serve GPLC clients of all sizes, and assist them by providing research information and practical knowledge to make economically sound decisions to improve their businesses.

INTRODUCTION

Beef cattle production systems both domestically and globally are dependent on forages which are often of low-quality, and the impact of forage quality on cattle performance becomes greater as the percentage of forages in the ration increases. Therefore, forage quality is most critical for those production phases that occur before finishing. The harvesting and storing of forage crops as silage has been an important component of cattle feeding programs for many years, and some early instances of producers ensiling crops for subsequent feeding date back to the late 1800's. While silages have always been a centrally used feed for cattle, the production of traditional alfalfa and native grass hay has decreased in many regions over the last 10 to 15 years partly due to the increase in corn and soybean production. Crop residues represent a forage that has increased due to more grain production, but many have re-evaluated the use and value of silage in backgrounding and cow-calf rations which is the focus of this discussion.

SILAGE STATISTICS

The forages used in our industry have changed in recent years and are continuing to evolve with the ever-moving dynamics of beef and crop production. Our first-hand experience with producers and research data have proven that to be true. In the U.S., total acres harvested for all hay production in 2017 were 12% lower than in 1990, with production down approximately 10% (USDA). During that same time, both acres harvested and tonnage of alfalfa hay produced declined by approximately 35% nationwide. However, during the same 27-year time span, all acres harvested for corn in the U.S. increased by 22% with total grain production increasing by 84% (USDA). It appears that the feeding industry has responded to these changes in forage availability by altering the type of forages used in rations. Vasconcelos and Galyean (2007) reported in their initial survey of consulting feedlot nutritionists that 31% of respondents used alfalfa hay as either the primary or secondary source of forage in finishing rations. The same survey was conducted again recently (Samuelson et al., 2016) and showed that while alfalfa hay was used as the primary forage source by only 20.8% of nutritionists, more respondents surveyed used other forages such as crop residues than in the prior survey. In general, we have also observed much less availability of traditional forages like alfalfa and grass hay, and more use of low-quality crop residues such as corn stalks or wheat straw. The land-use shift from hay and pasture towards crops is very real and is contributing to the increased use of crop residues in growing and finishing rations. Interestingly, these survey data suggest that silage use in feedlots has stayed relatively constant. In the initial survey (Vasconcelos and Galyean, 2007), 41 and 34% of respondents used corn silage as the primary and secondary forage source, respectively. In the follow up survey (Samuelson et al., 2016) the percentage of nutritionists using corn silage as either the primary or secondary forage source was equal at 37.5%, with a noticeable increase (13.9%) from the prior survey in the use of sorghum silage as a secondary forage source. In recent years, we have seen a general trend of more interest in silage production, particularly from producers that have not harvested silage as of late.

On a broader scale, USDA data can be helpful in identifying trends in silage production overtime. During the 1970s, corn harvested for silage in the U.S. averaged over 9.2 million acres per year yielding approximately 12.4 ton per acre. Acres harvested for silage in the U.S. in the 1990s averaged 5.9 million per year at 14.7 ton per acre. Over the past 8 years, U.S. acres harvested for silage have average 6.3 million per year at 19.1 ton per acre. These data suggest that while silage acres have declined from 40 years ago, production has not dropped due to improvements in corn hybrid technology (i.e. use of silage varieties, drought and disease resistant genetics) and growing conditions (i.e. increased use of irrigation, fertilization, and pest and weed control). Again, this supports the nutritionists' survey data that silage use in the beef cattle feeding industry appears to have either remained steady or increased in recent years.

Corn and sorghum silage production data for 2017 for selected states are presented in Tables 1 and 2, respectively. As a percentage of total corn acres planted, producers harvested 2.19 to 6.12% of acres as silage averaging 21 ton per acre. The exception was drought-affected South Dakota, where 9.12% of total corn acres planted were harvested for silage yielding only 12.5 ton per acre. Producers in NE, KS, SD, and TX harvested sorghum silage at an average yield of 12.3 ton per acre with most of the production located in KS and TX.

BACKGROUNDING

The use of silages lends many benefits to backgrounding operations, particularly for those producers that own or rent crop ground. For backgrounding yards that strictly purchase their feed, using silage is typically not as feasible unless they can buy it from another operation and haul it a reasonable distance. Although harvesting silage represents a significant time and monetary investment for the producer, one of the biggest advantages is simply having a high-quality feed stored in inventory. This gives operations with silage more flexibility with rations and at times they may be less affected by hay and forage shortages due to drought or other causes. A disadvantage to silage is that once the crop is chopped and packed, it must be fed for it to be marketed, unlike hay which can be sold more easily due to its ability to be transported with less cost per ton of DM. A recent report (Asem-Hiablie et al., 2016) indicated that feedlots in the Northern Plains and Midwest fed silage in backgrounding rations at average dry matter inclusions of 17.1% (range 0-78%) and 22.2% (range 0-67%), respectively. Feeding silage at 20 to 50% (dry matter basis) would be very common in many backgrounding rations, but cattle do well at levels above 50% which are fed in some instances. Often, our inclusion levels in rations are set by the tonnage harvested and cattle inventory throughout the year, with the goal to avoid running out early or carrying over large amounts of silage into the next year. We recommend keeping silage limited to ≤ 15% of the ration on a dry matter basis in starting/receiving rations for most cattle coming directly off pasture, but cattle can be adapted to higher levels once started and eating well.

