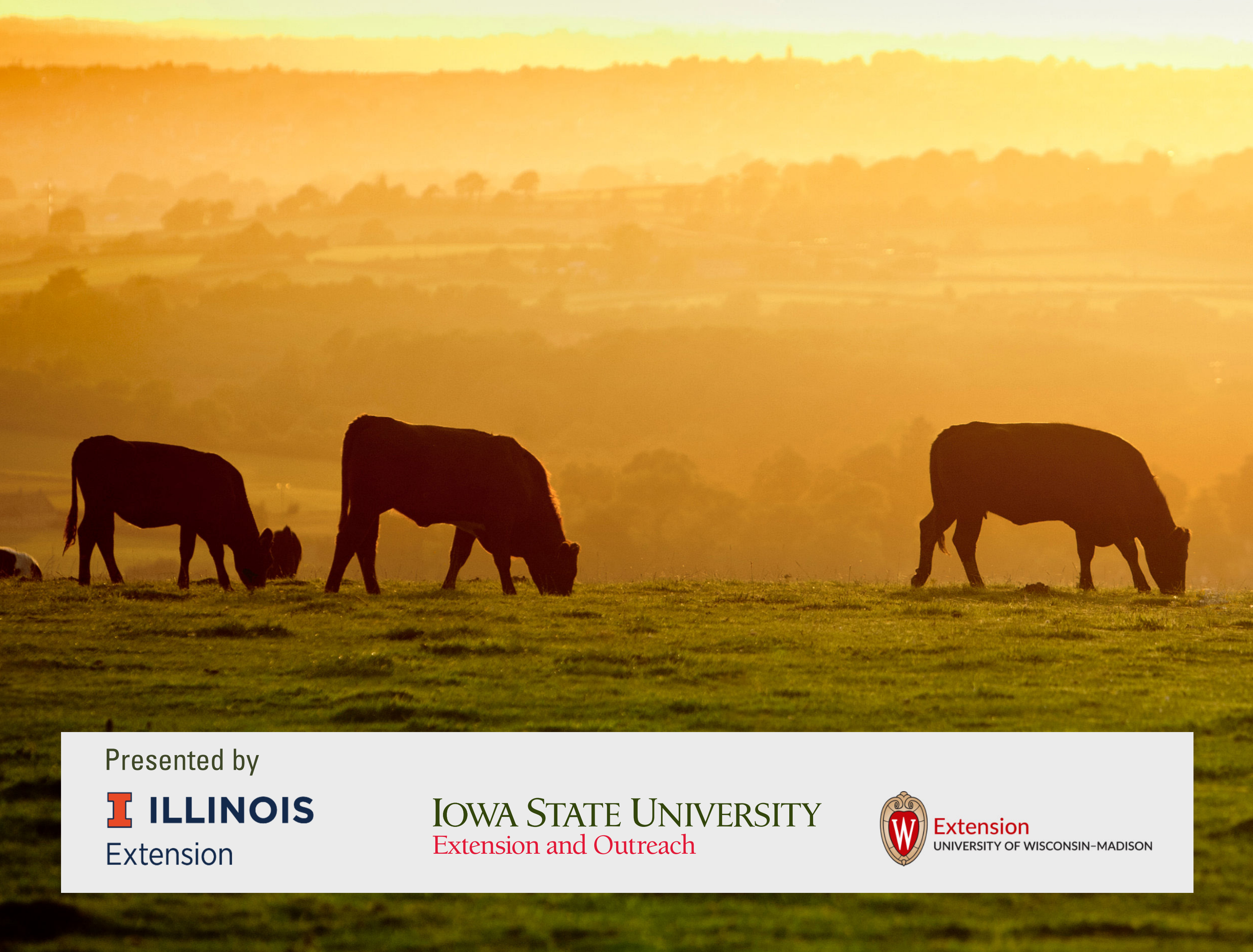
Driftless Region
Beef Conference

January 30-31, 2020 | Grand River Convention Center, Dubuque, Iowa



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Driftless Region Beef Conference

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U.S. Cattle Production Sustainability Overview

Greenhouse Gas Emissions Breakdown in the U.S.

According to the U.S. EPA's greenhouse gas (GHG) emissions inventory, ***2% of U.S. emissions come directly from beef cattle***[1] (methane from cattle belches, methane and nitrous oxide from manure). Total direct emissions from all agricultural production, crops and livestock collectively, were 8.4% of U.S. emissions in 2017. Agriculture, land use, land use change, and forestry combined in the United States are a net sink of CO_2 equivalent (CO_2e) emissions, meaning they removed 172 million metric tons of CO_2e from the atmosphere in 2017.

Table 1. 2017 U.S. Greenhouse Gas Emissions Sources and Sinks[1]

Item	Million metric tons CO_2e	% of US total GHG emissions
Beef cattle	138.3	2%
Other animal ag	117.5	2%
Crop agriculture	286.3	4%
Agriculture total	542.1	8%
Transportation	1800.6	28%
Electricity	1732	27%
All other human-caused GHG emissions	2382	37%
U.S. total GHG emissions	6456.7	100%
Land use, land use change, forestry	-714.1	
Agriculture, land use, land use change, forestry	-172	

What's the Global Situation Look Like

Large disparities in emissions intensities, or GHG emissions per lb of beef produced, exist across regions of the world. The U.S. has one of the lowest beef GHG emissions intensities: 10 – 50 times[2] lower than other parts of the world. Most of this variation is driven by the number of cattle required to produce beef. For example, the U.S. produces around 18% of the world's beef with 8% of the world's cattle herd.[3] Fewer cattle required for a given amount of beef produced means fewer GHG emissions and fewer natural resources required to produce human nourishment. The U.S. is a leader in beef production efficiency because of scientific advancements in beef cattle genetics, nutrition, husbandry practices, and biotechnologies.

Correcting the Misinformation

A quick Google search of beef and GHG emissions will result in a wide range of statistics. Unfortunately, two types of conflation typically occur that muddy the waters. First, globally-relevant statistics are often conflated with U.S. emissions, and second all emissions from livestock production are often ascribed to beef.

Globally, life cycle emissions from livestock production (emissions from feed production to consumer) are 14.5% of GHG emissions. ***Global beef life cycle emissions are 6% of the world's GHG emissions.***[4] The disparity between these two percentages is due to the other forms of livestock agriculture accounted for in the 14.5% figure, such as poultry, pork, and dairy production. In the United States, ***beef cattle production produces 3.7% of U.S. GHG emissions from a life cycle perspective***[5] (adding in feed production, fuel and electricity use, etc. to the 2% estimation from the EPA inventory). The GHG emissions produced by U.S. beef cattle contribute only a fraction of the GHG emissions attributed to global beef production, as most cattle in the world are located outside U.S. borders. ***U.S. beef cattle emissions are less than ½ percent of the world's GHG emissions***.[6]

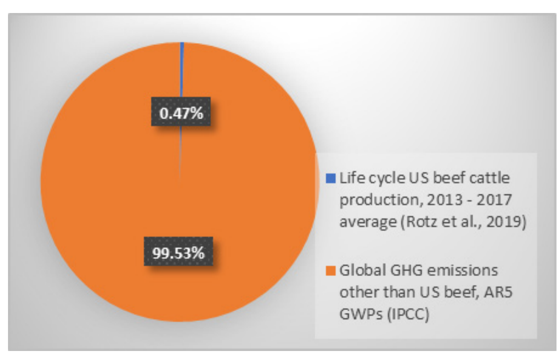

Figure 1. *U.S. beef cattle production emissions in the context of total global GHG emissions*

Upcycling is the Ruminant Advantage

Cattle are ruminants. This means they have a symbiotic relationship with the microorganisms that live within their specialized stomach compartments that provides them their upcycling superpower. Upcycling is converting something of little to no value to a higher value product. Cattle upcycle every day, converting solar energy in plants that's inaccessible to humans to high-quality protein, micronutrients, and ancillary products such as leather and pharmaceuticals. The U.S. beef cattle industry provides more than two times the high-quality protein (accounting for amino acid profile and bioavailability)[7] to the U.S. food supply than cattle consume: cattle directly contribute to food security. Additionally, beef is rich in micronutrients such as Zinc, Iron, Selenium, Choline, Niacin, Riboflavin, Vitamin B_{12} and Vitamin B_6.

Cattle Provide Far More than Beef

Cattle production results in more benefits to society than just the excellent nutrient package that is beef. Cattle are a source of fiber (leather), fertilizer, fuel, and wealth. Beef cattle operations represent over 1/3 of U.S. farms and ranches[8] – the single largest segment of U.S. agriculture. Cattle production preserves and enhances grassland ecosystems. Cattle grazing can help mitigate the risk of catastrophic wildfires.[9] Cattle grazing lands help regulate and purify the water supplies for major municipalities in the United States.[10] Conservatively, the ecosystem services of cattle ranching and farming provide $14.8 billion of societal value in the U.S.[11] In short, cattle production is a key part of the social fabric of America, from cultural contributions of cowboy Americana to provisioning of heart valves to people. Cattle are a self-replicating, solar-powered plant-based protein source with numerous unmatched co-benefits. Humanity has depended upon cattle production for the whole of civilization and will continue to do so far into the future: beef cattle production is sustainable.

Beef cattle production is always getting better

Despite having a highly resilient and efficient beef production system in the USA currently, cattle producers are always looking for ways to get better. Compared to 1975, it takes 36% fewer cattle[12] to produce the same amount of beef today. This dramatic improvement in efficiency has been driven by improvements in beef cattle genetics, nutrition, biotechnologies, and husbandry practices that result in improved animal well-being. Research and extension and adoption of new knowledge is a continuous process that delivers on incremental improvements in reducing beef cattle production's resource use and environmental impacts. Advancements in grazing land management, genomically-enhanced expected progeny differences (EPDs), methane-inhibitors, integrated crop-livestock systems, water recycling technology, and manure composting are just a few of the examples of new technologies being deployed and tested that will further enhance the sustainability of U.S. beef production. Ultimately, the U.S. beef industry is resilient and well-positioned to continue to provide U.S. and international consumers a superior animal source food in a socially and environmentally responsible manner for decades to come.

For more information, go to www.beefresearch.org/beefsustainability.aspx

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BEEF
Funded by the Beef Checkoff

Why BQA matters and what's next

Lacey Alexander, North American Beef Welfare Lead, Cargill, Wayland, IA

State of the union

- Busy few years of packers and customers announcing BQA commitments
- BQA has driven several improvements as reflected by NBQA results
- Industry still has a few opportunities that will require outreach and research

Why BQA and BQAT matters

- Americans (consumers) are several generations removed from direct farming
- Customers are consumers with more info and power
- NGO's are watching and can cause a lot of heartburn
- Be glad you are an American: Feb 20, 2020 Canadian HAR Transport Regulations

What's next and how you can help

Fit to transport

- If they are questionable at home, they will be questionable at slaughter
- Cattle very rarely make a miraculous recovery on the trailer; hot cattle will probably get hotter and lame ones will get lamer
- Cattle have a long ways to walk at the plant
- BQAT or bust!

Welfare at slaughter

Management through measurement: audits

- Internal in person
- Internal on camera
- External planned 3rd party
- External surprise 3rd party
- Remote video auditing

Research

- Pneumatic stunner bolt length
- Head dimension by breed
- Trailer design
- Carcass bruising
- Mud scoring
- Hide damage
- 1 stun vs 2 stun
- PSSS1 vs PSSS21
- Shade
- Transport space requirements

Impact of cow nutrition and early calf management on lifelong performance and carcass merit

Allison M. Meyer, associate professor, University of Missouri

Introduction

We know that genetics and environment both contribute, often through their interaction, to phenotypes such as growth, health, fertility, and carcass quality. As our tools for genetic selection improve, it is critical that we manage animals appropriately to allow them to express their genetic potential. This is especially true when it comes to nutritional management, and a growing area of research known as "developmental programming" or "fetal programming" has shown us that in order to produce cattle than meet their genetic potential, proper nutrition is essential beginning at conception.

Developmental programming is the theory that the environment an animal is exposed to early in life, especially during the prenatal and pre-weaning periods, affects its development and has lasting impacts on its health and performance. Producers have long known that keeping pregnant cows well-nourished and healthy is important for the successful birth of live, healthy calves. Despite this, beef cows often are fed low quality hay or pasture during gestation, which may not meet the dam's nutrient requirements for maintenance and growth of the fetus. Research on developmental programming in beef cattle is a growing area that demonstrates the importance of providing proper nutrition during gestation to allow for optimal fetal growth and development.

