# 2014 Driftless Region Beef Conference

## Conference Proceedings

January 30-31, 2014

Grand River Center
Dubuque, Iowa

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## Proceedings of the

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# Cropping and livestock systems: Manure and soil quality

Jerry L. Hatfield, Laboratory Director, National Laboratory for Agriculture and the Environment, Ames, Iowa

Agriculture across the Midwest was founded on the integration of crop and livestock systems. This integration was based on the utilization of crop production for animal feed and utilization of the manure as the nutrient sources for the crops. This same integration of components of the agricultural system exists today but we no longer view these components as an integrated puzzle and tend to consider crop and livestock production as separate systems. The Midwest is one of the most intensive agricultural systems leading in corn and soybean production, dairy, hog and poultry production and can serve as an example of the value of returning to viewing agriculture as an integrated system.

Agriculture faces a number of challenges which will affect our ability to feed the world and provide food security. These challenges can be simply stated as the intersection of climate change and soil degradation. Variation in crop production across years is due to a combination of variation in climate, mainly rainfall, as typified in Figure 1. In the past four years there has a decline in corn and soybean production because of the variability in weather during the growing season. At the field scale, there is variability in crop yields due to a combination of weather and soil. One of the critical soil parameters affecting crop production is the soil organic matter content and the linear relationship to soil water holding capacity. This can be seen in Figure 2. As organic matter increases the greater the available soil water for different soils.

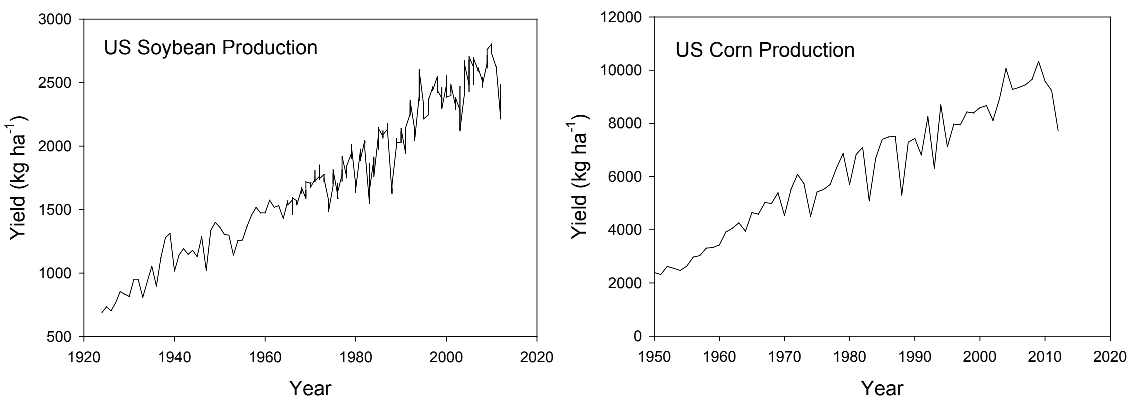


**Figure 1.** Corn and soybean yield.

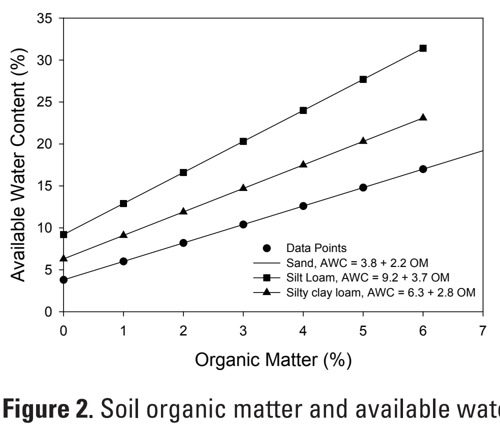


**Figure 2.** Soil organic matter and available water for 3 different soils.

This aspect becomes critical because crop production is dependent upon the amount of water transpired by the crop. Simply stated, the more water transpired by the crop, the higher the crop yield. Field scale research has demonstrated that soils with low water holding capacity show a decreased yield because of the lack of soil water during the grain-filling period. This effect is evident during years with below normal rainfall during the late July through early September period. An aspect of climate change across the Midwest is that our rainfall patterns are beginning to show a trend toward decreasing amounts in the summer and increased amounts during the spring period. As we begin to experience more variation in the weather during the growing season the greater the impact of soil quality on variation in crop production. Observations of crop production across the Midwest has shown that the higher the soil quality the higher the yield and less chance of yield loss during adverse weather conditions.

The Midwest has an advantage compared to other regions of the United States with the good soils and intensive animal production systems with the capacity to produce large amounts of manure. Utilization of manure as part of the agronomic system offers two distinct benefits for agronomic systems which include nutrient supply for the crop and improvement of soil quality. Manure is a valuable source of nitrogen, phosphorus, potassium, and micronutrients. Organic sources of nutrients offer the potential of being more available in sequence with crop demand during the growing season.

The most overlooked value of manure is the role in improving soil quality. Soil properties which exhibit a positive response to the utilization of manure include bulk density, aggregation, soil organic matter, and soil biological activity. Soil quality is an interaction of a number of factors; however, improvement of soil quality is initiated with providing a stable food source for microbial activity. Manure provides a balanced carbon and nitrogen source which supports microbial activity and when coupled with soil management practices which don't disturb the root systems of the previous crop there is a positive response to bulk density, organic matter, and aggregation. Bulk density is improved because the soil aggregates become more stable and allow for a more efficient exchange of carbon dioxide and oxygen between the soil and the atmosphere. This is a critical component in improving soil quality because a stable soil microenvironment is necessary to allow the soil biological activity to increase. The increase in soil microbial activity provides the foundation for the increase in organic matter in the soil. Organic matter increases are necessary for any improvement in soil quality and continual soil biological activity is needed as the sustaining factor in providing the mechanism for incorporating manure into a valuable soil resource.

On-farm evaluations of manure management has demonstrated that the combination of reducing tillage by utilizing strip tillage systems as a method of incorporating liquid manure greatly improved soil quality within a five year period. The strip tillage system prepared the soil for the planting of the next crop and limited the soil disturbance. One of the attributes of this system has been the placement of the tillage strip to avoid disturbing the previous root system and allowing these roots to be utilized as food source for the soil biological systems. The increased aggregate stability increases the infiltration rate of rainfall into the soil and also decreases the potential for soil erosion.

Incorporation of manure into a fertilizer source by reducing the water content and balancing the nutrient content offers the potential to be a valuable soil nutrient source because of the stimulation of the soil biological activity. The increased soil biological activity increases the nutrient cycling and availability to the growing crop and there has been an increase in corn production as a result of a combination of enhanced nutrient availability during grain-filling and improved soil quality leading to improved soil water supply. The value of manure can not be overlooked and Midwestern agricultural systems have the potential to become more efficient in the utilization of the natural resources, e.g., water, nutrients, and light, with the incorporation of manure as part of the management system. Improvement of soil quality provides the foundation for enhanced crop production and resilience to climate variability. The linkage between water, nutrients, and soil management must be understood to be able to continue to increase crop production.

# What did Discovery Farms learn about nutrient and sediment loss from studying a Wisconsin beef and cash grain farm?

Mark Riechers, Riechers Beef, Darlington, Wisconsin and Amber Radatz, co-director, University of Wisconsin Discovery Farms

Riechers Beef is the family farming operation owned by Mark and Jan Riechers along with their sons Joe and Jeff. Joe is actively engaged in the operation having taken over many of the daily chores and management decisions from Mark. Jeff frequently assists with the cropping and livestock duties. Mark and Jan's family also includes their daughter January and their 11 grandchildren.

The farm is in Lafayette County, just west of Darlington. Riechers Beef finishes beef steers, and produces feed through a direct plant (no-till) corn and soybean cropping system. Corn is harvested as either silage or grain and then stored and fed to the cattle. Approximately two thirds of the residue from corn grain harvest is removed for livestock bedding. The soybeans are almost all sold to a local seed company. Depending on the following year's crop rotation and soil test levels, solid beef manure is surface applied to the cropland.

This farm was chosen by the Discovery Farms Steering Committee to represent medium sized beef feedlot operations that have the majority of their cropland devoted to row crop production. The farm is located in the southern end of Wisconsin's driftless region. The moderate sloping landscape and field configuration on 160 acres of the home farm provided us with three watersheds varying in size from 17 - 40 acres, all under the control of the cooperating farmer. Water quality monitoring began in December 2003 and concluded at the end of September 2010.

## Impact of farming system on runoff

The direct plant cropping system has proven to be effective in enhancing the infiltration of precipitation. This system has added organic matter to the soil and enhanced soil structure. Crop management practices have the most significant impact on runoff volume while the ground is not frozen, and 80% of the total runoff occurred while the ground was frozen or covered with snow. Total precipitation lost as surface runoff from this farm was less than the state average (6% compared to 8%). Farmers who have adopted no-till or direct plant systems believe that their farming systems have less soil erosion and therefore lower nutrient losses. The study on Riechers beef indicates that soil loss is significantly lower, and that total runoff is also lower. However, winter losses play a more dominant role in nutrient loss and care needs to be taken with manure and nutrient applications during the late winter runoff period (February and March).

