University of Kentucky
College of Agriculture, Food and Environment
Cooperative Extension Service

Feeding Corn Silage to Beef Cattle

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Corn silage can be an economical feedstuff for most classes of beef cattle. Kentucky is in the upper transition zone, which allows for the growth of warm- and cool-season forages. Corn, a warm-season grass, grows well in the state and may be harvested for either grain or silage. Implementing sound harvest and cattle management strategies and determining the nutrient content to balance rations will allow for successful feeding of corn silage to beef cattle.

Hybrids and Types

When considering corn for silage production, investigate what hybrids are available and known to perform well in your region. Many states provide corn silage variety trial information that contains information on yield and quality. Kentucky's 2019 corn variety trial information can be viewed at https://graincrops.ca.uky.edu/variety-testing. In general, later maturing hybrids (about 115 to 120 days) may be considered for higher yield potential.

Besides yield, traits to consider include disease and pest resistance. The development of multiple trait seed corn varieties has provided several options. Early marketed traits included glyphosate herbicide and BT corn borer resistance. Insect resistance traits developed include rootworm, earworm, and other traits for above ground insect protection. Disease resistance for stalk rot was also introduced into some hybrids. Additional herbicide resistant traits include glufosinate and 2,4-D. Many modern hybrids have several of these traits "stacked" into a single hybrid containing multiple traits for insect and herbicide resistance.

Forage yield and nutrient content/digestibility are key traits to consider when evaluating silage varieties. With a "dual-purpose" hybrid, used for grain or silage, the developed ear when full of kernels contributes half of the total weight toward silage yields. Since half the weight comes from the ear and kernels, forage from these hybrids tend to be high in energy. Many modern dual-purpose hybrids have leaves that stay greener longer into plant development, allowing for more biomass and energy yield. Many farmers are tempted to buy tall hybrids that look like massive plants in the field. In previous silage hybrid trials, corn height did not correlate with silage yield. Silage performance, not plant height, should be considered when purchasing hybrids.

Forage digestibility is an important consideration. Dual purpose hybrids typically have strong stalks that will remain upright until grain is harvested. Lignin is an important component to strong stalks. Lignin decreases plant digestibility. Often, a corn hybrid listed solely as a "silage corn" will have weaker stalks and less lignin, which is better for digestibility. These hybrids should be grown only for silage. Even further reductions in lignin occurs with the Brown Mid-Rib (BMR) trait available in some varieties. BMR hybrids should be grown only for silage. However, avoid decreases in forage yield to achieve greater digestibility. With so many varieties and traits available, corn hybrid trial information will ease the selection process.

Planting, Harvesting, and Storage

Corn for silage should be planted at the same time as corn for grain to maximize tonnage. April 1 to May 1 is typically the ideal range of dates to plant corn in Western Kentucky; April 15 to May 15 is ideal for Central and Eastern Kentucky. Corn for silage is typically planted at higher populations than corn for grain. An increase of 2,000 to 4,000 plants per acre is suggested on dual-purpose hybrids. Fertility and herbicide applications should follow recommendations from your agronomist or Extension office to improve yields. Scout corn fields routinely for pests and diseases such as gray leaf spot and Northern corn leaf blight. Consult with your agronomist for assistance with management recommendations for optimizing yield and quality. For more information on producing corn silage,

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consult UK Extension publication *Producing Corn for Silage* (AGR-79) at http://www2.ca.uky.edu/agcomm/pubs/agr/agr79/agr79.pdf.

Harvesting corn for silage should occur when total plant moisture is near 65 percent (35% dry matter). This moisture may correspond to the 50 to 75 percent starch layer on the kernels on some hybrids and to blacklayer on other hybrids. Whole plant moisture, not milk line or black layer, should drive harvest timing. Monitoring whole plant moisture content is important to ensure harvest occurs near the targeted moisture level. Silage harvested at too high of a moisture content will lead to excessive seepage. Corn harvested too dry will not chop as fine or pack as well. Corn chopped too wet or too dry may result in improper ensiling and poor silage quality.