Nutrient demands of pregnancy

Beef cow nutrient requirements increase dramatically in mid- and especially late gestation due to rapid fetal growth (NRC, 2000). For example, the energy requirements (NEm requirements) of a 1200 lb beef cow increase from 9 Mcal NEm/day on day 120 of gestation to 13.5 Mcal NEm/day on day 270 of gestation (Figure 1). During this time, the proportion of total energy requirements that goes to fetal growth increases from less than 4% at day 120 to 38% on day 270 of pregnancy. Protein requirements increase similarly to energy requirements during pregnancy. Thus, when weaning occurs and nutrient requirements decrease because lactation ends, nutrients needed for gestation and fetal growth increase.

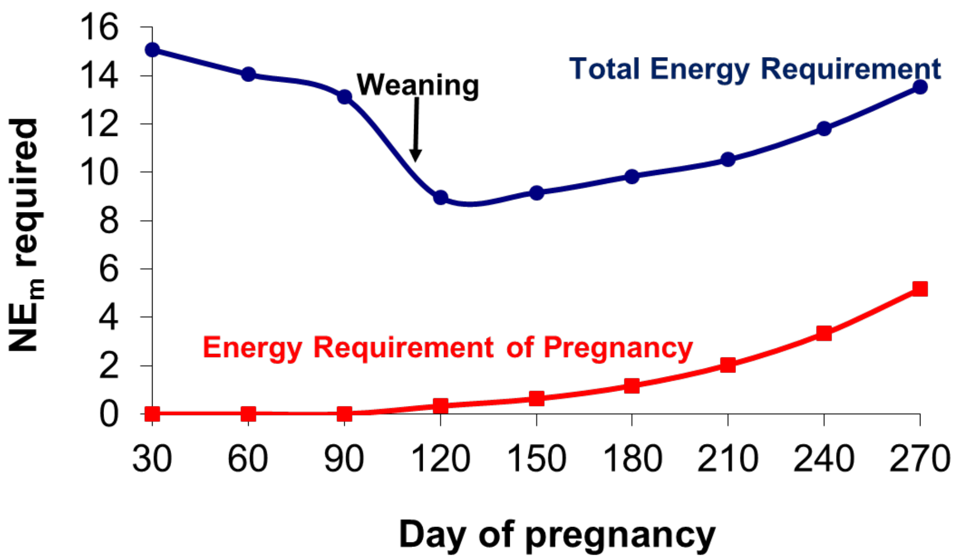

Figure 1. Beef cow energy requirements of pregnancy (adapted from NRC, 2000)

Early lactation is the most nutrient-demanding time of a mature cow's life, as energy and protein requirements increase from calving through peak milk. This is why as producers, we typically take this into consideration and provide higher quality forage or feed for early lactating females.

Furthermore, growing females (especially first- and second-calf heifers), require additional energy and protein for their own growth during both gestation and lactation. Cold stress can also greatly increases energy requirements (but not protein requirements), and can cause pregnant or lactating cows to be in a negative energy balance during winter and cool, wet springs.

Critical periods of development

Cows that do not consume enough nutrients during gestation will partition nutrients to the developing fetus, even utilizing body stores of fat and protein to protect the fetus, but this has its limits. When nutrient requirements are not met during gestation or nutrients are diverted to growth (growing heifers) or lactation (early gestation), fetal growth may be impaired. The effects of this vary based on the specific periods during fetal and neonatal life in which this nutrient restriction occurs.

The first weeks after breeding are important for embryo development and recognition of pregnancy by the cow. The placenta, or site of fetal and maternal attachment and nutrient and waste exchange during gestation, begins to develop during this period also, then has rapid growth in early to mid-gestation. The organ systems of the fetal calf form and begin to develop during early to mid-gestation, and then grow rapidly as the calf increases growth in late gestation. The time immediately around birth and early calf life are both important for the final maturation of organs to prepare the calf for life outside of its dam.

Recent research indicates that nutrition during gestation impacts milk production of the cow and ewe as well, even when her nutrient requirements are met postpartum. This means that effects of nutrition during pregnancy can extend past calving and decrease the amount of quality of milk produced, further affecting calves. We have also long known that nutrition of lactating cows greatly impacts milk yield and quality as well. Thus decreased nutrients available in milk for calves can be caused by cow nutrition pre- and postpartum.

Impacts on calves

Depending on what nutrients are restricted during pregnancy (e.g. all nutrients, protein, energy, minerals, etc.), and the period in which this restriction takes place, calf growth, development, health and performance can be greatly affected. Calves from dams that have been nutrient restricted during late gestation typically have decreased fetal growth, which may result in lighter birth weights. These lower birth weights are not necessarily good, however; low birth weights can mean poor development, increased sickness, and possibly death loss.

Although many producers strive for low birth weights to decrease dystocia, decreased birth weights caused by poor cow nutrition are not a good way to accomplish this. Calves that have not reached their genetic potential for birth weight may have had poor development, be immature at birth, and are often not ready to face the challenges of life outside of the uterus. This is especially concerning when calving in cold conditions.

Whether birth weight has been decreased or not, nutrition of the dam during gestation can affect pre- and post-weaning growth of calves. This leads to decreased weaning weights, heifer weights at breeding, and steer slaughter weights because of reduced average daily gain. Additionally, feed efficiency has been altered in some calves due to nutrition during gestation.

Altered growth and feed efficiency are not the only results of nutrient restriction during pregnancy, however. Nutrition during gestation can affect many important organ systems in the body, which decreases or changes their functions in the animal. These changes that have been observed in beef cattle research include decreased carcass weight and yield, reduced marbling and carcass quality, decreased heifer reproductive performance, and poor health after birth and into the feedlot (summarized in Table 1). Although many of these impacts have come from poor nutrition of cows during late gestation (approximately last 90 days of pregnancy), some have also been observed with poor early- and mid-gestation cow nutrition. Although much more research is needed to determine why these effects are present and how they may be reversed, it is apparent that nutrition of cows during pregnancy has many effects on calves.

Table 1. Impacts of Nutrition during Pregnancy on Calf Performance*

Trait affected	Effects of altered nutrition during pregnancy
Growth traits	Decreased average daily gain
	Decreased weaning weights
	Decreased breeding weights
	Decreased slaughter weights
	Altered feed efficiency
Carcass composition	Decreased hot carcass weight
	Decreased muscle mass
	Decreased marbling and quality grade
	Altered tenderness
Reproductive performance of daughters	Increased age at puberty
	Decreased conception and pregnancy rates
	Altered hormone production
	Decreased milk production
Health	Increased calf sickness
	Increased feedlot morbidity

*Data summarized from Caton and Hess, 2010; Du et al., 2010; Funston et al., 2010; Meyer et al., 2012, and Wu et al., 2006

Summary

Developmental programming occurs in beef cattle, often because of maternal nutrient restriction during the critical periods of fetal or calf growth. Calf growth, health, reproductive performance, and carcass quality can be negatively affected. Additionally, milk production of the dam may be impacted by nutrition during pregnancy, having further effects on nursing offspring. Nutritional management of beef cows should allow them to meet the increasing nutrient requirements due to fetal growth during gestation to prevent negative effects on calves.

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Baled silage management

Wayne Coblentz, USDA-ARS, U.S. Dairy Forage Research Center, Marshfield, WI

Introduction

Baled silage is an attractive forage preservation option for many small or mid-sized dairy and beef producers. This ensiling method is attractive because of several clear advantages over conservation of forages as dry hay:

- i) less risk of rain damage because a shorter window of suitable weather is required to wilt, bale, and wrap the forage;
- ii) better potential to harvest the forage crop at an earlier or more appropriate maturity;
- iii) little or no spontaneous heating during storage;
- iv) better retention of leaves, especially from legume forages; and
- v) greater potential for outside (uncovered) storage because the silage is wrapped completely in plastic film, and therefore sheds water.

Oftentimes, producers can utilize some of their existing haying equipment, thereby reducing some of the start-up costs associated with this ensiling technique.

Management goals

Generally, most management principles for baled silages are the same as those for conventionally chopped silage. Producers should start with a high-, or an appropriate-quality forage for their targeted classes of livestock. Baled silage should never be viewed as a corrective measure for storage of poorly managed forage crops. Forages can be baled in either large-round or large-square bale packages, but the most important goal is to create an anaerobic (without oxygen) environment in which plant sugars are converted into fermentation acids (lactic acid is most desirable) by microorganisms adhered to forage plants at the time of ensiling. Theoretically, the production of fermentation acids lowers the pH of the forage mass, ideally creating a fermented silage that is stable as long as anaerobic conditions within the silo are maintained. Much like chopped silages, rapid establishment and continued maintenance of anaerobic conditions are critical for several important reasons:

- i) respiration by active plant cells must be terminated quickly to prevent losses of the sugar (substrate) necessary for silage fermentation;
- ii) anaerobic conditions are critical for the efficient growth of lactic-acid-producing bacteria;
- iii) aerobic yeasts and molds will cause aerobic deterioration (spoilage) when the integrity of the silage plastic has been compromised; and
- iv) aerobic deterioration will result in dry matter (DM) losses, increased concentrations of fiber components, and decreased energy density within the silage.

Establishment and maintenance of anaerobic conditions

Recommendations for appropriate DM bale density are 162 kg DM/m^3 (10 lbs DM/ft^3) (Jennings, 2011). Although operator experience is important in creating dense bales, other management practices, such as reducing tractor/baler ground speed, increasing PTO speed, and creating thinner windrows, also will help to maintain bale density. Forage moisture concentration also can affect bale density; Figure 1 depicts the relationships between DM density and bale moisture for 4 × 4-ft round bales of alfalfa/orchardgrass. Bales were made at a constant tractor/baler ground speed of 5.5 mph, and with or without engagement of a bale-cutting mechanism within the baler (Coblentz and Akins, 2019). Wet bales (68% moisture) fell below the recommended DM density target (9.4 lbs DM/ft^3), but drier bales (46% moisture) exceeded the common recommendation by 45% (13.6 lbs DM/ft^3). Marginal increases (< 5%) in bale densities may be observed by engaging bale-cutting mechanisms within the baler, although their primary function is normally to facilitate easier blending of baled silages into total mixed rations.

Typical recommendations for sealing bales are to use 6 to 8 layers of plastic that should be applied within 4 hours of baling (if possible). Some studies suggest that as few as 4 layers may facilitate a good fermentation, but depending on the value of the forage crop, this may not provide acceptable security for maintaining an anaerobic environment. Bales should be placed on a site free from rocks, tree limbs, and other debris that could easily puncture the plastic wrap. Equal care should be given to placing wrapped bales at a site that does not shelter skunks, rats, or other vermin that may puncture the plastic.