## Impact of winter manure applications

Riechers Beef utilizes surface applied manure as a fertilizer and mulch on the soil surface. The 7 years of monitoring clearly indicate that timing of manure application is one of the most important day to day management decisions. Manure was surface applied shortly preceding runoff in 2004, 2005, and 2009. The phosphorus losses were two to five times greater in the basins with manure application during this critical time period. When applications were made weeks or months prior to snowmelt or earlier in the winter, nutrient losses were low. Nutrient losses on this operation were well within desirable levels when manure was properly applied, even though soil test phosphorus levels were excessively high. Soluble phosphorus losses were much more greatly affected by manure applications close to the runoff period than by soil test levels. Surface manure applications in the spring, summer, fall and early winter (November - January) produced acceptable levels of nutrient loss.

## Soil moisture as a runoff risk tool

Data from this farm were used to prove that soil moisture before a storm event is a good predictor of whether the given storm will produce runoff. Storm events with antecedent soil moisture of 35% or higher produced 77% of non frozen ground runoff during the study. Consider the soil moisture level when applying manure, and pay attention to weather forecasts. Recognize that water from a liquid manure application will increase soil moisture levels, and could increase risk of runoff after application. If soils are saturated after the application, even a small precipitation event could cause runoff.

## Potential for endocrine disrupter loss

The Riechers farm participated with the Wisconsin State Laboratory of Hygiene on a project to assess the potential effects of hormones in livestock manure. The research project found that a large majority of hormones are rapidly degraded in the environment, and that preventing manure from entering waterways will prevent hormones from entering surface water. Further study of the hormones found that the mechanisms for hormone transport are necessary to determine potential impacts on aquatic organisms.

## Designing conservation systems for the 21st century

Throughout the years, Riechers Beef has installed numerous conservation practices to reduce the potential for soil erosion. However, the equipment industry is ever-changing with new options for getting cropping practices done more efficiently and effectively. Equipment has grown to a size where old conservation practices like terraces and contour strips no longer fit. Producers have adopted alternative conservation practices (direct plant systems) to reduce runoff and therefore the need for terraces and/or contour strips. Terraces were removed in one basin on the Riechers farm while monitoring continued for the following year. Data from that year did not show a negative impact on sediment and nutrient loss from removal of the terraces. However, more data would be necessary to adequately assess the difference between surface water losses with and without the terraces.

## Changes on the operation

Manure is an essential part of the farming system at Riechers Beef, but the operation has limited storage capacity which means that winter manure application is necessary (which is very common in Wisconsin). The Discovery Farms Program was able to document that manure can be applied on frozen ground provided that there is adequate time for the manure to bond with and/or infiltrate the soil. However, manure applied shortly before runoff, during the runoff period or on fields where the manure cannot interact with the soil had unacceptable levels of loss. The Riechers and other producers with livestock have been using this information to identify the most critical time periods for runoff and plan accordingly by temporarily storing, stacking, or working with conservation professionals to identify fields with the lowest risk of nutrient loss in must-spread situations. In addition, Riechers Beef has covered its open lots to keep precipitation away from animals and manure, and allows cleaning earlier in the winter before critical runoff periods. Runoff alerts have also been provided by producer groups, Discovery Farms and state agencies to make livestock farmers aware of high risk runoff periods.

Being aware of soil moisture levels is not only important for runoff management, but also to minimize compaction and damage to the fields during manure application, planting, spraying, or harvesting activities. Riechers Beef have always been careful to stay out of the fields when compaction is a risk, but through the use of the soil moisture monitoring during the study period, they have been able to more accurately identify time periods to avoid field operations.

As mentioned previously, terraces were removed in one 40 acre field because they no longer fit the equipment, and Mark and Joe Riechers believed that advancements in direct plant technology had reduced soil disturbance enough to make up for the impact of the terraces on soil erosion. The Riechers cropping system is unique and carefully managed to keep the productive soil in place.

As a result of data from this operation and other Discovery Farms sites, a winter manure spreading risk advisory message is sent out annually based on current conditions. This data refined our ability to predict when winter runoff will occur and allows us to spread this knowledge through educational sessions and written documents available on our website.

The strong dataset on the relationship between soil moisture and runoff is documented in a peer reviewed journal article and could help producers determine the amount of liquid manure to apply and when to avoid manure applications.

*This is an excerpt from 'Riechers Beef 9: Lessons Learned at Riechers Beef'. The fact sheet is part 9 of a 9 part series and can be found along with the rest of the fact sheets on the web at: www.uwdiscoveryfarms.org or by calling the UW-Discovery Farms Office at 715-983-5668.*

# Cover crop mixes to meet grazing needs

E.M. Mousel, Extension Cow-Calf Educator, University of Minnesota, Grand Rapids, MN

## Introduction

Although cover crops, green manure, etc. have traditionally been used in the agroecosystem to better manage soil fertility, soil moisture, weeds, pests, and crop diseases; livestock grazing also can be added to the list of services cover crops can provide. There are literally hundreds of potential cover crop species that can benefit the agroecosystem therefore, matching cover crop species to soil types, management objectives, and future uses is critical to getting the most out of any cover crop program. This seminar will outline some decision points producers will need to consider when evaluating cover crops for grazing.

## Cover crops for grazing

There are literally hundreds of species that can be used as cover crops. For the sake of simplicity, there are six major categories of cover crops. A few of the major species are listed under each category.

**Table 1.** Categories of cover crops and major species.

| Brassicas | Clovers | Legumes | Cereal grains | Annual grasses | Summer annuals |
|---|---|---|---|---|---|
| Turnip | White clover | Hairy vetch | Rye | Annual ryegrass | Sorghum |
| Radish | Crimson clover | Sweet clover | Barley | | Sudangrass |
| Rape | Red clover | Winter peas | Oats | | Sorg.xSudan |
| Kale | Burnett clover | Alfalfa | Triticale | | Millets |

## Cover crop decision tree

### *Cost*

The primary concern for a cover crop program is cost. Cover crop species and mixes can range from very cost effective to outrageous, depending on the objectives of the program and the cover crop species involved. Later on in the program I will talk about potential species mixes and costs for different grazing scenarios.

### *Moisture*

The second major issue with using cover crops for grazing is moisture content of the forage. Moisture content of grazable forage from cover crops can range dramatically depending on species planted and management. Moisture content will affect animal performance greatly and therefore should be managed carefully. Brassica species like turnips, rape, kale, and radishes will contain roughly 90% water in the field. Cereal grains will contain about 60% water and warm-season annuals like millet will contain about 50% water. In contrast, corn stalks will contain about 10% moisture.

Carbon to nitrogen ration is another key to influencing animal performance in a grazing situation. Generally speaking, the greater the carbon to nitrogen ratio of a forage, the more fiber the forage contains. More fiber means lower digestibility and less performance from grazing livestock. However, in reality there is an optimum range of C:N ratio of 40-45:1. Using different species of cover crops that have different moisture contents and C:N ratios in mixes is the best way to manage animal performance. However, it also is important to understand that cover crop species that have a C:N ratio of 40:1 are muchmore expensive than species that have a C:N ratio of 25:1. Therefore, it is important to manage cost at the same time.

### *Cold tolerance*

Another critical aspect to any cover cropping program is cold tolerance of target species. Considering that the vast majority of cover crop grazing occurs in late-fall to early winter, cold tolerance of grazing species becomes very important. Brassicas species have excellent cold tolerance and will stay green well into the winter before finally freezing out by January or February. Cereal grains such as rye, barley, oats, and annual ryegrass also have pretty good cold tolerance. However, summer annual species such as sorghums, sudangrass, sorghumxsudangrass hybrids, and the millets have very poor cold tolerance. These species will brown-up and die at the first hint of frost. Unfortunately, cold tolerance and yield of grazable forage are generally inversely related, so it is important to have a conceptual idea of when species are going to be grazed before planting.

### *Residual*

Contrary to popular belief, grazing is generally not a very efficient process and the amount of forage that is actually removed by grazing animals is largely over estimated. For many producers this has led to problems concerning field residue following grazing. As a general rule, less than 40% of forage in a field will actually be consumed by grazing livestock. Much of it will be trampled on, urinated on, and defecated on; leaving large quantities remaining in the field. This concern becomes paramount when considering spring field work for subsequent crops.

## Summary

When managed properly, cover crop species can provide quality grazing at a reasonable price; in additional to other agronomic goals of the producer. The key to a successful cover crop program is balancing the objectives of the program and cost. Keeping the cover crop decision tree in mind when developing the cover crop program will enhance its effectiveness to the producer.

# Beef feed storage from an engineering perspective

Brian J. Holmes, PhD, Professor Emeritus, Biological Systems Engineering, University of Wisconsin-Madison

There is a large potential and actual feed loss in the beef industry. There are engineering solutions to some of the causes of feed loss but those solutions can have capital investment and annual cost requirements. To keep a beef operation economically viable, costs incurred must be recovered by savings. Table 1 can be used to estimate the value lost per ton of hay when an estimated loss of dry matter occurs. One way to use this table is to assume a certain practice can save 10 % dry matter loss when hay is valued at $150/ton. Under this condition, $15/ton of hay can be saved. Whatever system saves $15/ton, it must not cost more than $15/ton to implement for it to be a viable alternative.