Chop length should be near ½ inch for beef cattle to aid in packing. Reduced packing density will have a detrimental impact on fermentation by allowing for longer aerobic fermentation. Poorly fermented corn silage will have reduced shelf life or stability during feeding and lower palatability, reduced intakes and animal performance, and increase the risk of disorders such as listeriosis. Silage should be managed to minimize exposure to air, providing an anaerobic environment. Cover silage drive-over piles with plastic weighted down with tires to reduce spoilage after harvest. Research has shown that inclusion of spoiled silage negatively impacts intake.

Beef operations will have greater face stability and reduced shrink losses if silage is stored in a bag. Bunkers are faster to fill, quicker to feed out, but also have a larger surface area requiring higher daily feeding rates. Upright silos can maintain a fresh silage face and provide long term storage for corn silage. However, upright silos are slower to fill and unload and have the greatest maintenance costs. When considering storage type, determine the amount of silage to be fed daily to provide an estimate for how much of the face will be removed daily.

The following is an example for determining the feeding rate of silage to assist in deciding on storage method.

- Determine the amount of silage dry matter (DM) fed on a daily basis. A herd of 50 beef cows is feeding 30 pounds of silage as-fed daily. 50 cows x 30 lb silage = 1,500 lb silage as-fed. If the silage is 35 percent dry matter the pounds of dry matter fed daily is 525.
- Determine silage density in storage. Densities of 11 to 15 lb of DM/cu ft would be common for bags, and the midpoint of 13 may be used.
- Determine the amount of silage per foot of bag. The volume of a cylinder is calculated as π*(radius of bag)^2*length of bag (1 foot). A bag 8 feet in diameter with a density of 13 lb DM/cu ft would have approximately 650 lb DM per foot of bag.
- This would result in feeding about 9 to 10 inches off the face of the bag daily for these 50 cows.

When feeding silage from a bag, the recommendation is to remove at least 12 inches of spoilage daily during cold temperatures to minimize heating and spoilage, and more should be removed during warm weather. Higher densities, 15 lb DM/cu ft, may be seen in well packed bunker and upright silos. This greater density reduces air infiltration into the pile slowing secondary aerobic fermentation that leads to heating and spoilage.

During colder weather it is recommended that 6 to 12 inches be removed from bunkers and uprights. In warmer weather, the removal rate should be increased to near 18 inches. The example above with 50 cows is borderline for maintaining a fresh silage face. Larger diameter bags such as a 9, 10, or even 12 feet are available, but larger bags would result in less of the face being removed and greater spoilage with limited number of cows as in this example.

A horizontal bunker 24 feet wide and 8 feet high would have approximately 2,880 pounds of dry matter per foot. Feeding the 6 inches recommended feeding rate would provide 1,440 pounds daily that needs to be fed. The take-home point is the bunker or bag size should be dictated by the amount of silage fed daily to minimize spoilage.

Producers intending to store silage in a bag should consider location of the bag. The site should be well drained and away from surface water drainage. Consider developing either a high traffic gravel pad or concrete pad for the bags. The site should be away from trees and other rodent habitats to minimize damage to the bags. Repair any holes in the bag immediately.

When feeding from bags, bunkers, and drive-over piles, minimize face disturbance. The goal is to minimize air infiltration into the pile. Silage facers that cut off the silage face work well on large horizontal bunkers but not for smaller bags. Aggressive lifting with loader buckets is discouraged. Scraping down with the loader bucket or using the side of the bucket to shave off the face is suggested. Loosen only as much silage as needed for the day. Silage left unpacked in the pile, bag, or bunker will begin to heat and spoil.

Nutrient Content

After corn silage has fermented four to six weeks, silage may begin to be fed. Remove the spoiled silage from the end of the bag/bunker and compost for spreading back on a field at a later date. Obtain several grab samples from the face that will be fed. Place these into a plastic bucket and mix thoroughly. Collect approximately ½ pound of material and place in a plastic zip-top bag. Place the bag in a freezer overnight and mail to your forage laboratory of choice for determination of nutrient content. Nutrient content of silage can vary based on grain-to-forage ratio, variety, fertility and other factors. The nutrient content range for a few nutrients is shown in Table 1.