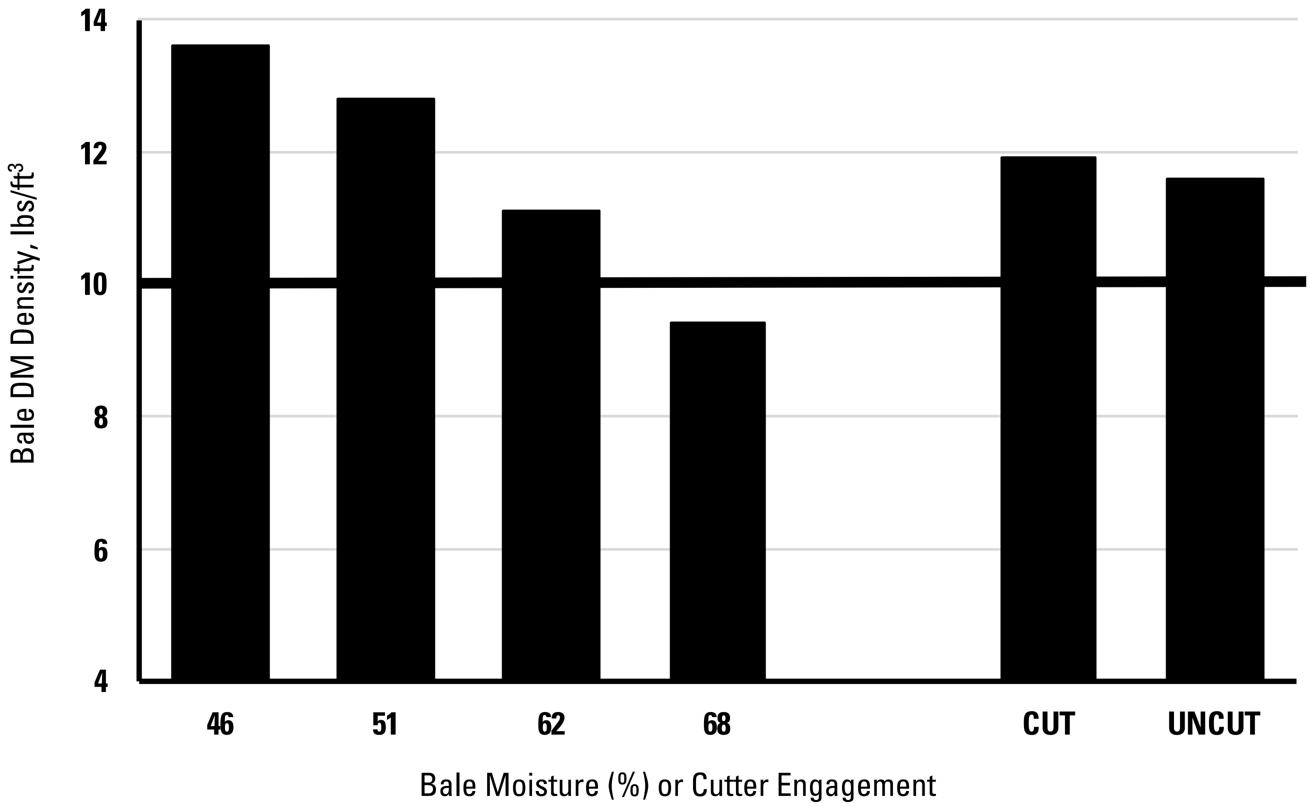


Figure 1. Relationship between DM density and bale moisture for alfalfa/grass forages made with a tractor/baler ground speed of 5.5 mph, and with or without bale-cutter engagement (adapted from Coblentz and Akins 2019). The black horizontal line represents the recommended 162 kg DM/m^3 (10 lbs DM/ft^3) density target suggested by Jennings (2011).

A common question posed by producers concerns the length of time they have to wrap silage bales after baling operations are completed. This can be problematic whenever a rented or hired bale wrapper is delivered to the farm late, or if inclement weather delays bale removal from the field. Normally, recommendations are for wrapping as quickly as possible, but a recent study conducted at the University of Wisconsin Marshfield Agricultural Research Station suggests that damage to the baled forage through respiration is probably relatively minor during the first 24 hours post-baling (Figures 2 and 3; Coblentz et al., 2016). Damages to forage crops will likely become more severe when delays exceed that time interval.

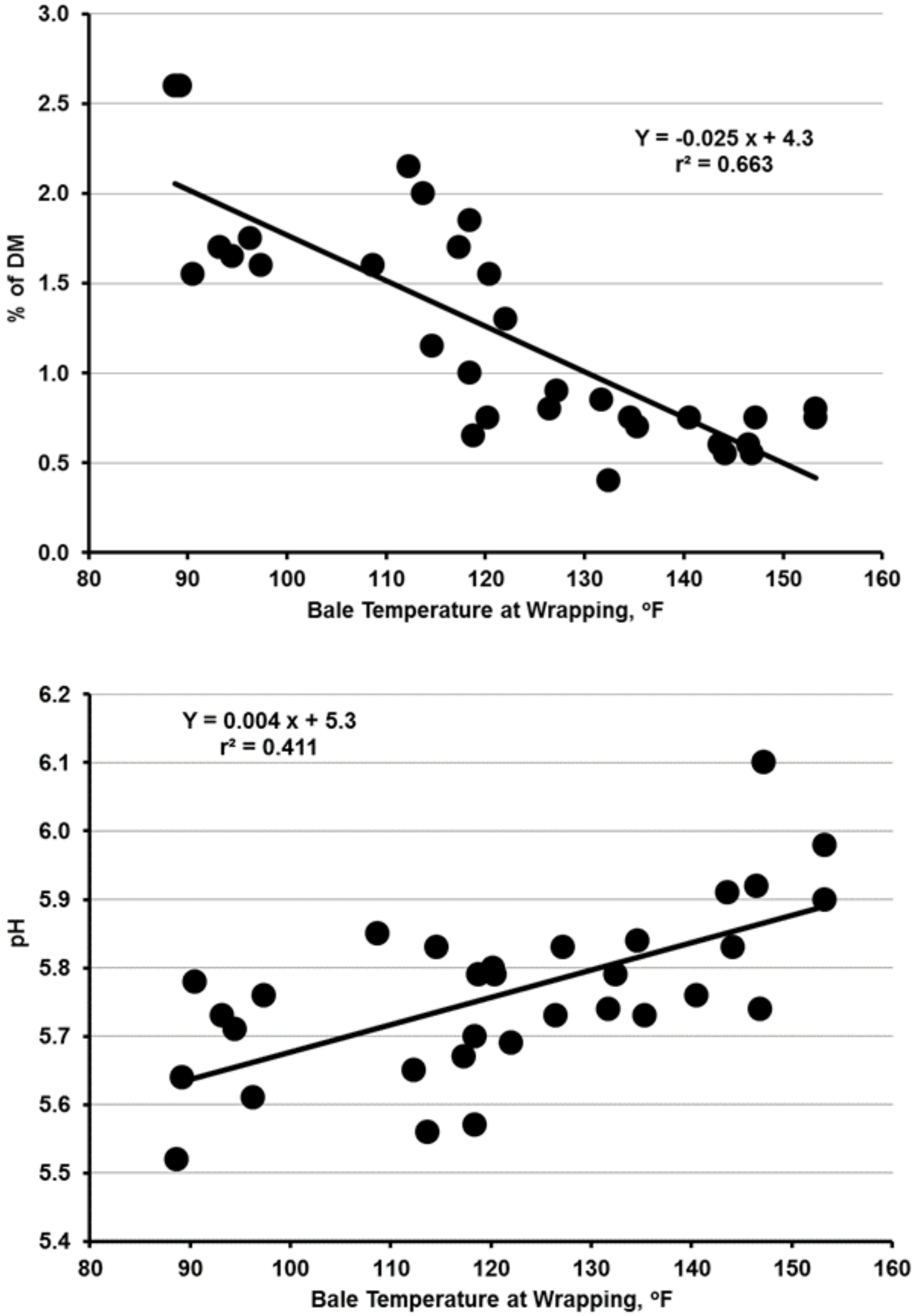
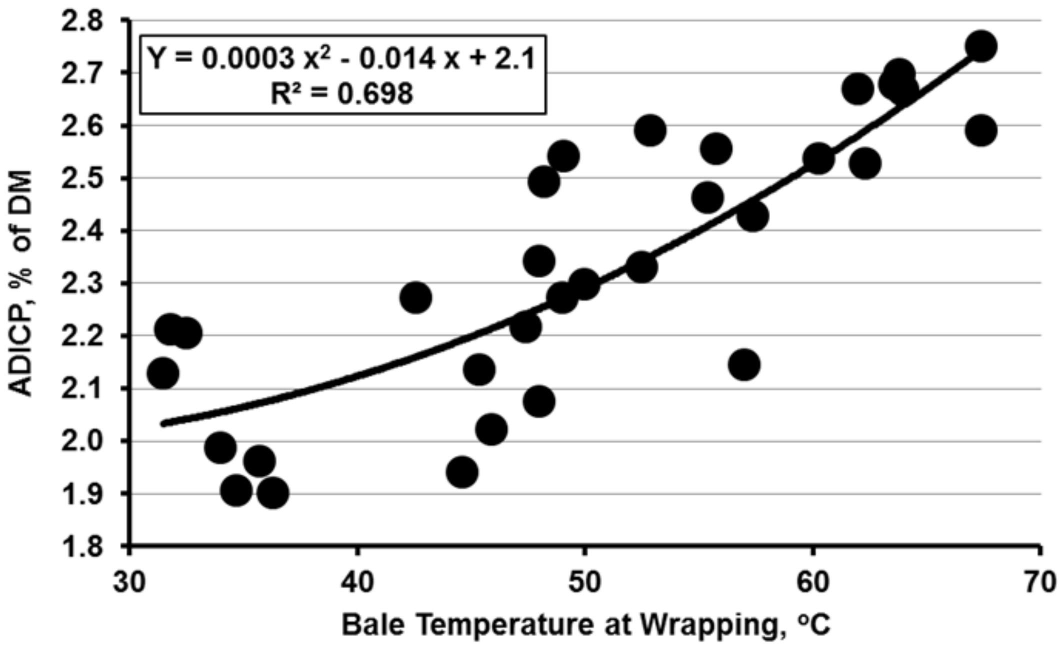


Figure 2. Concentrations of lactic acid (top) and final pH (bottom) for alfalfa/grass round-bale silages wrapped 0, 1, 2, or 3 days after baling, and expressed as a function of internal bale temperature (°F) at the time bales were wrapped (Coblentz et al., 2016).



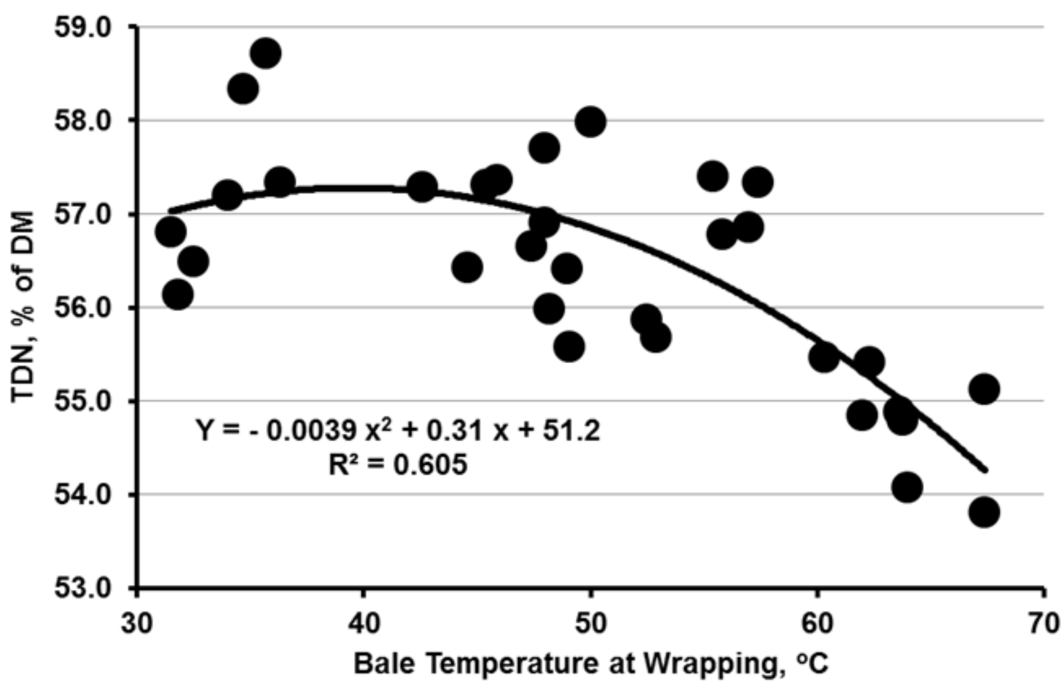


Figure 3. Concentrations of acid-detergent insoluble crude protein (ADICP; top) and total digestible nutrients (TDN; bottom) for alfalfa/grass round-bale silages wrapped 0, 1, 2, or 3 days after baling, and expressed as a function of internal bale temperature (°C) at the time bales were wrapped (Coblentz et al., 2016).