**Table 1.** Value of hay lost as a function of hay price and dry matter loss*

| | Hay Price ($/Ton hay) | | | | | |
|---|---|---|---|---|---|---|
| **DM Loss (%)** | **50** | **100** | **150** | **200** | **250** | **300** |
| | | | *Value Lost ($/Ton hay)* | | | |
| **5** | 2.5 | 5.0 | 7.5 | 10.0 | 12.5 | 15.0 |
| **10** | 5.0 | 10.0 | 15.0 | 20.0 | 25.0 | 30.0 |
| **15** | 7.5 | 15.0 | 22.5 | 30.0 | 37.5 | 45.0 |
| **20** | 10.0 | 20.0 | 30.0 | 40.0 | 50.0 | 60.0 |
| **25** | 12.5 | 25.0 | 37.5 | 50.0 | 62.5 | 75.0 |
| **30** | 15.0 | 30.0 | 45.0 | 60.0 | 75.0 | 90.0 |
| **35** | 17.5 | 35.0 | 52.5 | 70.0 | 87.5 | 105.0 |
| **40** | 20.0 | 40.0 | 60.0 | 80.0 | 100.0 | 120.0 |
| **45** | 22.5 | 45.0 | 67.5 | 90.0 | 112.5 | 135.0 |
| **50** | 25.0 | 50.0 | 75.0 | 100.0 | 125.0 | 150.0 |

*Hay assumed to be 16% moisture

## Where do the dry matter losses occur in hay making?

Hay dry matter losses occur in the harvesting, storage and feeding processes. Table 2 can be used to estimate losses occurring in the harvest process. Values can vary quite a bit based on weather and technology and management used. Dry matter losses occurring in this phase can influence the losses that occur in the storage phase. Hay stored outside and exposed to oxygen, precipitation, high humidity, shade, warm temperature and soil moisture decomposes at a faster rate than when protected from moisture sources. The longer hay is stored under high rate decomposing conditions the higher will be the overall loss of dry matter. Table 3 can be used to estimate losses that occur in hay stored under a variety of conditions in a moist climate. The method by which hay is presented to beef cows and their feeding behavior influences the degree of feed waste. Slant bars on the feeding fence can limit how much hay is pulled through the fence and onto the ground. Once feed is on the ground it is susceptible to trampling and will not be consumed. Feeder design has a large effect on how much feed is wasted by the animals. If the feeder is designed so feed pulled from the bale is dropped within the feeder, loss will be less than if dropped on the ground and is trampled. Table 4 is based on research and observation of animal wastage.

**Table 2.** Expected dry matter losses for hay harvested as dry hay, wrapped silage bales and chopped for silage. Values in parentheses are typical.*

| Process | Dry Bales | Wrapped Silage Bale | Chopped for Silage |
|---|---|---|---|
| Mow and Condition | 1-4 (2) | 1-4 (2) | 1-4 (2) |
| Respiration | 1-7 (5) | 1-7 (5) | 1-7 (4) |
| Tedding | 2-8 (3) | 2-8 (3) | 2-8 (3) |
| Swath Inversion | 1-3 (1) | 1-3 (1) | 1-3 (1) |
| Rake | 3-20 (7) | 1-20 (5) | 1-20 (5) |
| Rain | 0-50 (5) | 0-50 (3) | 0-50 (3) |
| Bale | 3-9 (6) | 2-8 (5) | N/A |
| Chop | N/A | N/A | 1-8 (3) |
| Plastic wrap | 0-3 (1) | 0-1 (0.5) | N/A |

* 1% DM Loss is typical for mowing/conditioning and tedding grass hay

**Table 3.** Estimates of dry matter loss for hay stored under a variety of conditions in a moist (> 40 inches precipitation/year) climate. Values in parenthesis are typical.

| Storage Type | Dry Hay Bales | Silage Bales |
|---|---|---|
| | ---------- dry matter loss (%) | ---------- |
| On Floor/Stone Base w Roof | 3-5 (3) | N/A |
| On Ground w Plastic Wrap | 4-10 (4) | 1 |
| On Ground w Plastic Sleeve | 4-10 (5) | N/A |
| On Ground w Roof | 2-10 (4) | N/A |
| On Ground, Net Wrap, Breathable Wrap | 2-7 (3) | N/A |
| On Pallets, Tarp | 2-17 (3) | N/A |
| On Stone Base, Tarp | 2-17 (4) | N/A |
| On Pallets, Uncovered | 3-20 (9) | N/A |
| On Stone Base, Uncovered | 3-20 (9) | N/A |
| On Ground w Tarp | 4-30 (9) | N/A |
| On Pallet, Net Wrap, Uncovered | 5-9 (6) | N/A |
| On Stone Base, Net Wrap, Uncovered | 5-9 (7) | N/A |
| On Ground, Net Wrap, Uncovered | 2-20 (8) | N/A |
| On Ground, Plastic Twine, Uncovered | 5-20 (10) | N/A |
| On Ground, Uncovered, Sisal Twine | 5-30 (15) | N/A |

**Table 4.** Dry matter loss based on feeding method for beef cows

| Feeding Method | Dry Matter Loss (%) |
|---|---|
| Whole round bale on the ground | 50 +/- |
| Strip of hay on the ground | 24 |
| Strip of hay on the ground-electric fence limits access | 18 |
| Cradle feeder with inclined bars | 15 |
| Ring feeder with round bale | 6, 13 |
| Trailer feeder with vertical bars | 11 |
| Cone feeder with round bale | 4 |

Consider the example of a producer who teds his hay, harvests dry hay in plastic twine wrapped large round bales without being rained upon during harvest, stores the bales on the ground outside and feeds the bales to beef cows in a strip on the ground. The loss of hay might be in the order of 57% (23% + 10% + 24%). If that same producer placed the plastic twine tied bales on a stone base with a tarp and fed the bales in a cone feeder, the expected losses might be in the order of 31% (23% + 4% + 4%). The savings for changing the practices is 26% (57% – 31%). The savings for hay at $150/T is $39/T (150$/T * 0.26). If the increased cost of the stone base, tarp and the cone feeder(s) is less than $39/T of hay fed, the change will be profitable.

An economic analysis of feed storage alternatives considering initial and annual costs can help establish the better system alternatives for your operation. This analysis can be facilitated by spreadsheets available for download. Look at the "Hay Storage Cost Comparison A1-15" spreadsheet on the Iowa State University Ag Decision Maker web site, http://www.extension.iastate.edu/agdm/decisionaidsall.html

A more complicated spreadsheet is available as "Comparing Round Bale Storage Costs" available on the UW Extension Harvest and Storage page of the Team Forage web site at http://www.uwex.edu/ces/crops/uwforage/storage.htm

## Can silage be used for a beef herd?

One way to use hay as silage is as wrapped silage bales. The hay is baled at 40-50% moisture and wrapped to exclude oxygen as individual bales or as tube wrapped lines of bales. Compared to dry hay, losses can be reduced by shortening the time hay is exposed to respiration, reduced loss in raking and baling and a reduced chance of being rained upon before harvest and elimination of exposure to oxygen during storage. Losses in feeding will be similar to those listed in Table 4 unless the feed is not consumed within five days, whereupon feed instability may develop.

Some beef producers are considering if chopped forage can be stored in bunker, pile or bag silos for their operation. If the forage is harvested at the correct stage of maturity and moisture, packed into the storage tightly and covered properly, good quality silage can be made. One of the big concerns is if the feedout rate can be large enough for the size of herd and the storage selected. If not, high levels of feedout loss due to aerobic deterioration can be experienced. Table 5 was developed to help answer the question of what minimum size herd is needed to have adequate feedout rate from three different types of silage storage.

**Table 5.** Design criteria for silage storages.

| Criteria | Bunker silo | Pile silo | Silo bag |
|---|---|---|---|
| Face Removal Rate (in/day) | 12 | 12 | 18 |
| Height (ft) | 8 | 10 or 5 | N/A |
| Width/Diameter (ft) | 20 | N/A | 8 |
| Side Slope (rise/run) | N/A | 1/3 | N/A |
| Dry Matter Density (lbs DM/ft$^3$) | 15 | 15 | 13 |

In the case of corn silage, the animals in the feedlot were assumed to be equal in number for growing (700 lbs/animal) and finishing (1000 lbs/animal). Growing animals receive 12.25 lbs DM corn silage/animal/day and the feeders receive 5 lbs DM corn silage/animal/day. The values in Table 6 show the minimum feedlot herd size to justify the type of silage storage based on assumptions used in the analysis.

**Table 6.** Minimum number of animals in a feedlot to assure adequate feed out rate from a corn silage storage.

| Silo Face Removal Rate (in/day) | Storage Type | | | |
|---|---|---|---|---|
| | **Bunker Silo (8′ x 20′)** | **Pile Silo (10 ft high)** | **Pile Silo (5 ft high)** | **Silo Bag** |
| | ---------------- *Minimum number of animals in feedlot* ---------------- | | | |
| 12 | 278 | 520 | 130 | N/A |
| 6 | 139 | 260 | 65 | N/A |
| 18 | N/A | N/A | N/A | 114 |

The smallest herd in a feedlot is 65 animals when a 5 ft tall pile is built and fed out at 6 inches per day. The next smallest herd (114 animals) uses an 8 ft diameter silo bag fed at 18 inches per day. Obviously, larger storages require larger herd sizes to be fed out at reasonable rates.