Feeding Corn Silage

Corn silage will be a novel feedstuff for most newly purchased calves and cows. Fermented feedstuffs often require an acclimation period. Intakes are often low the first three to seven days before cattle acclimate to novel feedstuffs. Silage offered must be fresh and free of spoiled silage to encourage consumption. Cattle that have a functioning rumen can utilize silage in their diets. Silage can be fed to

10- to 12-week-old weaned calves. However, smaller cattle have limited rumen capacity and dry matter intakes may be limited with high moisture diets. Beef cattle weighing 300 pounds and up can effectively utilize corn silage as part of their diet. Cattle will commonly consume corn silage at a rate of 5 to 7 pounds per 100 pounds of body weight. A 500-pound feeder calf may consume 25 to 35 pounds of corn silage as-fed daily.

Corn silage is higher in energy than other stored forages as a result of the grain content. Corn silage will typically contain 40 to 55 percent grain. A kernel of corn has approximately 67 to 70 percent starch resulting in silage containing about 30 to 35 percent starch. Testing silage for starch content will provide an indication of the grain-to-forage ratio, which will have a direct impact on the energy calculations for total digestible nutrients (TDN) and net energy values (NEm and NEg). Starch will ferment at a more rapid rate in the rumen. Rumen microbes utilizing starch can give rise to lactic acid or lactate. Lactate is a stronger volatile fatty acid leading to a greater potential to lower rumen pH in comparison to the other predominate VFAs (acetate, butyrate, propionate). Being a novel fermented feed with significant starch levels provides the rationale for transitioning cattle to corn silage diets over 10 to 14 days.

Introducing silage at 1 percent of body weight as-fed will provide a small amount of silage to acclimate cattle while minimizing feeding waste. As cattle consume the silage offered and are coming to feeding areas aggressively for silage, increase the amount offered by five pounds per head. Maintain the same feeding rates for at least three to four days before increasing the amount of silage offered. Ensure all silage is consumed daily before increasing feeding rates. Do not leave silage in the bunk for more than a day. Heating and spoilage will begin immediately once exposed to oxygen leading to a reduction in palatability. Additionally, the bacteria that leads to listeriosis grows in aerobic conditions.

Corn silage is relatively low in crude protein, averaging near 8 percent on a DM basis (Table 1). A common mistake made by cattle feeders when first utilizing silage is not balancing the dietary protein level by adding a supplemental protein source. Growing calves require 12 to 14 percent crude protein in their diet depending on growth rates. Corn silage alone will not provide sufficient protein to support efficient growth or lactation. Additionally, corn silage typically has a marginal calcium-to-phosphorus ratio near 1:1. The calcium level in the diet may need to be increased depending on the other feedstuffs in the diet to avoid urinary calculi. Corn silage may be used with a variety of feedstuffs and in various combinations for beef cattle. Example corn silage diets are shown in Table 2. However, diets should be developed with your nutritionist to provide a balanced diet that meets the nutrient needs of the cattle.

Value of Silage

Generally speaking, corn silage has been considered an economical energy feedstuff for cattle. The high yield potential of corn for silage contributes to its competiveness relative to other feedstuffs. However, corn requires significant input costs to optimize yield. Additionally, the availability of silage chopping equipment and baggers or custom harvesting opportunities has limited adoption of feeding silage in some areas.

In making the decision whether to plant corn for silage, several factors must be considered. The approach to valuing corn silage can be done in a variety of ways. Using the bushel price of corn and a multiplier constant is a quick method to value corn silage. For example, the elevator bid price of corn would be multiplied by a factor of 6 to 8 to approximate the value of standing corn. The numbers refer to the bushels of corn expected in a ton of corn silage. If the elevator bid for corn was $4.20/bu, the value of corn silage in a field would be $33.60 per ton as-is using a factor of 8. This approach is simplistic and may not account for all the cost of growing, harvesting, and storing corn silage. For a more detailed approach on valuing corn silage for feeding, consider reading AEC 2014-18 *Valuing Corn Silage for Beef Cattle Feed 2014 Guide* at https://agecon.ca.uky.edu/files/cornsilagevalue.pdf.

Corn silage can be valued on a cost per nutrient basis in relation to other feedstuffs. This approach utilizes commonly available feedstuffs as reference feeds to value the energy and protein content. This approach doesn't fully account for the feeding value of a feedstuff, but the approach is useful to approximate feeding values of alternatives. Corn silage value determination is shown in Figure 1, in which soybean meal was valued at $450 per ton and corn at $150 per ton to provide a feeding value for corn silage of $45/ton as-is. The cost of delivery, storage, and shrink losses (10 to 50 percent) are not accounted for in this example and must be considered. When valuing corn silage on a nutrient basis with this approach, feeding corn silage would be advantageous when the nutrient based value exceeds

Table 1. Nutrient content of corn silage.