Moisture management

Generally, baled silage should be packaged at 45 to 55% moisture (Shinners, 2003), and the average moisture for the whole field or group of bales should be about 50%. This recommendation contrasts sharply with normal targets (< 70%) for most precision-chopped silages. Historically, these recommendations for baled silages were somewhat equipment related, particularly with respect to safety issues associated with bale weight, as well as the limitations of some balers to package excessively wet forages. Although these reasons remain relevant, (silage) baler design has improved to accommodate wetter forages, and fewer producers attempt to transport or handle silage bales with undersized tractors. Another important reason for the reduced moisture recommendation associated with baled silages is the potential for clostridial fermentations, which produce undesirable end products, such as butyric acid and ammonia, and depress voluntary intake by livestock. Recent work at the University of Wisconsin Marshfield Agricultural Research Station has detected elevated concentrations of these undesirable fermentation products when the moisture of wrapped alfalfa bales approached 60% (Figure 4); on this basis, 60% should be considered the upper moisture threshold for alfalfa, which is especially sensitive to clostridial fermentations because of its relatively low sugar concentrations (4 to 7%) and high buffering capacities (inherent or natural resistance to pH change). Oftentimes, cool-season grasses are much more forgiving in this respect. Generally, the production of silage fermentation acids is positively associated with moisture concentration. As a result, the fermentation of baled silages is inherently restricted compared to precision-chopped silages, thereby resulting in a slower fermentation and a greater (less acidic) final pH (Figure 5). A further common observation is that producers are frequently baling and wrapping forages that are drier than recommended (< 45% moisture); this is not necessarily a problem from a preservation perspective, but fermentation can be even more limited, thereby placing greater emphasis on the importance of excluding air for good preservation.

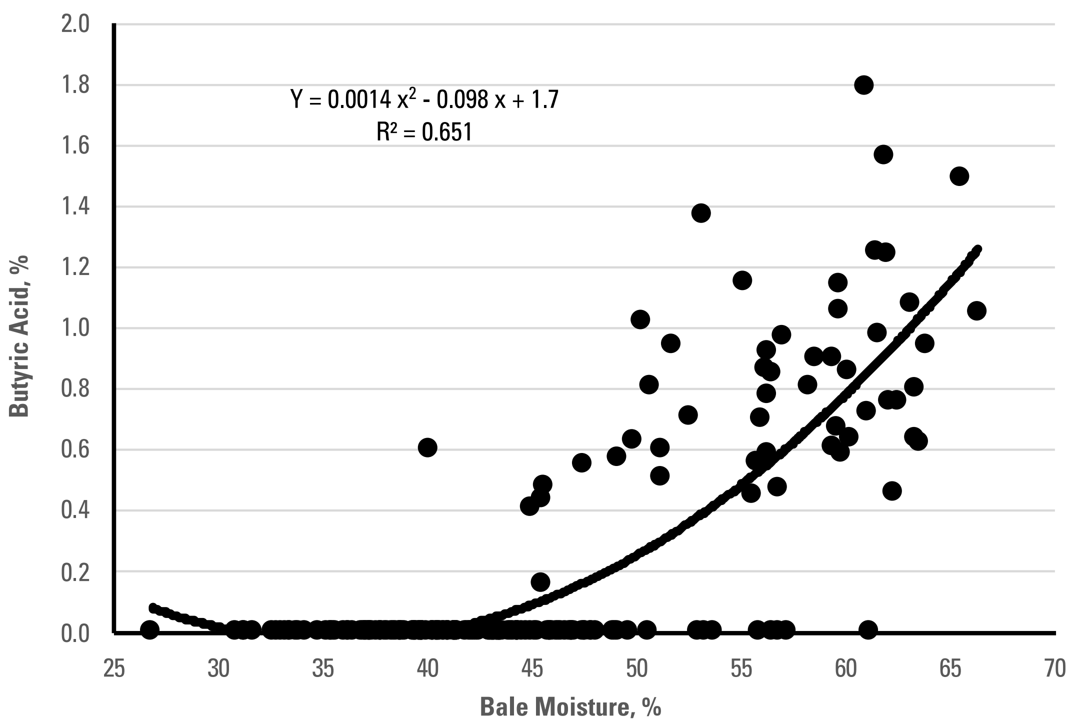


Figure 4. Concentrations of butyric acid in alfalfa round-bale silages expressed as a function of initial bale moisture (adapted from several studies).

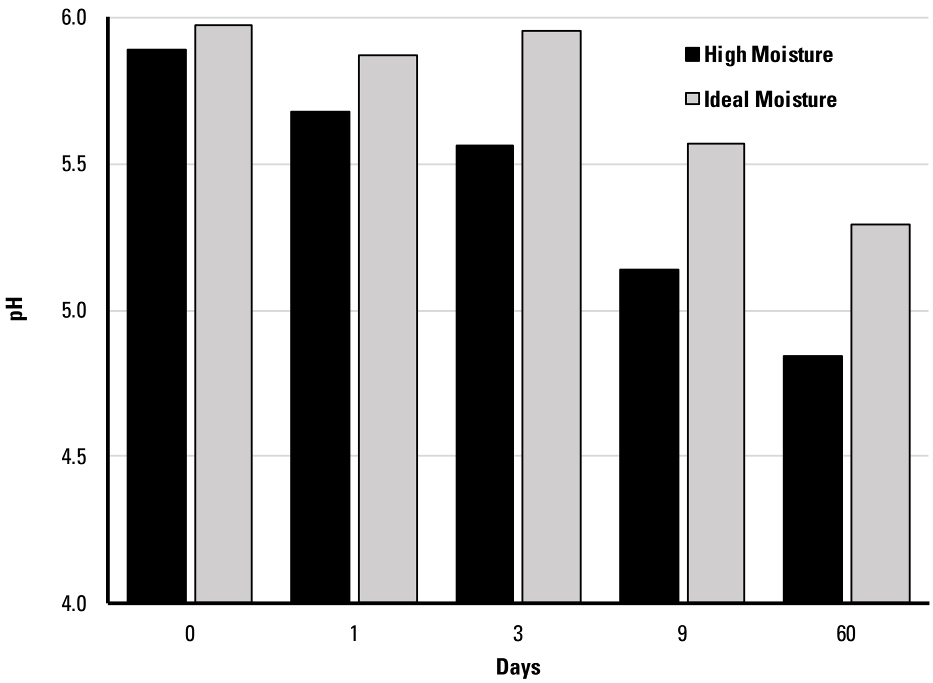


Figure 5. Rates of fermentation for alfalfa forages ensiled in large-round bales at high (60 to 65%) or ideal (49 to 54%) moisture (adapted from Nicholson et al., 1991).

Other differences between baled and chopped silages

Some other differences between baled and chopped silages are worthy of note. First, chopped silages have reduced particle length, but baled silages are usually packaged as long-stem forage. This lack of chopping action within baled silages forces sugars from inside the plant to move largely by diffusion to reach lactic-acid producing bacteria adhered to the outside of forage plants, which is a process that normally limits the rate and extent of fermentation. A good illustration of this concept (Figure 6) can be obtained from a unique study by Nicholson et al. (1991), where the fermentation of precision-chopped and baled silages were compared at the same forage moisture concentration. After a 60-day fermentation period, the final pH for the chopped silage was > 0.6 pH units lower (more acidic) than observed for the baled silage. In addition, baled silages often are less dense than chopped silages, which also may restrict the availability of sugars to lactic-acid producing bacteria, and further slow the rate of fermentation.

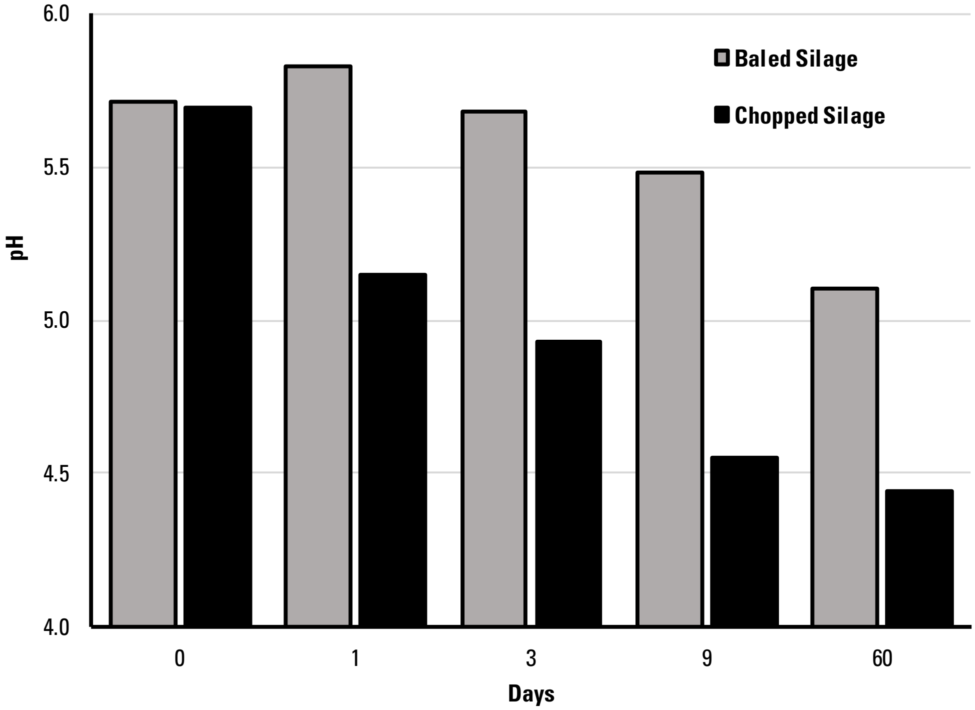


Figure 6. Rates of fermentation for baled compared to precision-chopped alfalfa/grass forages ensiled at 61% moisture (adapted from Nicholson, et al., 1991).

Feedout

The use of in-line bale wrappers, in which bales are wrapped around the circumferential surface of each bale, but are butted together in a continuous row, has generated numerous questions about aerobic stability upon exposure to air, particularly when bales are designated for sale as a cash crop. A study was conducted during January in northern Arkansas (Rhein et al., 2005) in which wheat and orchardgrass baled silages wrapped with an in-line wrapper were exposed to air simultaneously and monitored for aerobic stability for about a month. Although there were a few bales that exhibited elevated bale temperatures after 2 weeks of exposure, most bales remained stable throughout the month-long exposure period. Obviously, ambient temperatures in the southern Ozarks are warmer in January than those in the north-central US, yet some flexibility with respect to stability and subsequent usage of baled silages was observed. This suggests that baled silages likely will remain stable during winter months for several weeks, but it should not be inferred that this would be the case during warmer months.

Questions about inoculants

Producers frequently ask questions about the use of silage inoculants. Research studies evaluating inoculants for baled silages are very limited relative to chopped silages; as a result, it is difficult to support recommendations with good research data. However, for ensiling baled alfalfa, there may be 3 circumstances that especially warrant inoculation with lactic-acid producing bacteria. These include alfalfa forages that:

i) have suffered damage from rainfall events during wilting;

ii) received dairy slurry or other manures during the current growth cycle (Coblentz et al., 2014); or

iii) have been packaged at the 60% moisture threshold at which production of butyric acid may become problematic.

Summary

Most principles for management of baled silages are similar to those for precision-chopped silages, but there are some key differences. Baled silages normally ferment more slowly than chopped silages, and likely will have a final pH that is less acidic. Some of these differences can be attributed to the long-stem nature of most baled silages, but the recommended lower moisture concentration (45 to 55%) also plays an important role in restricting fermentation. Furthermore, many producers harvest and wrap forages at moisture concentrations even less than recommended, oftentimes resulting in minimal production of fermentation acids. As a result, even more emphasis should be placed on establishing and maintaining an anaerobic environment for silage fermentation and preservation.

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Calving management for improved neonatal calf survival

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Pre-weaning calf death, estimated to be 5-6% by USDA-APHIS (2017), is a major loss for cow-calf producers. Each dead calf results in costs from breeding, feeding, and routine health care of a pregnant cow with no profit from the calf.

Based on USDA-APHIS (2010) survey data, about 2/3 of beef calf pre-weaning death occurs between birth and 3 weeks of age, indicating that this is the most critical period for calf survival. This early time in a calf's life is referred to as the neonatal period. Common causes of calf loss include predator related mortalities, digestive and respiratory problems, calving-related problems such as dystocia, weather related deaths, and other disease.

Good management of pregnant cows and neonatal calves can increase calf survival during this period, and tips are given below. It is important to consult a veterinarian about vaccination strategies and treatment of disease.