A similar question is asked about using hay silage for the beef cow herd. Using the same assumptions of Table 5 and a hay silage consumption rate of 26 lbs hay silage DM/cow/day, the minimum cow herd size was developed in Table 7.

The smallest herd is 22 cows when a 5 ft tall pile is built and fed out at 6 inches per day. The next smallest herd (38 cows) uses an 8 ft diameter silo bag fed at 18 inches per day. Obviously, larger storages require larger herd sizes to be fed out at reasonable rates.

**Table 7.** Minimum number of beef cows to assure adequate feed out rate from a hay silage storage.

| Silo Face Removal Rate (in/day) | Storage type | | | |
|---|---|---|---|---|
| | **Bunker Silo (8′ x 20′)** | **Pile Silo (10 ft high)** | **Pile Silo (5 ft high)** | **Silo Bag (8′ dia.)** |
| | ---------------- *Minimum number of cows in herd* ---------------- | | | |
| 12 | 93 | 174 | 44 | N/A |
| 6 | 46 | 87 | 22 | N/A |
| 18 | N/A | N/A | N/A | 38 |

# Use of unique or non-traditional feeds: Are we revisiting old school feedlot diets?

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## Introduction

Corn prices have been variable the past few years and generally more expensive. As a result, we have initiated a few different research programs to address these needs. Early on, grain was expensive ($5/bu or more), distillers grains (wet or modified) were relatively inexpensive as a percentage of grain price (70 to 90% on a dry-to-dry basis), and corn residue (baled stalks) were relatively inexpensive ($50 to $70/ton). As a result, research focused on how to use more residue and distillers grains and less corn grain. Two research areas were evaluated: alkaline treatment of corn stalks and increasing use of corn silage as methods to decrease corn usage. The questions were if you decrease corn inclusion, will performance be maintained or will feed conversion get worse. Even with some depression (increase) in F:G, will cost of gain be more competitive.

More recently, price of corn has moderated compared to historical highs ($4/bu), price of distillers grains has increased relative to corn (100 to 140% price of corn, depending on location and timing), and residue has stayed relatively constant in price ($50-$70/ton). As a result, things are different.

Our assessment is that each crop year may be different and appears to impact the optimum approach for feeders. Having research that "applies" to these various scenarios is helpful for sound decision making. Of course, the breakeven on cattle is impacted the most by purchase price of incoming feeder cattle for feedlots. Given current industry statistics, tight cattle supplies will be the economic driver in the near future. This situation of tight cattle supplies and expensive feeders doesn't diminish the importance of feed costs, in fact, the current situation suggests feed costs may be more critical than in the past due to the large investments now required to buy and finish cattle.

## Alkaline treated corn stalks

We have conducted a series of studies over the past 4 years focused on alkaline treatment of corn stalks (and wheat straw) to enhance its digestibility and then feed at greater than "normal" to replace a small portion of corn grain. A large amount of research data are available from the 1970s where different alkaline treatments were evaluated to make low quality forages more digestible. Some chemicals are stronger than others, but the focus of our research has been on using calcium oxide, which is converted to calcium hydroxide in water, to alkaline treat the residues. Calcium oxide was most logical in our opinion as it provides needed calcium in feedlot diets, it is less caustic than some alternatives, and the oxide form produces some heat when converted to hydroxide in water which may be beneficial. We have not compared calcium oxide to hydroxide in these settings.

We have conducted six feedlot pen studies, two growing cattle pen studies, one individually fed finishing experiment, and one feedlot digestion experiment. In the initial feedlot study, we compared treated corn stalks, wheat straw, or corn cobs with 5% calcium oxide to untreated or native stalks, straw, or cobs and fed these at 20% of the diet DM (Shreck et al., 2012a). All diets also included 40% wet distillers grains plus solubles (WDGS). We also included a control diet that had 10% native forage as a blend of the 3. Compared to the control with 10% roughage, gains and feed conversion (F:G) were the same when 20% treated forage was fed compared to 10% native. For straw and stalks, cattle fed 20% native residue gained less and had poorer (i.e., greater) F:G. Two studies were conducted with calf-feds or summer-fed yearlings and designed similarly whereby 20% treated, 20% native, and 5% native corn stalks were fed with 40% modified distillers grains plus solubles (MDGS) on a DM basis (Johnson et al., 2013). Calf-feds fed 20% treated stalks had similar ADG and F:G as control fed steers, and both were better than feeding 20% untreated stalks as you would expect (Table 1). For summer fed yearlings, steers fed 20% treated stalks had numerically lower (but statistically similar) ADG and poorer F:G than control fed steers, but much better than feeding 20% native stalks (Table 1).

**Table 1.** Finishing performance and carcass characteristics of calf-fed or yearling steers fed 5% stalks (CON), or 20% stalks (NONTRT) or 20% alkaline treated stalks (TRT). (Johnson et al., 2013)

| Diet | CON | NONTRT | TRT | P - value |
|---|---|---|---|---|
| **Calf-feds** | | | | |
| DMI, lb/d | 22.4 | 22.9 | 22.4 | 0.42 |
| ADG, lb[1] | 3.67[a] | 3.24[b] | 3.61[a] | <0.01 |
| F:G[1] | 6.36[a] | 7.05[b] | 6.22[a] | <0.01 |
| HCW, lb | 860[a] | 812[b] | 854[a] | <0.01 |
| Dressing % | 63.3[a] | 62.0[b] | 63.6[a] | <0.01 |
| 12th Rib Fat, in | 0.51 | 0.41 | 0.48 | 0.07 |
| Marbling[2] | 582[a] | 532[b] | 551[a] | <0.01 |
| **Yearlings** | | | | |
| DMI, lb/d | 26.8[a] | 28.8[b] | 27.6[a] | <0.01 |
| ADG, lb[1] | 4.18[a] | 3.77[b] | 4.04[a] | <0.01 |
| F:G[3] | 6.42[a] | 7.65[b] | 6.85[c] | <0.01 |
| HCW, lb | 914[a] | 878[b] | 901[a] | <0.01 |
| Dressing % | 62.8[a] | 60.9[b] | 61.3[c] | <0.01 |
| 12th Rib Fat, in | 0.59 | 0.53 | 0.57 | 0.16 |
| Marbling[2] | 574 | 537 | 556 | 0.09 |

[a, b, c] Means within a row with unlike superscripts differ (P< 0.05).
[1] ADG based on carcass-adjusted final BW = HCW/0.63.
[2] Marbling: 500 = small0, 600 = modest0.

To test this futher, a commercial study was conducted whereby the control diet (6% stalks along with 35% WDGS were compared to feeding 20% treated stalks. Steers had similar DMI between treatments (P = 0.23). On a live basis, steers fed TRT were 19 lb numerically lighter (P = 0.19) in shrunk live BW at the end of the feeding period compared to CON (Table 2). As a result, ADG was decreased by feeding TRT compared to CON (P = 0.06) and cattle were less efficient (P = 0.01), with a 0.20 increase in F:G. Carcass weights were 20 lb lighter (P = 0.04) for TRT fed steers compared to CON. Therefore, when performance was adjusted for 63% dress final BW, ADG was decreased (P < 0.01) by 0.20 lb/d for TRT compared to CON. Less gain resulted in poorer F:G for TRT steers compared to CON (P < 0.01). There was a significant block by treatment interaction for carcass-adjusted ADG, which was tested due to 4 replications per block. Feeding TRT decreased ADG by 0.32 lb/d in block 1 (northern cattle) whereas ADG only decreased by 0.06 lb/d in block 2 (Mexican cattle) compared to CON. As a general rule, feeding TRT resulted in lighter carcasses, and lower dressing percentage. With no change in intake, the decrease in ADG resulted in poorer feed conversions and some subtle impacts on carcass quality, which reflect poorer ADG.

**Table 2.** Performance and carcass characteristics of commercial feedlot steers fed either alkaline treated corn stover at 20% of diet DM (TRT) or a conventional control with 6% stover (CON) blocked by two different types of steers and arrival date (Cooper et al., 2014).

| | CON | TRT | P-value |
|---|---|---|---|
| **PERFORMANCE** | | | |
| DMI, lb/d | 23.36 | 23.58 | 0.53 |
| Live | | | |
| Final BW, lb | 1372 | 1353 | 0.19 |
| ADG, lb | 4.04 | 3.94 | 0.06 |
| F:G | 5.79 | 5.99 | 0.01 |
| Carcass-adjusted | | | |
| Final BW, lb | 1401 | 1370 | 0.04 |
| ADG, lb | 4.25 | 4.05 | <0.01 |
| block 1 | 4.68 | 4.36 | |
| block 2 | 3.81 | 3.75 | |
| F:G | 5.53 | 5.83 | <0.01 |
| **CARCASS CHARACTERISTICS** | | | |
| Hot Carcass Weight | 882.8 | 862.9 | 0.04 |
| Fat Depth | 0.51 | 0.49 | 0.07 |
| Ribeye Area | 13.3 | 13.1 | 0.11 |
| Yield Grade | 3.29 | 3.21 | 0.29 |
| Quality Grade Distribution | | | |
| % Prime | 0.45 | 0.30 | 0.53 |
| % Choice | 57.94 | 51.74 | 0.02 |
| % Select | 38.66 | 42.64 | 0.09 |
| % < Standard | 2.95 | 5.33 | 0.14 |

[1] P-values for effect of diet (CON vs TRT). P-values for block and interaction between block and diet are in the original publication.