As with any feeds, managing silage to minimize shrink is very important. For a custom backgrounding operation that is marking up their feed to sell, minimizing shrink represents a way to capture revenue.

Poorly managed silage that spoils and loses dry matter represents a cost and requires additional mark up to account for the lost feed. Every step in the process of making silage affects shrink: dry matter at harvest, chop length, bunker or pile filling and packing, inoculation, covering, and feedout. At current feed prices, silage appears to be economical in growing rations. Silage priced in the ration at $35 per ton can lower ration costs by as much as $16 per ton as-is or $7 per ton of dry matter depending on the inclusion and moisture level of the ration. If gain is constant, cost of gain could be lowered $0.02-$0.04/lb, with further reductions as the level of silage in the ration increases. With hay prices near $70+ per ton, silage becomes an attractive feed because it is a less expensive, higher quality forage source with additional energy from the grain component.

COW-CALF OPERATIONS

There is significant value of silages to beef cow-calf operations in today's production environment. In past years, it may have been considered uncommon to feed silages to beef cows but we have observed that it is recently becoming more typical. One reason may be that cow-calf operations are generally becoming larger, and consequently most producers can afford to own a mixer wagon or truck by spreading out the cost of machinery over more animals. Also, when the ethanol industry experienced significant growth 10 to 15 years ago, wet by-products were relatively inexpensive so many producers capitalized on it by purchasing feed mixing and delivery equipment if they didn't have it already. With the price of pasture near $2.00 per cow per day or greater (depending on region and stocking rate), a TMR using silage can be often fed to cows at a price less than grass or other supplementation methods with those savings put back towards paying machinery costs and depreciation. It is also common for many cow-calf producers to retain their calves for backgrounding after weaning allowing them to use the equipment throughout the year for more than one purpose. Likewise, those same producers likely find more justification for harvesting silage as they can feed it to both cows and calves.

Nutritionally, silages represent an excellent energy source in cow-calf rations by providing digestible fiber. They can be used to meet the energy requirements of cows to maintain BCS and weight and fit particularly well in rations fed post-calving with other forages. A big advantage to using silages in cow rations is the improvement in palatability and conditioning observed by adding a wet feed. This can be very important in situations where wet by-products are limited or unavailable, and the remaining feeds in the ration are dry. Cows can easily utilize 10 to 40 lb per cow per day of silage as-fed depending on the composition of the other ingredients.

Another important reason for the increased use of silage in cow-calf operations is that many producers are diversified with both crop and cattle enterprises. This obviously gives producers significant flexibility in being able to devote acres to silage as needed in conjunction with their existing plans for crop production. The increased conversion of traditional forage and pasture acres to crop production in recent years has been well documented (Wright and Wimberly, 2013) and more cow-calf operators are seeing the benefits of utilizing forages in tillable acres as cover crops and silage crops. One common challenge with silage for many cow-calf producers lies in harvesting and storing the crop itself. Unlike dairies or large feedlots that routinely harvest silage, cow-calf producers may not necessarily harvest silage annually and may lack experience with putting up quality silage. As is often the case in drought years, they may plant acres with the intention of harvesting the crop as grain and don't consider it for silage until the crop has failed. This clearly presents a challenge because by the time the decision is made to harvest it for silage, the dry matter is often too high for adequate packing and fermentation to occur. Adequate labor to accomplish all the tasks necessary for harvesting silage can be an issue for many operations. Most silage piles are made as drive-over piles or in an earthen bunker or trench, and many piles are not adequately packed or tarped. When a silage is not packed well due to moisture content, packing pressure or time, or chop length, oxygen is not completely packed out of the silage, allowing mold growth to occur. The end result is often a silage with higher dry matter and pH, shorter bunk life, more spoilage and shrink, and less digestible fiber. This demonstrates the importance of forethought and planning on the part of the producer, and likewise working with their nutritionist to ensure all steps are taken to maximize the quality of the feed.