Breeding to calving

1. **Provide Proper Nutrition and Vaccination to Cowherd during Pregnancy**: The first strategy to improve calf survival is to provide proper nutrition, management, and vaccination of pregnant cows. Late pregnancy is an especially important time to keep cows in adequate body condition by providing energy and protein supplementation as necessary. This is also not a time to skimp on mineral and vitamin supplementation.
2. **Improve Your Calving Environment**: Providing as clean and dry environment of an environment as possible will improve early calf health. Calving environments with mud and dirty bedding can carry pathogens that lead to calf illness and umbilical infections. Although barns are often considered ideal for calving during cold or wet conditions, these are often also ideal breeding grounds for pathogens that cause scours. It is a good idea to move cow-calf pairs outdoors once the calf is dry and has consumed adequate colostrum. But if this is not feasible, bedding should be kept as clean as possible with optimal ventilation. Disinfection of barns and equipment before and during the calving season can decrease pathogen load.
3. **Detect Calving Early**: Early detection of dystocia or calving problems is key to increasing calf survival. Calving dams should be checked with enough frequency to identify problems with calving and neonatal health early. Ideally, heifers are checked with greater frequency due to increased likelihood of dystocia. Certainly labor, facilities, and operation type will determine what frequency of checking cows and heifers is practical.

   Some calving detection technology, including cameras, may be economical for seedstock or club calf producers. Our lab recently demonstrated that pedometers can detect changes in behavior of cows and heifers leading up to calving (Duncan and Meyer, 2019), although further work is necessary to determine if these can be programmed to notify producers during calving.
4. **Prepare for Calving Problems**: Calves should be born with front feet first, followed by the nose. If this does not occur, assistance is likely necessary. Additionally, having a chute or head catch near the calving area along with supplies to assist with pulling calves (OB chains and handles, shoulder-length plastic sleeves, OB lube, and mechanical calf puller), clean and nearby, will help if problems occur. In general, females in labor should make progress every 30 minutes after a water bag is visible.
5. **Feed Cows at Night**: Feeding a supplement in the evening has been shown to shift more calving times to daylight hours. This helps ensure that newborn calves are seen, and any intervention can be provided during the day. This also provides a good opportunity to note any cows that choose not to come up for supplementation, either because they have a new calf, or are actively calving. Nighttime feeding will not make all cows calve during the day, but it is an easy way to decrease chances for midnight calving emergencies.

Post-calving

1. **Monitor Calf Vigor and Colostrum Intake**: Monitoring early calf behavior can be useful to producers to catch problems at an early enough stage to allow for intervention. The main goal for a newborn calf is to get nutrients and immunoglobulins via passive transfer from the cow's colostrum. Following a normal delivery, most calves stand within one hour of calving and nurse within the first two hours of age. If this does not occur, the cow and calf should be watched (from a safe location) to try to determine the reason. For spring-born calves, cold temperatures may cause the calf to use its energy to stay warm rather than stand, so this is a common reason for decreased vigor.

   Colostrum should be consuming within 6-12 hours, as immunoglobulin absorption decreases rapidly after this time. Assisting the calf with nursing from its dam is often is enough to ensure adequate consumption, but providing colostrum or colostrum replacer may be necessary. If possible, providing the calf with colostrum from its own mother through a bottle or esophageal feeder is ideal. If this is not possible, frozen colostrum from other cows can be thawed slowly using hot water. A more convenient alternative is to purchase colostrum replacer that can be reconstituted with water.

2. **Manage Calf Temperature**: Cows with good maternal instincts will lick their calves to remove fluids. It is important for the neonate to get dry and maintain a normal body temperature. In temperatures near or below freezing, calves still may not be able to dry fully which can cause hypothermia, delayed colostrum intake, and possible death. Hypothermic calves often need to be brought into a warm barn or possibly into calf warmer, vehicle, or other building to have a chance at survival. Once calves are dry, warm (normal rectal temperature near 102°F), and fed, they can withstand most cold temperatures. Calves in cold conditions use energy to maintain their body temperature, taking energy from growth, however. Windbreaks, bedding, or other ways to decrease cold stress in calves may improve neonatal growth, as long as it doesn't spread disease (e.g. dirty bedding, overcrowded barn).

   Fall-born calves have the opposite problem, as hot temperatures at birth do not usually bother the calf, but become dangerous as the calf ages. Providing shade for calves born in summer and early fall is critical to prevent heat stress and dehydration, which can result in death for calves, especially 1-10 days of age.

3. **Monitor Calf Health**: Calves should be checked at least daily, and they should appear full, bright, and vigorous after 24 hours of age, even in difficult conditions. Weak calves, those that were pulled, or those that needed assistance to nurse, should be monitored closely.

   Scours are typically the first disease to strike young calves, as early as the first few days of life. Dehydration is the biggest concern with scouring calves, so providing fluid and/or electrolytes (via bottle or esophageal tube) is often the most effective treatment. It is best to consult a veterinarian about scours treatment plans and to have all therapies (e.g. electrolytes) ready prior to calving season.

   Calves should also be monitored for symptoms of respiratory disease (coughing, nasal discharge), especially as they get older and in cold or wet conditions. Treatments can differ greatly depending on symptoms and conditions, so a veterinarian should be contacted with the first case each calving season.

Overall

Good cow and calf management before and after calving, can greatly improve calf health and survival on beef cow-calf operations. Preparation for the calving season is key, as problems often occur during inclement weather or at inopportune times.

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Feeding silage in beef operations

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Introduction

Feeding corn silage is not a new concept for finishing beef cattle. Most feedyards process corn silage to be fed as a roughage at low inclusions. In general, corn silage contains 50% forage and 50% grain and is commonly added at 5 to 15% of diet DM in finishing diets. With silage containing 34 to 38% DM (62 to 66% moisture), then proportion in the diet on a DM basis is quite different than proportions on an as-fed basis and conversion is needed when adding ingredients to mix the final diet, thus all percentages are corrected to a DM basis. Most nutritionists feed silage assuming it were 100% forage whereas inclusion should probably be considered on an equal NDF basis to other forages, or assuming it is 50% forage given that the corn content is about 50% on a DM basis. Another consideration is that the grain is very wet high-moisture corn in silage.

With more distillers grains supply and expensive grain years ago, we researched feeding corn silage at greater than usual (i.e., roughage source only) inclusions and the impact on performance and economics of feedlot cattle. Many feedyards in the Midwest are farmer-feeder operations that own their own cattle and crop ground. If priced correctly and shrink is managed, silage is one of the most economical sources of energy which lead to research to maximize inclusion. In addition, numerous technologies may further benefit silage use such as hybrid selection and traits, kernel processing, and different combinations with grain and distillers grains. Lastly, recent laboratory and performance data suggest that the protein in silage is mostly degradable and the RUP content is considerably lower than previously thought (approximately 10% of CP as RUP). This paper will focus on recent research on corn silage inclusion, impact of hybrids, and kernel processing when used in growing and finishing beef systems.

Corn silage inclusion

Past research focused on increasing corn silage and replacing corn grain, which was economical at inclusions of 40 to 60% when grain was expensive. The perception was that if grain is cheap, then feeding elevated amounts of corn silage was not economical. However, some yards tend to use silage to “grow”calves as well for a period of 40 to 70 days before stepping them down on silage and up on grain. A silage growing program will normally contain 70% silage or more in the diet.

We have conducted numerous experiments in the past 7 years evaluating elevated amounts of silage for finishing cattle. In 5 experiments that compared 15% inclusion to 45% inclusion for finishing cattle, ADG decreased by 5.2% or 0.2 lb/d (Table 1). In some studies with yearlings, cattle fed 45% silage tended to eat more, with less impact on ADG. In calf-fed studies, feeding 45% silage either resulted in no change in intake or slight decrease compared to feeding 15% so no significant change in DMI. However, feed conversion is consistently poorer with F:G being 6.7% greater for cattle fed 45% silage compared to 15%. In almost all studies (except for two specific examples discussed later), cattle were fed the same days which resulted in cattle being marketed with slightly lower marbling scores and fatness. Despite being economical, no producers have adopted this practice of elevating silage inclusions. Managing the inventory needed in large operations is a limitation, and in general, producers and nutritionists focus on feed conversion. At times, the focus on F:G is at the expense of profitability or cost of gain.

Table 1. Effect of 15% or 45% corn silage (DM basis) on performance and carcass characteristics across 5 experiments.

	Treatment[1]		
Item	**15**	**45**	***P*-Value**
Pens, n	58	58	
Performance			
DMI, lb/day	24.5	24.9	0.17
ADG, lb[2]	3.86	3.66	<0.01
Feed:Gain[2]	6.29	6.71	<0.01

[1] Across 5 experiments, 22 pens of yearlings, 36 pens of calf-feds. Diets fed with either 20 or 40% distillers grains.
[2] Calculated from hot carcass weight, adjusted to a common 63% dressing percentage
[3] Marbling Score 400-Small^{00}, 500 = Modest^{00}

Many feedyards are open to growing cattle for a period prior to finishing. We wanted to evaluate feeding 45% corn silage (on average) by feeding 75% silage for the first half of the feeding period and 15% silage for the second half of finishing, and compare to feeding either 15% or 45% silage continuously over the whole feeding period (Ovinge et al., 2019). In addition, cattle fed 45% silage were consistently less fat than cattle fed 15% silage. Therefore, ultrasound was used and we attempted to slaughter cattle at equal fatness by feeding cattle on the treatments with elevated silage 28 days longer. Cattle fed 75/15 or 45% silage had similar intake, ADG, and F:G to one another (Table 2). However, both treatments resulted in lower ADG and poorer (i.e., greater) F:G than cattle fed 15% silage. Because cattle fed 75/15 or 45% silage continuously were fed 28 days longer to get to similar fatness, HCW was greater for those treatments compared to feeding 15% to get to the same fatness. Two additional experiments have been completed since then evaluating corn silage inclusion with increased days to ensure equal fatness. Wilson et al. (2020) fed 14, 47 or 80% corn silage to steers for 168, 195, or 238 days, respectively, to an equal fat depth of 0.51 inches suggesting the extra days fed were ideal to market on equal fatness. As expected, the extra days and growth potential by feeding more silage lead to increased HCW, but lower ADG. Feeding more silage hurt F:G as expected, but increased profit, even when feeding an extreme amount of silage to finish the cattle (i.e., 80% inclusion). Our assumption is that producers will more readily adopt a high inclusion silage growing program, allow the cattle to increase frame size and final weights (HCW) while yet marketing at ideal fatness when finished.

Very recently, Wilson et al (unpublished) fed 15 or 45% silage for 185 or 213 days to equal fatness to evaluate liver abscesses. In this study, feeding tylosin (Tylan, Elanco Animal Health) was included or not in both base diets as a 2×2 factorial. Cattle fed 45% silage had 27 lb heavier HCW but ADG was decreased by 0.25 lb/d. Feeding tylosin improved feed efficiency by 2.5% in diets with 15% silage, but did not impact efficiency with 45% corn silage. As expected, cattle fed 45% silage were less efficient that cattle fed 15% silage. The major outcome was that liver abscess rate decreased from 34.5% to 19.2% in 15% silage dies when tylosin was fed. No impact was observed on liver abscesses due to tylosin in diets with 45% corn silage which both averaged 12.4% abscess rate.

Table 2. Effect of growing cattle on corn silage at 75% followed by 15% compared to cattle fed 15% or 45% continuously, with cattle fed elevated silage longer to equal fatness (Ovinge et al., 2019).

	Treatment[1]			
Item	**15**	**45**	**75/15**	***P*-Value[2]**
Pens, n	12	12	12	
DOF, d	153	181	181	
Performance				
DMI, lb/day	23.7	23.6	23.0	0.09
ADG, lb[3]	4.02[a]	3.82[b]	3.73[b]	<0.01
Feed:Gain[3]	5.88[a]	6.18[b]	6.17[b]	<0.01
Carcass Characteristics				
HCW, lb	829[a]	877[b]	866[b]	<0.01
Dressing Percentage	62.73[a]	61.65[b]	61.75[b]	<0.01
LM Area, in²	13.13[a]	13.51[ab]	13.64[b]	0.05
Marbling Score[4]	460	480	473	0.32
Backfat Thickness, in	0.53[a]	0.60[b]	0.55[ab]	0.05
Liver Abscesses, %[5]	6.25	2.08	3.13	-

[a,b] Means with different superscripts differ ($P < 0.05$).
[1] Treatments were 15% silage inclusion, 45% silage inclusion, and 75 to 15% silage inclusion
[2] P-value for the main effect of corn silage inclusion
[3] Calculated from hot carcass weight, adjusted to a common 63% dressing percentage
[4] Marbling Score 400-Small[00], 500 = Modest[0]0
[5] Liver abscess data did not converge

Corn silage hybrid impacts

If cattle are going to be fed 45% silage in feedlot diets, other technologies may be beneficial if fiber digestion can be improved. One example would be use of brown midrib corn silage hybrids. Hilscher et al. (2018a) evaluated feeding a brown midrib hybrid or a brown midrib with a softer endosperm compared to a control hybrid on performance. At 15% inclusion, the softer endosperm brown midrib hybrid increased gain compared to the other 2 hybrids, but not a large impact due to the brown midrib trait at 15% inclusion (Table 3). However, at 45% inclusion, feeding either brown midrib hybrid increased gain compared to the control hybrid with variable impacts on F:G. In a growing study, the response to brown midrib hybrids improving performance was different than what was observed in the finishing trial. Cattle fed either brown midrib hybrid had dramatically greater intakes compared to control (Table 4). As a result of a 3 lb greater daily DMI, ADG was increased by 0.6 lb/d but no differences were observed in F:G across the 3 silage hybrid treatments. Feeding brown midrib silage growing diets with 80% silage inclusion increases fiber digestion (Table 5) which increases passage, increases DMI, increases ADG, but does not impact F:G in silage growing programs. The reason is that when 80% silage-based diets are fed, intake is limited by gut fill. In finishing diets where intake is limited more by energy, then intake may increase but doesn't appear as dramatic as growing diets. In a follow up finishing study with 40% silage inclusion, feeding the same brown midrib hybrids increased DMI by 1.1 to 1.5 lb/d, increased ADG by 0.35 to 0.40 lb/d, and improved F:G by 4.6% compared to a control hybrid (Table 6). Those cattle were very big yearlings consuming an average of over 30 lb of DM daily.