In these studies, stalks were ground through a 3-in. screen and tub ground prior to treating. We wanted to evaluate feeding stalks ground through either a 1 in. or 3 in. screen to determine the impact of forage grind size on the treatment process and effectiveness. While cattle fed a 1 in. grind did slightly better (numerically) in terms of ADG and F:G compared to the control and statistically better than the 3 in. grind in terms of F:G, grinding through a 3 in. screen and treating was similar to feeding a control with only 5% stalks (Shreck et al., 2012b; Table 3). Regardless of grind size, treating stalks fed at 20% well outperformed native stalks for both ADG and F:G. We recommend a 3 in. grind, but there may be slight improvements to going even smaller although grinding costs and time increase. This is also dependent on moisture content of stalks.

Another question is whether the inclusion of wet or modified distillers grains matters relative to performance response. Peterson et al. (2014a) fed 10, 20, or 30% treated stalks in diets with either 20% or 40% MDGS. These data suggest that as treated stalks increase above 10% in diets with only 20% MDGS, ADG and F:G get linearly worse (Table 4). However, in diets with 40% MDGS, feeding 10 to 20% treated stalks maintains performance, which gets worse at 30% (quadratic response).

**Table 3.** Performance and carcass characteristics (Shreck et al. 2012b)

| Item | Control | 1"Grindsize Treated | 1"Grindsize Untreated | 3" Grindsize Treated | 3" Grindsize Untreated | F-test | Factorial P-value[2] Grind[1] | Factorial P-value[2] Trt[1] |
|---|---|---|---|---|---|---|---|---|
| **Steer performance** | | | | | | | | |
| DMI, lb | 24.01[abc] | 23.60[bc] | 24.50[ab] | 23.45[c] | 24.78[a] | 0.04 | 0.87 | <0.01 |
| ADG, lb | 3.67[a] | 3.73[a] | 3.28[b] | 3.58[a] | 3.21[b] | <0.01 | 0.02 | <0.01 |
| F:G | 6.54[ab] | 6.32[a] | 7.47[c] | 6.55[b] | 7.72[b] | <0.01 | 0.01 | <0.01 |
| **Carcass characteristics** | | | | | | | | |
| HCW, lb | 868[a] | 873[a] | 831[b] | 858[a] | 825[b] | <0.01 | 0.26 | <0.01 |
| Dressing % | 61.39 | 63.63 | 62.06 | 63.10 | 61.89 | 0.26 | 0.08 | <0.01 |
| 12th rib fat, in | 0.57 | 0.55 | 0.51 | 0.56 | 0.52 | 0.24 | 0.51 | 0.07 |
| Marbling[3] | 595 | 568 | 546 | 590 | 579 | 0.11 | 0.07 | 0.27 |

[1] Fixed effect of grind size (1" vs 3") and fixed effect of chemical treatment
[2] No significant grind size x chemical treatment interaction was observed (P > 0.37); 3500=Small, 600=Modest
abc Within a row, values lacking common superscripts, differ, when F-test is significant (P<0.05)

**Table 4.** Performance of finishing cattle comparing the simple effects of 10, 20, or 30% alkaline treated stalks with either 20 or 40% MDGS along with the control diet that included 5% untreated stalks and 20% MDGS (Peterson et al., 2014a).

| | | 20 distillers | | | | | 40 distillers | | | | | | P-values | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Item | Control | 10 | 20 | 30 | Lin[1] | Quad[2] | 10 | 20 | 30 | Lin[3] | Quad[4] | SEM | F-Test[5] | DxT[6] |
| **Performance** | | | | | | | | | | | | | | |
| DMI, lb/d | 23.5$^{ab}$ | 23.5$^{ab}$ | 23.8$^{ab}$ | 23.1$^{b}$ | 0.51 | 0.25 | 23.8$^{ab}$ | 24.2$^{a}$ | 24.3$^{a}$ | 0.34 | 0.70 | 0.32 | 0.18 | 0.47 |
| ADG, lb | 4.07$^{ab}$ | 3.90$^{bc}$ | 3.71$^{cd}$ | 3.32$^{e}$ | <0.01 | 0.23 | 4.05$^{ab}$ | 4.13$^{a}$ | 3.63$^{d}$ | <0.01 | <0.01 | 0.07 | <0.01 | 0.21 |
| F:G | 5.79$^{a}$ | 6.02$^{b}$ | 6.40$^{c}$ | 6.98$^{d}$ | <0.01 | 0.54 | 5.89$^{ab}$ | 5.88$^{ab}$ | 6.70$^{d}$ | <0.01 | <0.01 | - | <0.01 | 0.07 |
| **Carcass Characteristics** | | | | | | | | | | | | | | |
| HCW | 907$^{ab}$ | 888$^{bc}$ | 868$^{cd}$ | 824$^{e}$ | <0.01 | 0.24 | 905$^{ab}$ | 915$^{a}$ | 858$^{d}$ | <0.01 | <0.01 | 9 | <0.01 | 0.26 |
| Dressing, % | 64.4$^{a}$ | 63.7$^{bc}$ | 63.1$^{cd}$ | 61.2$^{e}$ | <0.01 | 0.05 | 64.1$^{ab}$ | 63.8$^{ab}$ | 62.5$^{d}$ | <0.01 | 0.11 | 0.3 | <0.01 | 0.21 |
| LM area, in.$^2$ | 14.4$^{a}$ | 14.0$^{ab}$ | 14.2$^{ab}$ | 13.8$^{b}$ | 0.54 | 0.23 | 14.1$^{ab}$ | 14.5$^{a}$ | 14.0$^{ab}$ | 0.67 | 0.10 | 0.18 | 0.18 | 0.93 |
| 12$^{th}$ Rib fat, in. | 0.58$^{a}$ | 0.53$^{a}$ | 0.46$^{b}$ | 0.39$^{c}$ | <0.01 | 0.98 | 0.59$^{a}$ | 0.53$^{a}$ | 0.43$^{bc}$ | <0.01 | 0.45 | 0.02 | <0.01 | 0.74 |
| Marbling[7] | 459$^{a}$ | 488$^{a}$ | 488$^{a}$ | 470$^{a}$ | 0.30 | 0.53 | 476$^{a}$ | 462$^{a}$ | 463$^{a}$ | 0.44 | 0.62 | 13 | 0.42 | 0.31 |

$^{abcde}$ From the F-test, means lacking common superscripts, differ $P < 0.05$;
[1] Linear contrast for treated stalks within 20% MDGS inclusion
[2] Quadratic contrast for treated stalks within 20% MDGS inclusion;
[3] Linear contrast for treated stalks within 40% MDGS inclusion
[4] Quadratic contrast for treated stalks within 40% MDGS inclusion;
[5] Overall F-test statistic comparing the Control to all other treatments
[6] DxT is the distillers inclusion by alkaline treated stalks inclusion interaction;
[7] Marbling score where 400=Small$^0$

It is unclear the cause of the depression in ADG observed in this commercial study and in one of the 5 experiments conducted at UNL where feeding 20% treated stalks did not result in similar performance. Interestingly, both studies where equal performance was not observed were conducted with yearlings fed in the summer and resulted in a 6.7% increase in F:G (Johnson et al., 2013) or a 5.4% increase (Cooper et al., 2014) in F:G when steers were fed TRT compared to CON. It is unclear if cattle type, season, or some other variable impacts cattle performance when replacing corn with alkaline treated stalks. Table 5 provides an overview of the feedlot studies conducted where similar treatments were fed. Across studies, two showed no difference, three showed that treated stalks were poorer, and two studies showed numerical improvements but that was due to grind size in one of them. One of the studies that were poorer response to treated stalks was due to only 20% inclusion of MDGS.

In studies that included 20% stalks that were not treated, performance was dramatically worse with 10 to 20% increases in F:G for cattle, which illustrates that you cannot just increase stalk inclusion and get similar performance.