Item	Min	Avg	Max
Dry matter, %	27	33	39
Crude protein, %	7.2	8.3	9.3
NDF, %	37	43	49
ADF, %	22	25	29
Starch, %	25	33	39
TDN, %	67	71	76
NEm, mcal/lb	0.68	0.75	0.82
NEg, mcal/lb	0.42	0.47	0.53

Source: Dairy One Interactive Feed Composition Library at https://dairyone.com/services/forage-laboratory-services/feed-composition-library/interactive-feed-composition-libraries/.

Table 2. Example diets containing corn silage for beef cattle.

Feedstuff, lb as-fed	Dry, late gestating cow	Early lactating cow	500- to 700-lb calves w/ 2.5-lb ADG	Finishing cattle, 1000 lb
Fescue hay	15	16	--	--
Corn silage	20	30	20	12
Soybean meal	--	--	2	--
Dried distillers grains	2	6	1	5
Corn	--	--	3	14
Mineral	In accordance with feedtag			

the cost of production estimate. Be sure that all costs of production, harvest, and storage along with shrink losses of silage are considered when valuing corn silage to get the most accurate estimate of the cost per ton when fed to beef cattle.

Conclusion

Corn is widely grown and well adapted to the region. Beef cattle producers may consider growing corn for silage as an economical alternative. Consider the production costs and anticipated yields to determine if this crop will improve your cattle operation's bottom line. Ensure quality feed by harvesting and storing corn silage properly. Working with your nutritionist or county Extension agent will increase your success when feeding corn silage. For additional information read the resources referred to in this publication as well as visiting with knowledgeable individuals.

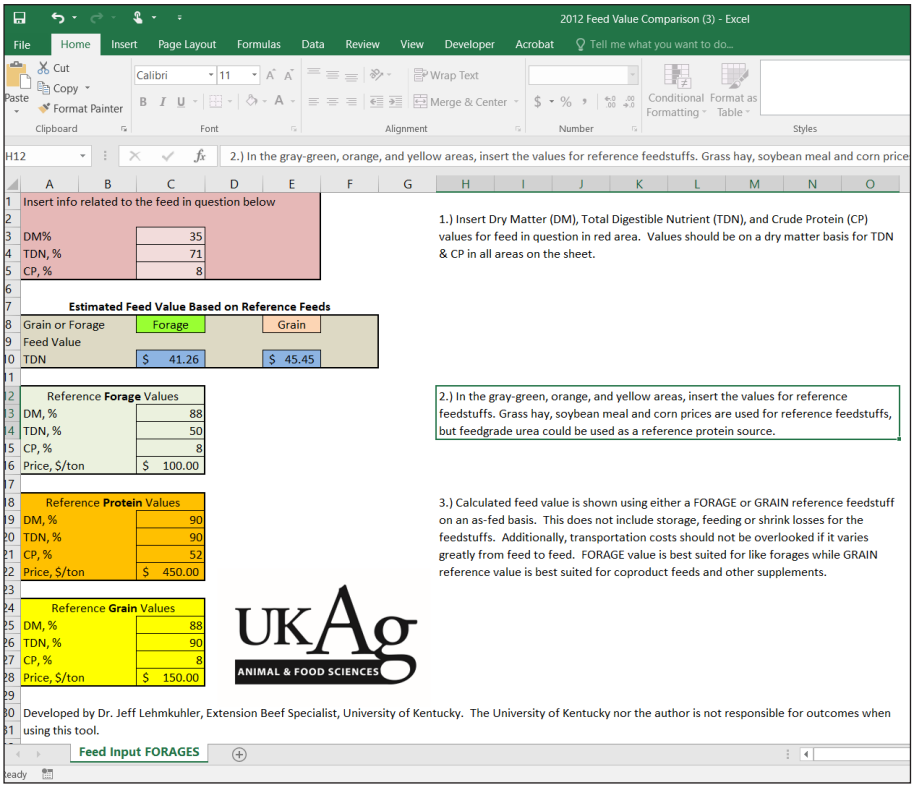

Figure 1. Nutritive value of corn silage utilizing corn and soybean meal as reference feeds.

Issued 9-2020