Table 3. The effects of silage inclusion and silage hybrid on feedlot performance and carcass characteristics in calf fed steers (Hilscher et al., 2018a Beef Report).

	Treatments[1]								
	15% Silage			45% Silage					
	CON	BM3	BM3-Exp	CON	BM3	BM3-EXP	Int.[2]	Sil[3]	Hyb[4]
Feedlot Performance									
DMI, lb/d	21.5	22.1	21.8	22.3	22.4	23.0	0.19	< 0.01	0.11
ADG[5], lb	3.73[b]	3.73[b]	3.88[a]	3.49[c]	3.67[b]	3.68[b]	0.05	< 0.01	< 0.01
Feed:Gain[6]	5.77[b]	5.92[c]	5.63[a]	6.38[e]	6.09[d]	6.26[e]	0.01	< 0.01	0.45
Carcass characteristics									
HCW, lb	882[b]	880[b]	898[a]	855[c]	875[b]	877[b]	0.04	<0.01	< 0.01
Dress, %	64.05[b]	64.15[a,b]	64.64[a]	62.75[c]	63.89[b]	63.87[b]	0.03	< 0.01	< 0.01
12th rib fat, in	0.56	0.55	0.59	0.47	0.49	0.52	0.76	< 0.01	0.23
Marbling score	451	455	475	413	425	443	0.90	< 0.01	0.03

[a,b,c,d,e] Means with different superscripts differ ($P < 0.05$).
[1] Treatments were control (CON; hybrid-TMR2R720), a *bm3* hybrid (BM3; hybrid-F15579S2), and an experimental *bm3* hybrid (BM3-EXP; hybrid-F15578XT) with a softer endosperm
[2] Silage concentration × Silage hybrid interaction
[3] Fixed effect of silage concentration
[4] Fixed effect of silage hybrid
[5] Final BW calculated based on HCW / common dressing percent of 63.8%
[6] F:G was analyzed as gain to feed.
[7] Marbling score 400 = small^{00}, 500 = modest^{00}

Table 4. Effects of feeding two different *bm3* corn silage hybrids on growing steer performance (Hilscher et al., 2018b).

	Treatments				
Variable	CON	BM3	BM3-EXP	sem	*P*-value
Initial BW, lb	714	713	714	0.7	0.80
Ending BW, lb	989[b]	1035[a]	1032[a]	4.9	< 0.01
DMI, lb/d	21.2[b]	24.0[a]	24.1[a]	0.2	< 0.01
ADG, lb	3.62[b]	4.23[a]	4.19[a]	0.06	< 0.01
Feed:Gain[2]	5.86	5.67	5.74	-	0.26

[a,b,c] Means with different superscripts differ ($P < 0.05$).
[1] Treatments were control (CON; hybrid-TMR2R720), a *bm3* hybrid (BM3; hybrid-F15579S2), and an experimental *bm3* hybrid (BM3-EXP; hybrid-F15578XT) with a softer endosperm.
[2] Feed:Gain was analyzed as gain to feed, the reciprocal of feed:gain.

Some companies have selected for better fiber or starch digestion characteristics. Many times, these hybrids are grown and only evaluated in the lab using assays to predict digestion in the animal or energy content. While some of these assays are very useful as predictors, some are not and can be misleading. The best measure for impact on performance is to feed and measure performance in controlled experiments.

Table 5. Effects of feeding two different *bm3* corn silage hybrids on intake and digestibility of nutrients (Hilscher et al., 2018c).

	Treatments[1]				
Item	Control	BM3	BM3-EXP	SEM	*P*-Value
DM					
Intake, lb/d	15.0	16.5	16.2	1.1	0.11
Digestibility, %	64.5	67.7	69.0	1.6	0.11
OM					
Intake, lb/d	13.8	15.1	15.1	1.0	0.11
Digestibility, %	66.8[b]	70.0[ab]	71.6a	1.4	0.05
NDF					
Intake, lb/d	5.9	6.5	6.1	0.4	0.08
Digestibility, %	45.3[b]	57.8[a]	57.0[a]	2.2	<0.01

[1] Treatments were control (CON; hybrid-TMR2R720), a *bm3* hybrid (BM3; hybrid-F15579S2), and an experimental *bm3* hybrid (BM3-EXP; hybrid-F15578XT) with a softer endosperm.

[a,b,c] Means with different superscripts differ ($P < 0.05$).

Table 6. Main effect of corn silage hybrid on cattle performance and carcass characteristics with silage fed at 40% of diet DM to finishing yearlings (Ovinge et al., 2018).

	Treatment1				
Item	Control	BM3	BM3-EXP	SEM	P-Value2
Pens	12	12	12		
Performance					
Initial BW, lb	882	882	882	11.8	1.00
Final BW, lb3	1310[a]	1347[ab]	1354[b]	13.7	0.07
DMI, lb/day	31.3[a]	32.4[b]	32.8[b]	0.33	0.01
ADG, lb3	4.12[a]	4.47[b]	4.54[b]	0.058	0.01
Feed:Gain3	7.58[a]	7.24[b]	7.22[b]	-	0.04
Carcass Characteristics					
HCW, lb	826[a]	849[ab]	853[b]	8.7	0.07
LM Area, in2	12.5	12.5	12.5	0.09	0.99
Marbling Score4	476[a]	516[b]	511[b]	7.1	0.01
Backfat Thickness, in	0.54	0.58	0.56	0.015	0.20
Liver Abscesses, %	9.09	4.73	6.46	2.86	0.56

[a,b] Means with different superscripts differ ($P < 0.05$).

[1] Treatments were control (CON; hybrid-TMF2H708), a *bm3* hybrid (*bm3*; hybrid-F15579S2), and an experimental *bm3* hybrid (BM3-EXP; hybrid-F15578XT) with a softer endosperm

[2] *P*-value for the main effect of corn silage hybrid

[3] Calculated from hot carcass weight, adjusted to a common 63% dressing percentage

[4] Marbling Score 400-Small^{00}, 500 = Modest^{00}

Kernel processing

In the same study evaluating brown midrib hybrids at 40% inclusion, hybrids were kernel processed or not and the interaction between hybrid and kernel processing was evaluated. No interaction was observed between kernel processing and hybrid. A typical energy response was observed for kernel processing whereby ADG was not impacted by kernel processing silage and feeding it at 40% inclusion. However, steers fed silage that was kernel processed ate less feed to get the same ADG, resulting in a 2.9% improvement in F:G (Table 7). These data suggest that kernel processing of silage is worth about 7.25% improvement in F:G assuming the entire change in F:G is due to improving the silage fed at 40% of the diet (2.9%/0.4). A different recent growing silage study that evaluated kernel processing with silage inclusion of 80% of diet DM suggests a 6.6% improvement in the silage due to kernel processing (Brinton et al., 2020).

Table 7. Main effect of kernel processing of corn silage when fed at 40% of diet DM on growth performance and carcass characteristics (Ovinge et al., 2018)

	Treatment[1]			
Item	**-KP**	**+KP**	**SEM**	***P*-value[2]**
Pens, n	18	18		
Performance				
Initial BW, lb	882	882	9.6	0.99
Final BW, lb[3]	1337	1338	11.2	0.96
DMI, lb/day	32.6	31.8	0.27	0.04
ADG, lb[3]	4.38	4.38	0.047	0.93
Feed:Gain[3]	7.45	7.24	-	0.10
Carcass Characteristics				
HCW, lb	842	843	7.1	0.96
LM Area, in^2	12.5	12.5	0.07	0.78
Marbling Score[4]	501	501	5.9	0.97
Backfat Thickness, in	0.56	0.56	0.012	0.70
Liver Abscesses, %	4.60	9.23	2.32	0.34

[1] Treatments were not kernel processed (-KP) or kernel processed (+KP)
[2] *P*-Value for the main effect of kernel processing
[3] Calculated from hot carcass weight, adjusted to a common 63% dressing percentage
[4] Marbling Score 400 = Small^{00}, 500 = Modest^{00}

Silage in growing diets

Most growing diets are forage based. While forages can have fairly high CP levels, the majority is rumen degradable protein (RDP). The RDP is fermented in the rumen and utilized by the microbes for growth. The growing calf also requires metabolizable protein (MP) which is composed of rumen undegradable protein (RUP; feed protein that escapes degradation in the rumen) and microbial crude protein (MCP; microbes that pass out of the rumen and are a fairly high quality protein source for the animal). Growing diets based on corn silage largely depend on MCP as the source of amino acids for the animal as the RUP content of corn silage is very low. Accurately measuring the RUP content of corn silage has been challenging. Lab techniques designed to measure RUP values of feedstuffs are specific to either forages or concentrates, and corn silage is a blend of both. The DM content of the corn silage impacts the degradability of the protein (wetter corn silage has a lower RUP content) and the protein continually becomes more degradable with longer ensiling times. Two experiments using duodenally fistulated steers and in situ bags measured the RUP content of corn silage by breaking the silage down into forage and grain. Results suggest the RUP content of corn silage is 10% of the CP, meaning that the CP within corn silage is 90% rumen degradable (Oney et al., 2018).

Therefore, 2 trials were done with individually fed cattle to evaluate the response to increasing amounts of RUP supplement [Hilscher et al., 2016 (Table 8); Oney et al., 2017(Table 9)]. The supplement was a blend of SoyPass (50% CP, 75% of CP is RUP) and Empyreal (Cargill Corn Milling, Blair, NE; 75% CP, 65% of CP is RUP). Between the 2 trials, 9 levels of supplement were offered from 0 to 13% of diet DM. The highest level of supplement provided 5.5% of diet DM as RUP. With the combined data there was a quadratic increase in ADG as supplement increased, going from 2.50 lb/d to 3.05 lb/d with a peak at approximately 3.2% RUP. Supplementing the RUP improved both ADG and F:G by meeting MP requirements, interim BW measurements suggest this response was even more apparent early in the feeding period when MP requirements of growing calves are greatest. The first

30 days of a growing period are a critical time for RUP supplementation. With high quality corn silage and a little protein calves can grow at a rate approaching 3 lb/d. Utilizing DGS to provide some of the CP as RUP can increase gain beyond 3.5 lb/d. Formulating diets to meet the MP requirements of cattle is very important in order to be able to optimize the blend of corn silage and DGS and reach target body weight gains. This is especially true early in the growing period when MP requirements are greatest.

Table 8. Effects of increasing RUP in silage based growing diets on steer performance (Hilscher et al., 2016)

	Treatments[1]					*P* - value	
Variable	**0.5%**	**1.4%**	**2.4%**	**3.3%**	**4.2%**	**Lin.**	**Quad.**
Initial BW, lb	595	597	597	596	600	0.98	0.60
Ending BW, lb	791	824	855	842	868	< 0.01	0.88
ADG, lb	2.51	2.91	3.31	3.15	3.43	< 0.01	0.82
Feed:Gain	6.74	6.26	5.71	5.52	5.35	< 0.01	0.57

[1] Treatments were based on amount of RUP provided by the supplement (% of diet DM). All cattle were fed 88% corn silage with 0, 2.5, 5.0, 7.5, or 10% SoyPass + Empyreal (% of diet DM).