**Table 5.** Summary of F:G across experiments with 20% treated stalks (TRT) compared to a 5% stalks control (CON) or not treating (NONTRT).

| | Treatments | | | CON vs TRT | | CON vs NONTRT |
|---|---|---|---|---|---|---|
| | CON | TRT | NONTRT | DIFF | % DIFF | % DIFF |
| Johnson calf | 6.36[a] | 7.05[b] | 6.22[a] | -0.14 | -2.2% | 10.8% |
| Johnson yrlgs | 6.42[a] | 7.65[b] | 6.85[c] | 0.43 | 6.7% | 19.2% |
| Shreck 3” | 6.54 | 6.55 | 7.72 | 0.01 | 0.2% | 18.0% |
| Shreck 1” | 6.54 | 6.32 | 7.47 | -0.22 | -3.4% | 14.2% |
| Peterson 20% | 5.79 | 6.40 | - | 0.61 | 10.5% | - |
| Peterson 40% | 5.79 | 5.88 | - | 0.09 | 1.6% | - |
| Cooper | 5.53 | 5.83 | - | 0.30 | 5.4% | - |

These data suggest when treated residue gets above 20% of the diet, performance may be hindered and cattle consuming all the residue is likely a challenge. Our conclusions are to only include up to 20% treated residue, at least 25% corn (Shreck et al., 2013a), and at least 35 to 40% wet or modified distillers grains. All of our studies have been completed with either wet or modified distillers grains plus solubles, so it is not clear what the impact would be with dry distillers grains plus solubles. Likewise, other corn processing methods besides high-moisture and dry-rolled corn may impact these results too, but doesn’t really apply to this situation. At best, feeding treated stalks at 20% compared to traditional inclusions will give similar ADG and conversions. At worst, a 5 to 6% increase in feed conversion is possible. These risks should be taken into consideration when performing economics.

Lastly, many questions have been asked about use for backgrounding cattle or growing cattle. We have completed two studies (Peterson et al., 2014b; Shreck et al., 2014) and would suggest that it is not economical to treat stalks for growing cattle simply because the energy is not increased sufficiently in the diet to justify the costs. In these two studies, we included large amounts of treated stalks (60 to 70% of the diet). Treating stalks increased intake (probably due to greater ruminal digestion and subsequently passage rate), increased ADG, but did not dramatically impact the feed conversion (Table 6, Table 7). Our future research focus will include decreasing particle size (pelleting) and other potential treatments.

**Table 6.** Effect of crop residue and alkaline treatment on growing steer performance (Shreck et al., 2014).

| | Corn stover | | Wheat straw | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Item** | **Treated** | **Untreated** | **Treated** | **Untreated** | **SEM** | **CaO[1]** | **Residue[2]** | **CaO x Residue** |
| Initial BW | 729 | 729 | 728 | 727 | 0.64 | 0.59 | 0.43 | 0.19 |
| Ending BW | 844[b] | 834[c] | 868[a] | 841[b] | 2.60 | <0.01 | <0.01 | <0.01 |
| ADG | 1.67[b] | 1.52[c] | 2.02[a] | 1.63[bc] | 0.04 | <0.01 | <0.01 | <0.01 |
| DMI | 16.7 | 15.7 | 18.7 | 16.4 | 0.43 | <0.01 | <0.01 | 0.15 |
| F:G | 10.00 | 10.32 | 9.25 | 10.06 | - | 0.06 | 0.07 | 0.18 |

[1] Main effect of CaO + water or none
[2] Main effect of residue type (corn stover or wheat straw)
[3] Average profit/hd relative to untreated crop residue
[abc] Within a row, means lacking common superscripts differ, when interaction P < 0.05

**Table 7.** Effects of pelleting (Iowa Agricultural BioFibers) and chemical treatment on cattle performance (Peterson et al., 2014b).

| | Pelleted | | Not Pelleted | | | P-values | | |
|---|---|---|---|---|---|---|---|---|
| **Item** | **Untreated** | **$Ca(OH)_2$** | **Untreated** | **CaO** | **SEM** | **Pellet[1]** | **T[2]** | **PxT[3]** |
| Initial BW, lb | 688 | 689 | 688 | 688 | 1 | 0.49 | 0.49 | 0.82 |
| Ending BW, lb | 926 | 954 | 907 | 927 | 5 | <0.01 | <0.01 | 0.47 |
| ADG, lb | 2.97 | 3.31 | 2.74 | 2.99 | 0.06 | <0.01 | <0.01 | 0.44 |
| DMI, lb/day | 26.1 | 27.4 | 20.7 | 22.2 | 0.2 | <0.01 | <0.01 | 0.58 |
| Feed:Gain[4] | 8.80 | 8.29 | 7.55 | 7.46 | - | <0.01 | 0.05 | 0.18 |

[1] Fixed effect of pelleting
[2] Fixed effect of CaO or Ca(OH)2 treatment
[3] Pellet x CaO/Ca(OH)2 treatment interaction
[4] Statistics calculated on Gain:Feed

## Corn silage

With increase price of corn grain, corn silage may be a more economical feed to replace a portion of the corn grain in beef finishing diets. Research 40 years ago focused on the impact of different corn silage to corn grain ratios. It was not uncommon in that time period to finish cattle on corn silage-based diets. A summary done by the University of Minnesota suggested that silage could be fed at 40 to 60% inclusion and still be economical, although feed conversion is elevated.

With the increased usage of distillers grains, our questions were whether this research area needed to be revisited. Three feedlot experiments have focused on feeding elevated amounts of corn silage (varying) in diets with distillers grains (varying). In the first experiment, we fed 15, 30, 45 or 55% corn silage with diets that contained 40% distillers grains and two additional diets with 45% corn silage and no distillers and 30% corn silage with 65% MDGS (Burken et al., 2013a). As corn silage increased in the diet within diets containing 40% MDGS, ADG decreased linearly and F:G increases linearly (Table 8). Within diets containing 45% silage, feeding 40% MDGS resulted in better ADG and F:G compared to feeding corn as you would expect. We concluded that feeding more (i.e., 30 to 45%) than traditional amounts of silage (i.e., 15%) may be economical (Burken et al., 2013b) despite slightly lower ADG and poorer F:G. This study design does not really answer though whether feeding greater amounts of silage works better today (with distillers in the diet) compared to historical data.

Two additional experiments were conducted with exactly the same treatment design. The first one was with fall yearlings that were large when they started and fed during some inclimate weather (Burken et al., 2014). The second experiment was conducted over the summer with summer-fed yearlings (Burken, unpublished data). The treatment design was five treatments designed as a 2×2 plus 1 factorial. We fed either 15 or 45% corn silage in diets with either 20 or 40% corn silage along with a control diet that contained 40% MDGS and 5% corn stalks. In the first experiment, cattle fed the control performed similarly to the 40% MDGS with 15% corn silage suggesting the roughage source (stalks or silage) did not impact performance (Table 9). Feeding 45% silage decreased ADG and increased F:G compared to feeding 15%. However, the change in ADG and F:G was less when diets contained 40% MDGS as compared to 20% inclusion of MDGS.

In the second experiment with the same design, steers fed the control diet had numerically lower ADG and greater F:G compared to cattle fed 15% silage along with 40% MDGS suggesting that stalks were not as good of a roughage source as the corn silage. Steers fed 45% silage ate more than cattle fed 15% silage (Table 10) regardless of MDGS inclusion. Steers also gained less when fed 45% silage at both inclusions of MDGS as compared to 15% silage and so F:G was greater or poorer when silage was increased. However, no interaction was observed between silage inclusion and MDGS inclusion. Feeding 45% corn silage with 40% MDGS increased F:G by 5.4% compared to 15% silage in diets with 20% MDGS. Feeding 45% corn silage with 20% MDGS increased F:G by 5.9% compared to 15% silage, or about the same amount.

Should feeders use more than 15% corn silage to replace expensive grain? The answer to this question depends on economics. Much of the previous work on feeding silage used incorrect economics. How silage is priced relative to corn grain is quite complex and will be discussed. The data suggest that if we can ensile drier silage without a yield drag and without increased shrink, then feeding elevated amounts of silage (i.e., greater than 15%, perhaps 30 to 40% inclusion) is economical when grain is above $3.50 per bushel.

**Table 8.** Effect of corn silage and MDGS inclusion on cattle performance and carcass characteristics (Burken et al., 2013a).

| | Treatment[1] | | | | | | P-value[2] | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 15:40 | 30:40 | 45:40 | 55:40 | 30:65 | 45:0 | Lin. | Quad. | 30 | 45 |
| DMI, lb/day | 23.15 | 22.77 | 22.70 | 21.92 | 21.66 | 22.26 | 0.01 | 0.45 | 0.01 | 0.30 |
| ADG, lb[3] | 4.04 | 3.92 | 3.76 | 3.53 | 3.62 | 3.55 | <0.01 | 0.19 | <0.01 | 0.02 |
| Feed:Gain | 5.73 | 5.81 | 6.03 | 6.21 | 5.98 | 6.28 | <0.01 | 0.33 | 0.12 | 0.04 |
| 12th-rib fat, in | 0.55 | 0.53 | 0.52 | 0.43 | 0.50 | 0.49 | <0.01 | 0.09 | 0.29 | 0.29 |
| Marbling Score[4] | 556 | 557 | 543 | 532 | 547 | 539 | 0.13 | 0.52 | 0.55 | 0.85 |

[1] 15:40= 15% Corn Silage, 40% MDGS; 30:40= 30% Corn Silage, 40% MDGS; 45:40= 45% Corn Silage, 40% MDGS; 55:40= 55% Corn Silage, 40% MDGS; 30:65= 30% Corn Silage, 65% MDGS; 45:0= 45% Corn Silage, 0% MDGS.