FORAGE SORGHUMS AND SMALL GRAIN SILAGE CROPS

Sorghums can be an excellent silage crop for use in high forage rations for backgrounding cattle or cows. There are many different varieties of sorghums and Sudan grasses, some of which are high yielding for silage production and others which are better suited for grazing. Therefore, it is important for producers to understand their intended use when selecting a type of sorghum to use. In general, the silage hybrids identified by seed companies produce more tonnage and are later maturing (Bean and Marsalis, 2012). Forage sorghums for silage differ from corn silage in that the ratio of forage to grain is much higher as these crops generally are taller and have more leaf area than grain. Consequently, starch levels are typically lower for forage sorghum silage (≤ 25%) than corn silage (32-33%) resulting in a feedstuff that is lower in energy. However, if harvested at the correct DM (30-35%) and stored properly, these silages can be a very good source of digestible fiber. Most forage sorghum hybrids are either brown midrib (BMR) or non-BMR, with BMR hybrids containing less lignin than non-BMR sorghums. The main advantage with BMR hybrids is improved fiber digestibility. Relative to corn, forage sorghums are more resilient under high heat and drought conditions and accordingly are common in the Southern Plains. Production costs are also much lower for sorghum compared to corn. Under most growing conditions, forage sorghums produce 10 to 15 ton as-is per acre but yields in excess of 20 ton per acre can be achieved with adequate moisture. Since forage sorghums are harvested later in the fall, the timespan in which the crop can be harvested at 30 to 35% DM may at times be longer than with corn silage, giving it more flexibility on harvest timing. However, two common issues with sorghum silage include getting it to dry down adequately for proper harvesting and lodging (Bean and Marsalis, 2012).

Silage crops from small cereal grains have become very common in recent years again due to the increased use of alternative cover crops in existing corn and soybean production. These silage crops can include oats, wheat, triticale, barley and rye. One of the biggest advantages for these cool-season crops is that they are a cost-effective way to produce forage for either silage harvest or grazing and fit well when planted after harvesting wheat, hybrid seed corn, high-moisture corn, or corn silage. Aside from moisture being a major factor limiting production, success with these fall-planted crops is largely dependent on planting date, so the earlier they are planted the more growing-degree days are available for forage production (Drewnoski and Redfearn, 2015).

Small grain silages usually yield in a range of 5 to 10 ton as-is per acre, depending on maturity at harvest. Although the forage is highly digestible, overall energy content typically is less for small grain silages than corn silage, but protein levels are often higher (Table 3). As with any silage crop, dry matter at harvest, cut length, and adequate packing is key in determining how well the forage ensiles and stores. When harvesting small grain silages, packing to an adequate density can be a challenge. The physical nature of the forage and the hollow stems can allow oxygen to easily remain in the silage pile, so we will often see more spoilage and DM loss as a result if packing is not adequate. Recommended packing densities for corn silage or earlage are 45 lb per ft^3 of as-is silage, while densities for small grain silages should be closer to 30 lb per ft^3. Targeting a particle chop length of 3/8 to 1/2 inch will provide for a better pack because it enables the oxygen to escape more easily. Since small grain silages contain less starch than corn, less substrate is available for microbial fermentation and pH does not drop as rapidly at the onset of the ensiling process. Therefore, applying an inoculant to increase both the rate and extent of the fermentation process is highly recommended for small grain silages.

Accumulation of nitrates can also be an issue for corn, forage sorghums, and small grain crops, particularly when plants are stressed due to drought, hail, or frost. High levels of nitrogen fertilization can also contribute to nitrate accumulation. A benefit of harvesting these crops as silage is that fermentation will reduce nitrates by 40 to 50%, but other cautionary steps (diluting high nitrate forages with other feeds, adaptation of cattle to increasing nitrate levels, supplementation) may need to be taken depending on the level of nitrates present (Bolsen and Kuhl).

TABLE 1.

Corn acreage planted and corn silage production data by state, 2017.

State	Total corn planted, acres	Silage harvested, acres	Silage acres, % of total	Silage yield, tons/acre	Total silage production, tons
Nebraska	9,550,000	210,000	2.19	19.5	4,095,000
Kansas	5,500,000	250,000	4.54	21.5	5,375,000
Iowa	13,300,000	330,000	2.48	21.0	6,930,000
South Dakota[1]	5,700,000	520,000	9.12	12.5	6,500,000
Texas	2,450,000	150,000	6.12	22.0	3,300,000

[1]Drought year in 2017.

TABLE 2.

Sorghum silage production data by state, 2017.

State	Silage harvested, acres	Silage yield, tons/acre	Total silage production, tons
Nebraska	22,000	10.0	220,000
Kansas	85,000	13.0	1,105,000
South Dakota[1]	37,000	11.0	407,000
Texas	65,000	15.0	975,000

[1]Drought year in 2017.

TABLE 3.

Silage nutrient composition of small grain cereal crops and corn, %DM[1].

Crop	%TDN	%CP
Barley	64-68	9-11
Wheat	58-64	9-11
Oats	56-62	8-10
Triticale	54-58	8-10
Rye	52-56	7-9
Corn	70-72	7-8

[1]Adapted from Watson et al., 1993.

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