Table 9. Effects of increasing RUP in silage based growing diets on steer performance (Oney et al., 2017)

	Treatments[1]					*P*- value	
Variable	**0.4%**	**1.7%**	**3.0%**	**4.2%**	**5.5%**	**Lin.**	**Quad.**
Initial BW, lb	605	606	604	608	604	0.99	0.86
d 1-37							
Interim BW, lb	692	707	713	730	729	0.03	0.26
ADG, lb	2.34	2.74	2.96	3.29	3.38	< 0.01	0.06
Feed:Gain	6.45	5.62	5.24	4.83	4.48	< 0.01	0.10
d 38-83							
Ending BW, lb	808	833	829	864	857	0.01	0.17
ADG, lb	2.52	2.74	2.51	2.92	2.78	0.10	0.28
Feed:Gain	6.58	6.76	7.30	6.33	6.54	0.64	0.86

[1] Treatments were based on amount of RUP provided by the supplement (% of diet DM). All cattle were fed 85% corn silage with 0, 3.25, 6.5, 9.75, or 13% SoyPass + Empyreal (% of diet DM).

Conclusion

If corn silage is priced correctly, then feeding 2 or 3 times more silage to finishing cattle will result in poorer feed conversion by about 5% but is still economical. Response to feeding silage in growing diets or at elevated inclusions in finishing diets is impacted by silage hybrid and kernel processing. If more silage is going to be used during finishing, having sufficient bypass protein (RUP) is important, so adding distillers grains which is the cheapest source of RUP available is advised as diets increase in silage. Most of these studies used 20% or more distillers grains on a DM basis. If producers don't want to use 45% silage, but want to grow cattle on high-silage diets and step them down halfway through, then performance is the same as if feeding 45% silage continuously. In addition, cattle can be fed a bit longer and to heavier weights prior to getting too fat. Those economics get complex and need to be explored by individual operations.

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How much is rubber matting worth in a deep pit barn?

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Background and introduction

Recent expansion of the Midwest cattle industry has relied on intensification of cattle feeding operations in confinement buildings. There are many additional advantages for confinement buildings that include less required land, reduced environmental stressors, reduced mud, improved waste management, greater dressing percentage at slaughter, and improved cattle efficiency. However, many questions have arisen with the advent of the "modern" confined cattle feeding building. One of the most significant decisions in the building design is the flooring choice. Slatted floor buildings require a greater (50-100%) initial investment to build than a bedded pack barn. However, the popularity of slatted facilities has grown as they require significantly less labor compared with bedded pack barns and provide greater control to manage manure that is higher value. The majority (~80%) of new confinement buildings are slatted facilities including nearly all finishing barns (K. Mowrer, Coalition to Support Iowa's Farmers; N. Andersen, Illinois Livestock Development Group, personal communication). Constantly bedding barns requires substantial labor, and it requires a significant volume of bedding that can be difficult to procure or harvest. The more frequent cleaning of bedded facilities also necessitates more frequent application of manure which becomes more challenging as the acceptable window for manure application continues to shrink. Deep pit facilities allow custom pumping crews to reduce the number of days for manure management and may be able to reduce costs of manure handling while fitting a smaller window of manure application.

As the Midwest cattle industry continues to grow through the addition of confinement buildings with slatted floors, critical questions remain on how to collectively maximize cattle profitability, performance, and welfare in these facilities. Rubber mats are often considered essential to increase cattle comfort and welfare. While European researchers have investigated effects of rubber matting in their system (Brscic et al. 2015; Keane et al., 2018), their studies are underpowered, their cattle are not fed with growth promotants, and they have not evaluated how the lifespan of rubber matting affects cattle comfort and welfare. Rubber matting is a significant investment, but should matting be replaced to maximize comfort, growth performance, or when ripping, tearing, and re-anchoring of the mats necessitates their replacement? Moreover, how long should cattle be fed on slats before locomotion, welfare, and performance start to decrease and how does the age of rubber matting affect that decision? As the popularity of slatted-floored confinement facilities continues, there is a critical need to determine the value of rubber matting in cattle performance and welfare and to describe lameness that can occur while finishing cattle in confinement. Overall, this research is essential to ensuring a sustainable future for feeding cattle in confinement in the Midwest.

Research findings

The objective was to determine effects of interlocking rubber floor matting in slatted indoor cattle feeding facilities on cattle performance and carcass characteristics. In experiment 1, Fall-born Angus x Simmental steers (N = 206; BW = 503 ± 75 lb) were blocked by weight and assigned to 32 pens. Pens were randomly assigned to 1 of 4 treatments: new Max Grip Animat matting (MG), new Animat Pebble matting (PEB), old Animat Pebble matting (OLD), and no matting/concrete slating (CONC). Steers were fed a common diet for 209 days with an average stocking density of 39.8 ft^2 per steer. Final BW was affected ($P = 0.02$) by treatment with PEB steers being the heaviest, MG and CONC were intermediate, and OLD was the lightest. Treatment affected ($P < 0.01$) average daily gain with PEB steers being greatest, MG and CONC were intermediate, and OLD was the least. Flooring treatment did not affect overall dry matter intake ($P = 0.16$) or G:F (P = 0.94). Flooring treatment did not affect ($P \geq 0.19$) any carcass traits.

In experiment 2, Fall-born Angus x Simmental steers (N = 189; BW = 776 ± 95 lb) were blocked by weight and assigned to 21 pens. Pens were randomly assigned to 1 of 3 treatments: new Animat Pebble matting (PEB2), old Animat Pebble matting (OLD2), or no matting/concrete slating (CON2). Steers were fed a common diet for 153 days with an average stocking density of 28.4 ft^2 per steer. After 153 days on feed, flooring treatment did not affect ($P \geq 0.79$) BW or average daily gain. There were no treatment differences ($P = 0.31$) observed for overall dry matter intake. Flooring treatment did not affect ($P \geq 0.16$) any carcass traits.

Summary and implications

Steers in experiment 1 demonstrated a 4% advantage in average daily gain for cattle on new rubber matting compared with bare concrete slatting. Results from experiment 2 did not demonstrate a statistical difference between flooring treatments, but there was 2% numerical advantage for new rubber matting compared with bare concrete slatting. Greater differences between treatments in experiment 1 were likely additional due to days on feed during the experiment and the lesser stocking density. An additional 20-50 lb of final body weight could be expected when finishing cattle on rubber matting compared with bare concrete slats. The lifespan of rubber matting is highly variable and a major economic factor to consider. Results from experiment 1 demonstrate a performance advantage of new rubber matting compared with old rubber matting, but this effect was not replicated in experiment 2. Overall, results suggest the greatest benefit for new rubber matting should be expected when placing lighter weight calves in slatted indoor cattle feeding facilities.

Acknowledgements

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A survey on the production practices of confined cow/calf operations

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Introduction

Over the past 5-10 years, there has been increasing interest in the establishment of confined cow-calf operations in the Midwestern Corn Belt. There are multiple reasons for this expansion but they tend to center around land cost and availability. In this region, the use of land for grazing competes with crop enterprises and many operations find themselves priced out of adding acres for the cow herd. In many parts of the state land is not available to rent for a traditional cow-calf operation so confinement is being utilized to expand the existing herd or establish a new enterprise to support the next generation coming home to farm. As with all new production systems, there is a learning curve that needs to be mastered for producers, veterinarians and extension specialists. Therefore, the preliminary results of a survey of confined cow-calf operations will be reported here.

Survey methodology

The survey effort was supported by a grant from Boehringer Ingelheim Animal Health. Questions were written to cover such areas as nutritional management, animal health, and production management. ISU personnel reviewed question construction and type, prior to final survey design. A commercial survey tool (qualtrics^{XM}) was utilized to allow producers to take the survey online. The survey was advertised through the extension service of Midwestern states and placed on the Iowa Beef Center website. We were also able to collect contact information of confined cow-calf producers form veterinary practitioners, extension personnel, and other producers. These individuals were contacted via phone to see if they would be willing to take the survey. If requested, a paper copy was sent to producers that preferred to respond in writing. The survey can be found at:

https://iastate.qualtrics.com/jfe/form/SV_bgyUzdjBrQJaBFj

Results

A total of 34 producers filled out the survey, either online or written. Nine of the surveys were eliminated since the producer's description of their herd did not fit our definition of a confined cow-calf operation. Of the remaining 25 operations, most were either confined year round in a building or a drylot. These operations most commonly utilized a "tarp" covered building or an "Iowa Barn" system that allowed for outside access for the cattle. The rest used some form of limited grazing either during the summer or cornstalks in the fall.

Other results

1. The top five calf health concerns included: Calf scours, pneumonia, coccidiosis ("cocci"), "pink-eye", and bloat. Calf scours was an overwhelming choice as the primary concern for calf health. This would be similar to traditional production systems using pasture based grazing.
2. The top five breeding female health concerns included: Reproductive failure, lameness of the foot, respiratory disease (pneumonia), upper leg lameness, and mastitis. While reproductive failure and foot lameness would be a primary concern for grazing operations, the final three would appear to be a function of the herd being confined in a relatively small space.
3. Vaccination practices in confined cow-calf operations are very similar to traditional grazing herds (both calves and the breeding herd). This is most likely due to producers and their veterinarians using their past experience to build these protocols that have been based traditionally on grazing herds. Also with the popularity of the "Green" and "Gold" tag program in the state, calves will be vaccinated to meet those requirements regardless of how they are raised. It was interesting to note that intranasal vaccines were used by over 50% of the operations that responded to this survey.
4. Producers reported that they most commonly scrape manure from in front of the bunk line 2-3 times per

week during calving. The second most common answer was “every week”. Producers also reported adding bedding to the unit 2-3 times per week as well – with “weekly” being the second most common answer.

5. Current recommendations for space allowance for confined cow-calf operations (in a building) typically run from 90-120 ft^2 per head. We asked the producers taking the survey to estimate their space allowances for different times of the year. During the breeding season, space allowance ranged from 88-300 ft^2 per head. After calf weaning and during late gestation (precalving), square footage ranged from 44-300. During the calving season, producers estimated that they allowed 100-800 ft^2 per head. This wide range is undoubtedly influenced by the presence of confinement in a building (low end of range) versus a drylot setting (high end of range).
6. Differences in bunk space allowance were also seen among the respondents, but there was not as much variation between operations. During calving bunk space ranged from 22.5-36 inches per cow. This range fits nicely within the current recommendations for confined operations. Most operations kept this measure at a constant allowance year round, but some decreased it after the calves were weaned. This decrease in bunk space after weaning may be due to bunching the cows closer together to create open pen space for the weaned calves.
7. The adoption of reproductive technology is very high in these confined operations compared to more extensive grazing herds. Confined operations readily utilize estrus synchronization, artificial insemination, and embryo transfer (ET). Several of the respondents contract out their cow herd as ET recipients for multiple seedstock producers. Having the breeding herd in close proximity to the working facility allows for the utilization of these technologies.

Summary

This survey represents our first attempt to better understand how producers manage confined cow-calf units. Even within our definition of a confined operation, there appears to be significant variation in how these herds are managed. Best management practices for confined units are still evolving and are not fully understood. Hopefully, the type of information gathered with this survey tool will give the industry a clearer understanding and direction as to the best way to conduct needed research and provide extension programming.

Missouri steer feedout review

Eldon Cole, extension field specialist in livestock, University of Missouri; Eric Bailey, state beef nutrition specialist, University of Missouri

- Began in 1981 – Locally fed first four years.
- Joined forces with Iowa's Tri-County Steer Carcass Futurity in 2001 after feeding at three Missouri lots and one in Oklahoma. TCSCF has proven to be outstanding in providing our cow-calf owners useful data year in and year out.
- The steer feedout is an educational program to evaluate the genetics and management of calves as they influence feedlot performance and carcass traits. A chance to feed a sampling of the calf crop with low risk and determine if you're producing a steer that deserves a premium. It helps build your herd's resume'.
- Three hundred and sixty-seven herds have entered 7,745 steers. Entries come from all over Missouri but mostly, the southwest quarter of the state. Entries also come from Oklahoma, Arkansas, Kansas and Illinois.
- Since the beginning, there is an evaluation of the steers at weigh-in by individuals or a panel to assess subjective merit of the steers. Panel members may include Missouri Department of Agriculture Market Reporters, USDA graders, local cattle market personnel, feeder cattle order buyers, University of Missouri Extension Specialists, cattle feeders and breed association persons.
- The local market reporter or USDA person assigns a value to each individual steer that is used to establish, profitability of the steer and group during the feeding phase.
- We even give the audience cards and request they keep notes and select their favorites for feedlot gain, premium Choice and higher grades in the carcass, most efficient and most profitable. A Feedout Finale is held at the conclusion of some feedouts each year to review how the steers, as well as the panel, and audience did in predicting performance.