[2] Lin. = P-value for the linear response to corn silage inclusion, Quad.= P-value for the quadratic response to corn silage inclusion, 30 = t-test comparison of treatments 30:40 and 30:65, 45 = t-test comparison of treatments 45:40 and 45:0.

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

[4] Marbling Score: 400=Slight00, 500=Small00.

**Table 9.** Effect of corn silage and MDGS inclusion on cattle performance and carcass characteristics with large yearlings (Burken et al., 2014).

| | Treatment[1] | | | | | P-value[2] | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Control | 15:20 | 15:40 | 45:20 | 45:40 | F-test | Int. | Silage | MDGS |
| DMI, lb/day | 29.1 | 29.5 | 28.7 | 29.5 | 29.8 | 0.48 | 0.24 | 0.34 | 0.47 |
| ADG, lb[3] | 3.70[ab] | 3.95[a] | 3.64[b] | 3.44[b] | 3.62[b] | 0.09 | 0.08 | 0.06 | 0.59 |
| Feed:Gain[3] | 7.87[ab] | 7.46[a] | 7.87[ab] | 8.55[c] | 8.20[bc] | 0.01 | 0.08 | <0.01 | 0.71 |
| HCW, lb | 864 | 877 | 858 | 849 | 858 | 0.12 | 0.09 | 0.08 | 0.57 |
| 12th-rib fat, in | 0.47 | 0.47 | 0.50 | 0.47 | 0.48 | 0.65 | 0.82 | 0.65 | 0.20 |
| Marbling Score[4] | 540[b] | 583[a] | 548[b] | 554[b] | 532[b] | 0.03 | 0.54 | 0.05 | 0.02 |

[1] 15:20 = 15% Corn Silage, 20% MDGS; 15:40 = 15% Corn Silage, 40% MDGS; 45:20 = 45% Corn Silage, 20% MDGS; 45:40 = 45% Corn Silage, 40% MDGS

[2] F-test= P-value for the overall F-test of all diets. Int. = P-value for the interaction of corn silage X MDGS. Silage = P-value for the main effect of corn silage inclusion. MDGS = P-value for the main effect of MDGS inclusion.

[3] Calculated from hot carcass weight, adjusted to a common 62% dressing percentage.

[4] Marbling Score: 400=Slight00, 500=Small00.

[abcd] Within a row, values lacking common superscripts differ ($P < 0.10$).

**Table 10.** Effect of corn silage and MDGS inclusion on cattle performance and carcass characteristics with summer yearlings (Burken et al., unpublished; 2015 Beef Report).

| | Treatment[1] | | | | | P-value[2] | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Control | 15:20 | 15:40 | 45:20 | 45:40 | F-test | Int. | Silage | MDGS |
| **Performance** | | | | | | | | | |
| DMI, lb/day | 27.6 | 26.5 | 26.8 | 27.3 | 27.1 | 0.13 | 0.41 | 0.08 | 0.86 |
| ADG, lb[3] | 4.69 | 4.62 | 4.79 | 4.54 | 4.58 | 0.11 | 0.19 | 0.01 | 0.06 |
| Feed:Gain[3] | 5.88[bc] | 5.71[ab] | 5.59[a] | 6.02[c] | 5.92[c] | <0.01 | 0.63 | <0.01 | 0.09 |
| **Carcass Characteristics** | | | | | | | | | |
| HCW, lb | 893 | 887 | 898 | 879 | 882 | 0.18 | 0.41 | 0.02 | 0.13 |
| LM area, in$^2$ | 13.2 | 13.2 | 13.1 | 13.2 | 12.8 | 0.62 | 0.39 | 0.38 | 0.16 |
| 12$^{th}$-rib fat, in | 0.66 | 0.64 | 0.70 | 0.64 | 0.64 | 0.43 | 0.27 | 0.24 | 0.26 |
| Calculated YG | 3.83 | 3.75 | 3.98 | 3.71 | 3.85 | 0.54 | 0.66 | 0.44 | 0.10 |
| Marbling Score[4] | 450 | 437 | 459 | 454 | 431 | 0.74 | 0.12 | 0.72 | 0.98 |

[1] 15:20 = 15% Corn Silage, 20% MDGS; 15:40 = 15% Corn Silage, 40% MDGS; 45:20 = 45% Corn Silage, 20% MDGS; 45:40 = 45% Corn Silage, 40% MDGS

[2] F-test= P-value for the overall F-test of all diets. Int. = P-value for the interaction of corn silage X MDGS. Silage = P-value for the main effect of corn silage inclusion. MDGS = P-value for the main effect of MDGS inclusion.

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

[4] Marbling Score: 400=Slight00, 500=Small00.

[abcd] Within a row, values lacking common superscripts differ ($P < 0.10$).

For more information on our research in both of these areas, please visit our beef website (beef.unl.edu). We hosted a UNL Extension meeting at our Ag Research and Development Center near Mead, NE on June 20, 2012 focused on residue usage. This meeting was archived so presentations and slides are available at http://beef.unl.edu/cornresidues for the direct link. All of these data are available in the Nebraska Beef Reports which can be accessed at: http://beef.unl.edu under "reports" at the top of the page. In addition, numerous live webinars are available at the beef website on corn silage use, shrink and storage, and economics.

## Specific citations from beef reports


Burken, D. B., B. L. Nuttelman, T. J. Klopfenstein, and G. E. Erickson. 2013a. Feeding elevated levels of corn silage in finishing diets containing MDGS. Neb. Beef Cattle Rep. MP98:74-75.

Burken, D. B., T. J. Klopfenstein, and G. E. Erickson. 2013b. Economics of feeding elevated levels of corn silage in finishing diets containing MDGS. Neb. Beef Cattle Rep. MP98:76-77.

Burken, D. B., B. L. Nuttelman, T. J. Klopfenstein, and G. E. Erickson. 2014. Feeding elevated levels of corn silage and MDGS in finishing diets. Neb. Beef Cattle Rep. MP99:88-89.

Cooper, R., B. Dicke, D. J. Jordon, T. Scott, C. Macken, and G. E. Erickson. 2014. Impact of feeding alkaline-treated corn stover at elevated amounts in commercial feedlot cattle. Neb. Beef Cattle Rep. MP99:69-71.

Johnson, J. M., D. B. Burken, W. A. Griffin, B. L. Nuttelman, G. E. Erickson, T. J. Klopfenstein, M. J. Cecava, and M. J. Rincker. 2013. Effect of feeding greater amounts of calcium oxide treated corn stover and Micro-Aid on performance and nutrient mass balance. Neb. Beef Cattle Rep. MP98:70-73.

Peterson, S. J., B. L. Nuttelman, C. J. Schneider, D. B. Burken, J. C. MacDonald, and G. E. Erickson. 2014a. Optimum inclusion of alkaline-treated cornstalks and distillers grains fed to calf-fed steers. Neb. Beef Cattle Rep. MP99:72-74.

Peterson, S. J., B. L. Nuttelman, D. B. Burken, J. C. MacDonald, and G. E. Erickson. 2014b. Use of treated corn residues in growing diets. Neb. Beef Cattle Rep. MP99:62-63.

Shreck, A. L., C. D. Buckner, G. E. Erickson, T. J. Klopfenstein, and M. J. Cecava. 2011. Digestibility of crop residues after chemical treatment and anaerobic storage. Neb. Beef Cattle Rep. MP94:35-36.

Shreck, A. L., B. L. Nuttelman, W. A. Griffin, G. E. Erickson, T. J. Klopfenstein, and M. J. Cecava. 2012a. Chemical treatment of low-quality forages to replace corn in cattle finishing diets. Neb. Beef Cattle Rep. MP95:106-107.

Shreck, A. L., B. L. Nuttelman, W. A. Griffin, G. E. Erickson, T. J. Klopfenstein, and M. J. Cecava. 2012b. Reducing particle size enhances chemical treatment in finishing diets. Neb. Beef Cattle Rep. MP95:108-109.

Shreck, A. L., J. L. Harding, G. E. Erickson, T. J. Klopfenstein, and M. J. Cecava. 2013a. Evaluation of rumen metabolism and digestibility when treated crop residues are fed in cattle finishing diets. Neb. Beef Cattle Rep. MP98:58-59.

Shreck, A. L., C. J. Schneider, B. L. Nuttelman, D. B. Burken, G. E. Erickson, T. J. Klopfenstein, and M. J. Cecava. 2013b. Varying proportions and amounts of distillers grains and alkaline-treated forage as substitutes for corn grain in finishing cattle diets. Neb. Beef Cattle Rep. MP98:56-57.

Shreck, A. L., B. L. Nuttelman, C. J. Schneider, D. B. Burken, C. N. Macken, W. A. Griffin, G. E. Erickson, and T. J. Klopfenstein. 2014. Alkaline treated wheat straw or corn stover fed to growing calves. Neb. Beef Cattle Rep. MP99:67-68.

# New uses of stover: Stalklage as alternative forage

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## Introduction

In 2013, Illinois, Iowa, Wisconsin, and Minnesota represented 40% of the nation's planted corn acres (12.5%, 14.3%, 9.0%, and 4.3% respectively). Yields in IL, IA, and MN were all above the national average (NASS). High yields and high acreage results in an abundance of corn residue. High levels of residue are becoming a challenge for corn farmers, especially those in a continuous corn rotation.