A survey is given to participants to determine what they've learned from the feedout experience. Here are a few replies from 2019:

- How bulls affect results
- Carcass results
- I better understand feeder and carcass grades now
- How feedlot gains and grades vary
- You can't tell how calves will perform by just looking at them
- What steer performance shows about their sires
- Which cows and bulls are not profitable
- Makes you think more about your end product
- I'll use a cow's progeny performance to pick a steer my son will exhibit in the National Junior Angus Steer Carcass Show

Lessons from feedouts since 1981

Eldon Cole, extension livestock specialist, University of Missouri

- You can't tell a book or a steer's post-weaning performance and carcass by it's cover (hide – phenotype)
- The only way you'll learn your herd's genetics for overall performance is to feed them at least 2 or 3 times
- Send a representative group from your herd. Don't send 5 head, the minimum, with each one out of a different bull.
- The larger your herd, the more steers you should send. 25 to 50% of your steer calves is a target.
- Feedouts are not guaranteed money makers. The average profit per head during the period since 1981, is less than $50 (probably more like $35), year-in-year-out. The range runs from +$299 to -$609.
- Send calves from the middle of your herd, not the biggest and best. Some send their odd balls (rat tails, odd color, blue eyes) realizing they would be docked heavily as feeder calves at an auction.
- **Use** the results to make adjustments in genetic and management programs. ***That's the payoff!***
- Be willing to roll with the punches as there's a lot of good-natured ribbing about the steers. We ask the feeder evaluation panel to tell their honest feelings about each group.
- Feedouts tell about your herd health program. Follow the feedlot's vaccination protocol to the letter. Don't send cattle you've had to treat.
- There are lots of **average** cattle produced.
- A reasonable goal is to consistently have 70-80% of your carcasses grade Choice or higher; 70% Yield Grade 1 or 2 and 0% "outs". Outs are carcasses that suffer a severe price discount such as YG4, Standard quality grade, dark cutter, light or heavy carcasses.
- Track performance back to the sire and dam. Use data to market herd mates as feeders or breeding stock.
- You'll receive a ranking of your steers on retail value per day on test in the Missouri Steer Feedout and per day of age. The latter tells about your herd's performance from birth to slaughter.
- Temperament scores (TS) are given when steers are worked and should be 1's and 2's. Steers with an average
- TS – disposition score of 3 or higher results in a loss of $62 per head. On average 7.8% of the cattle fed in the TCSCF are 3's plus.
- Bad eyes, largely pink eye, are 34 lbs. lighter at weaning and gain 34 lbs. less while in the finishing phase. The heritability estimate for eye problems is 0.18.
- If you enter 5 head plus, steers sired by a registered bull, his progeny will be compared to other qualifying sires in a sire summary. Some of our entries out of local bulls compare favorably with "big-name" AI bulls.
- Know your feedlot and packer's desired grid. The Iowa, Tri-County program targets 0.45 to 0.5 inch of rib fat cover; carcass weights should be between 550 and 1050 lbs; they prefer no yield grades 4 or 5.

One longtime participant's feedout history

Missouri Steer Feedout

No.	ADG lbs.	% Low Choice +	% Yield Grade 1 and 2	% Outs	Profit or (Loss) $	Rank
5	2.95	100	40	0	70	(13-21)
5	3.92	20	80	0	133	(14-16)
5	3.29	40	80	0	(118)	(20-30)
10	2.95	40	90	0	26	(14-24)
10	3.01	60	70	0	11	(3-28)
10	2.94	60	80	0	130	(6-19)
10	3.22	60	50	10	104	(13-17)
10	3.61	40	40	0	91	(5-17)
15	3.06	60	67	0	(185)	(4-15)
15	3.33	87	67	0	194	(6-13)
10 (9)	3.10	89	89	0	(212)	(12-20)
10	2.97	60	60	10	(135)	(8-17)
10	3.50	90	80	0	328	(13-19)
5	3.60	80	60	20	(47)	(4-14)
10	3.56	90	20	0	49	(6-22)
8	3.30	75	25	12	(81)	(5-16)
10 (9)	3.37	78	44	11	(180)	(15-21)
5	3.60	100	0	0	106	(3-9)
Total or Average						
163 (161)	**3.26**	**68**	**60**	**2.0**	**27**	

Raising vs. buying replacement heifers

Lee Schulz, associate professor and extension livestock economist, Economics, Iowa State University

Selecting the most economical source of replacement females may be one of the more important decisions confronting a cow-calf producer, as this decision has major implications for effectively using resources, controlling costs, and sustaining the business for the long-term. Producers utilize heifer retention and purchasing of external females to expand their breeding herd. The National Animal Health Monitoring System 2008 cow-calf study performed by the U.S. Department of Agriculture, Animal and Plant Health Inspection Service indicates that 83% of operations expand by retaining and raising their own heifers. Whether to use raised or purchased replacements can be a complex issue, because each alternative has both advantages and disadvantages.

To assist producers in making this 'raise vs. buy' decision, Iowa State University Extension and Outreach has developed two partial budget spreadsheets to determine which management strategy is best in any given year. The spreadsheets and video tutorial are available at http://www.iowabeefcenter.org/heiferdevelopment.html. The first spreadsheet, *Buying Heifers for Beef Cow Replacement*, considers the returns and costs that will change if replacement heifers are purchased rather than raised from within the herd. The second spreadsheet, *Raising Heifers for Beef Cow Replacement*, considers the returns and costs that will change if replacement heifers are raised from within the herd rather than purchased. Economic effects are specified on a per-animal basis over the period of time between the decision to retain or sell a weaned heifer calf and when a purchased replacement heifer would arrive at the farm.

Although most producers raise herd replacements, purchasing replacements sometimes can be an attractive alternative. To illustrate this using the *Buying Heifers for Beef Cow Replacement* spreadsheet to analyze whether to continue raising replacements or purchase them, consider the following example. A cow-calf producer is considering selling raised heifer calves at weaning time and buying pregnant heifers at 22 months of age (2 months prior to calving). Heifer calves average 500 lbs. per head at 6 months of age and can be sold for $1.42 per lb., net of selling costs. The interest rate is 5.75%, which is based on the returns realized from the investment of returns (or reduction in borrowing) from the sale of the heifer calves. The feed, non-feed, and fixed costs assumed for a heifer raised during the 16 month period between weaning and the arrival of a purchased heifer on the farm are $464.25, $277.25, and $233.30 per head, respectively. It is assumed that a bred heifer at 22 months of age can be purchased for $1,750 per head, net of purchase costs (e.g., transportation). Using this information, a producer can determine if buying replacement heifers will increase farm net income.

For added returns, the example cow-calf producer expects to realize $802.66 if the heifer calf is sold and a replacement heifer is purchased 16 months later. Those returns stem from the sale of the heifer calf at weaning ($745.50) and interest earned or saved on that amount ($57.16), assuming an annual rate of 5.75% and a term of 16 months. The producer estimates there will be no increase in genetic improvement if heifers are purchased; if there were any multi-year gain in genetics, added returns would increase. For reduced costs, the producer eliminates the cost of raising a replacement heifer during the 16 month development period by purchasing a replacement. These cost reductions sum to $974.80 per head. Included in the cost savings are feed, non-fed, and fixed costs. The total added returns from buying rather than raising replacements is the sum of the added returns and reduced costs, which is $1,777.46 per head. Turning to the total added costs, the only added cost projected by the producer is the $1,750 purchase cost for the bred heifer. The producer estimates there will be no reduced returns (e.g., less genetic control, less control over disease). Subtracting total added costs ($1,750) from total added returns ($1,777.46) shows a net income increase of $27.46 per replacement if the producer switches from raising to buying replacement heifers. If the heifer purchased for $1,750 can garner additional value in added genetic merit over females that would have been developed internally through increased weaning weight, improved heifer progeny pregnancy, or improved stayability, then purchasing replacements becomes an even more competitive decision.

The above analysis assumes a market return on surplus home-grown forages, operating capital, operator labor and management, and no return on the existing investment in buildings, equipment, and facilities made available for use when heifers are no longer raised on the farm. To the extent these resources can be diverted to an alternative use (e.g., herd expansion) with returns exceeding these assumed levels, the analysis would understate the economic benefits (i.e., reduced costs) of buying heifers.

Cattle markets stronger in 2020

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Cattle inventories stable

Cattle inventories are projected to be stable to slightly lower in 2020 after increasing cyclically since 2014. Total cattle and calves inventory increased from a cyclical low of 88.2 million head in 2014 to 94.8 million head in 2019, an increase of 7.4 percent. The beef cowherd increased from a low of 29.0 million head in 2014 to 31.8 million head in 2019, up 9.7 percent. January 1, 2020 cattle inventories will be released by USDA on January 31, with all cattle and calves and beef cow inventories expected to be down up to 0.5 percent year over year.

Record beef production in 2020

Beef production is expected to increase less than one percent year over year and remain at a record level of 27.4 billion pounds. In the recent expansion, beef production increased from a low of 23.7 billion pounds to the projected 2019 level of 27.2 billion pounds, up 14.6 percent. Additionally, pork and poultry production are projected to be record large in 2020 and will combine with beef production to a projected total meat production of 107.6 billion pounds, up 3.0 percent over 2019.

Beef consumption and demand

Retail beef consumption was an estimated 57.9 pounds per capita in 2019 at the same time that retail beef prices increased by an average of 2.3 percent. This is an indication of strong beef demand. Beef consumption is projected to decrease to 57.1 pounds per capita, or 1.4 percent year over year, in 2020 as improved beef trade reduces residual domestic supplies.

Though beef demand is expected to continue strong in 2020, potential threats include large supplies of competing pork and poultry as well as sluggish macro-economic growth.

Beef exports and imports

Beef exports, which decreased roughly 4.5 percent year over year in 2019, are projected to rebound in 2020. A new bilateral trade agreement with Japan should restore U.S. beef export competitiveness lost in that market after U.S. withdrawal from the Trans-Pacific Partnership in 2018. Additionally beef exports to China are projected to grow modestly in 2020, aided by the recent partial trade agreement between the U.S. and China. However, beef exports to (mainland) China may be offset by reduced exports to Hong Kong. Recent approval of the revised NAFTA agreement, USMCA, will help maintain and stabilize beef trade in North America.

Beef imports increased by roughly two percent year over year in 2019 but are projected to decrease by seven to eight percent in 2020. Beef imports may decrease in part because of the tremendous growth in beef demand in China is redirecting beef flows from major beef exporting countries into China. China is now the largest beef importing country and the rapidly growing demand is augmented by the protein deficits resulting from the catastrophic losses of pork production in Asia due to African Swine Fever (ASF).

Adequate feed supplies

Feedgrain prices are expected to remain favorable with only slightly increased corn prices in 2020. Despite a 2019 corn crop estimated at 13.7 billion bushels, down 4.5 percent from the previous year, carryover stocks are projected at 1.8 billion bushels. This indicates ample corn supplies to ensure adequate feed for livestock production.

Total U.S. hay production was up 4.3 percent in 2019, despite struggles with both quantity and quality in some regions. December 1 hay stocks were up 6.9 percent nationwide but regional decreases were noted in the Great Lakes, Appalachian and southeast areas of the country. Hay prices are expected to average slightly higher in 2020 compared to last year.

Higher cattle prices in 2020

The combination of steady beef production, slightly tighter cattle numbers, and strong domestic and international beef demand is expected to push cattle prices modestly higher year over year in 2020, especially in the second half of the year. Feeder and fed cattle prices may average two to four percent higher year over year in 2020 but are expected to average four to nine percent higher in the second half of the year.

Factors to watch in 2020

Although cattle markets are expected to strengthen modestly with steady supplies and good demand, threats remain that could inject volatility in cattle and beef markets. Although some trade progress has been made, numerous trade issues remain that may impact markets. The U.S. economy is experiencing sluggish and precarious growth that could weaken further. Geopolitical tensions, currency values, energy prices and a U.S. presidential election are all factors that could affect markets in the coming year.