From 1975 to 2005 the average price of corn grain was $2.37/bu. From 2006 to 2012 the average price of corn grain was 4.89/bu.(NASS). These elevated prices apply pressure to investigate alternative feeds and additional forage levels in cattle rations. Because of the vast amount of corn stover available in the Midwest, it is logical to investigate the potential for its use in cattle rations.

Land values have been on a steep climb the last few years. Cropland values for IL, IA, MN, and WI have increased 17%, 23%,24%, and 7.1% respectively between 2011 and 2012. They increased again from 2012 to 2013 (IL – 16%, IA- 18%, MN- 20%, WI – 2%). Even pastureland values have steadily climbed upward. Illinois was up 11% in 2012 and another 19% in 2013. Iowa was up 13% in both '12 and'13. Minnesota gained 7% in '12 and 17% in '13. Wisconsin has been steady at around 1% in the last two years. These increases in land prices provide more incentive for intensive cropping systems and investigation into stover value.

Increasing amounts of residue, expensive feed prices, and record high land values may support a look into stover removal for livestock feed.

## Uses of corn stover

Corn stover has primarily been used as bedding and a low-quality forage for beef cattle. Although it has been intensely looked at as a fuel stock for burning and cellulosic ethanol, very little infrastructure has been developed in that area.

The best use of corn stover is grazing. Numerous data have shown the advantages of grazing crop residue. Cattle graze selectively, looking for the more palatable feedstuffs. In the case of cornstalk grazing, the more palatable parts of the plant are also more nutritious. Cattle first eat the remaining corn grain, then husks, then leaves, and finally the stalk.

The cost of grazing cornstalks is low; first because the cows graze and harvest their own feed and second, because all costs to produce the plant for grain production are attributed to the row-crop operation. Even with the cost of a temporary fence (which many farmers already have) and water, grazing cornstalks is more economical than feeding high-priced hay.

Grazing stalks can also have benefits for subsequent crops. Cows grazing cornstalks for 60 days will remove approximately 30 to 40 percent of the residue. Residue buildup has been a well-documented problem in many corn-on-corn fields with new hybrids. Cows deposit nutrients in the form of manure back on the field. As they graze, they reduce volunteer corn, considered a weed and a yield-robber in soybean fields

Grazing should be the first option for utilizing corn stover. However, many times fencing, water, and rental agreements limit cornstalk grazing opportunities.

Mechanically harvesting corn stover may be the only option in some cases. Baling corn stover will add costs in the form of fuel, labor, equipment costs, and fertilizer replacement costs. Even with these costs, it can still be an economical feed. Hauling manure back to the harvested fields will displace some fertilizer costs associated with stover removal.

If you consider harvesting corn stover mechanically, you must sharpen your pencil. Costs listed in the previous paragraph along with wear and tear on equipment can easily add enough cost to make corn stover less attractive as harvested forage.

Other challenges exist in baled corn stover. Stover bales that contain a high percentage of stalk will be higher in waste and less palatable. Bales that are higher in moisture also are prone to waste and severe palatability problems. Grinding bales to reduce particle size is a common strategy to mitigate these issues, however forcing cattle to eat bales that are contaminated with mold is strongly discourages. Contaminants, such as dirt, can also be high and reduce feed value of stover.

## High moisture stover for stalklage

Palatability and waste are among the largest factors limiting corn stover use as a livestock feed. Harvesting corn stover at a high moisture may allow for similar processing and ensiling potential as seen in corn silage. Nutrient analysis of the corn stover that is more immature may also be more attractive as a feedstuff.

### *Corn conditions*

An agreement with a local corn grower was reached to harvest corn silage and corn stover from the same acreage, same hybrids, same fertilizer level, and same management. Corn was planted on April 7th, 2013. This was one of the first available planting dates in the area. The field consisted of two modern GMO hybrids that were each planted at 50% of the total seed and distributed uniformly throughout the field. The fertilizer rate was moderate to high and typical of the area. Fungicide was applied to the crop.

### *Harvesting method*

High moisture corn was harvested with a newer model John Deere combine equipped with an 8 row head. The chaff spreader was turned off at the rear discharge of the machine. This allowed the combine to deposit harvest trash in a windrow. The windrow consisted of primarily husks, cobs, and some leaf. Within 24 hours of high moisture corn harvest, a discbine mower was used to mow the remaining stalk. The discbine pass resulted in 4 rows of the stalks to be included with the combine windrow.

A chopper equipped with a hay harvesting head was used to harvest the windrow. The stover was chopped into wagons which were used to transport the product to the bagging site. The stover was inoculated at the bagger. A water hose was ran (4 gal per minute) in the holding chamber on the bagger. The goal of the additional water was to incorporate the dry inoculant, not to increase moisture of the stalklage. The bagger was ran at approximately 40 psi. The stover was bagged and sealed for storage.

### *Nutrient analysis of feedstuffs*

**Table 1.** Nutrient analysis of Feedstuffs

| | Stalklage | Corn Silage | Hay |
|---|---|---|---|
| Moisture, % | 53.4 | 54.7 | 9.9 |
| DM, % | 46.6 | 45.3 | 90.1 |
| CP,% | 5.4 | 6.8 | 10.0 |
| Soluble Prot, % | 44.3 | 36.8 | 28.0 |
| ADF, % | 43.1 | 22.1 | 39.5 |
| NDF, % | 68.2 | 39.6 | 59.6 |
| Lignin, % | 4.2 | 2.1 | 6.9 |
| Fat, % | 0.8 | 3.0 | 1.4 |
| Starch, % | 4.5 | 37.5 | |
| Ash, % | 7.1 | 3.6 | 6.9 |
| IVDMD, % | 53.2 | 70.6 | 48.7 |
| NDFD-30, % | 45.4 | 45.2 | 41.6 |
| pH | 3.4 | 4.1 | |
| Nitrate-N, ppm | 77 | 43 | 28 |
| NEL, mcal/lb | 0.52 | 0.77 | 0.59 |
| NEM, mcal/lb | 0.48 | 0.69 | 0.47 |
| NEG, mcal/lb | 0.24 | 0.42 | 0.22 |
| iron, ppm | 708 | 73 | 113 |
| RFV | | | 90 |
| RFQ | | | 98.4 |

*Diets*

**Table 2.** Composition of diets on a dry matter percentage basis

| Ingredient | Stalklage Diet | Corn Silage Diet | Hay Diet |
|---|---|---|---|
| Stalklage | 60.0 | - | - |
| Corn Silage | - | 60.0 | - |
| Ground Hay | - | - | 60.0 |
| Ground Cornstalks | 25.0 | 25.0 | 25.0 |
| Corn Gluten Feed | 15.0 | 15.0 | 15.0 |

Diets were limit fed for a DMI at or above 1.5% body weight. Feed was delivered in fenceline bunks at approximately 8:00AM each day. No feed refusal was observed during the trial.

## Summary

Corn stover is abundant and ubiquitous throughout the Midwest. There is many opportunities for cattlemen to utilize corn stover as a low-cost forage alternative. The best option remains grazing. However, many circumstances prohibit grazing and thus mechanical harvest of corn stover needs to be further investigated. Harvesting corn stover at a high moisture may allow cattle farmers to produce a more palatable feed with less waste. Thus, eliminating two of the major challenges corn stover presents as a feedstuff. Harvesting high moisture corn may be a current practice for feedlots and larger farming operations. Earlier harvest dates associated with high moisture corn harvest may also be conducive to cover crop establishment and subsequent yields of cover crops. Producing stalklage as a forage may be part of a system that yields more value per acre, thus helping farmers deal with elevated land costs.

# Considerations for managing beef cows in confinement

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## Introduction

Continued volatility of grain markets, coupled with recent summer droughts, has had a significant impact on the Midwestern cow-calf sector in recent years. These factors, along with decreased land availability for grazing and forage production, has resulted in increased cost of production and left many producers pondering alternative management systems for their herds. One such management alternative that is capturing the interest of many producers is the concept of confinement housing of the cow herd. In many parts of the United States, where year-round grazing is either not feasible, or is not implemented, confinement housing of the cow herd is not necessarily a novel practice. Often times, cows are placed on a sacrifice paddock or drylot with varying degrees of access to shelter for a period of time during the winter months, leading up to and sometimes through the calving season. However, with reduced land access and increasing forage prices, an increased proportion of producers are managing cows in confinement during times of the year traditionally devoted to grazing. With these management alterations come various considerations that should be acknowledged.

## Yardage and facilities

Spacing needs per cow-calf unit will vary depending on the confinement system being implemented. If utilizing a drylot scenario, a general rule of thumb is 500-800 square feet per pair, although recent studies at the University of Nebraska and North Dakota State University have used 400 and 1200 square feet per pair, respectively. However, in well drained soils and lots that have mounded areas, it may be possible to maintain performance on as little as 250-300 square feet per cow-calf unit. In an under-roof scenario where cows are not given access to a drylot, most recommendations suggest a minimum of 80 square foot per pair, with a 120 square foot or more needed per pair if the same pen is utilized for calving. Also, though not a requirement, it is strongly suggested that first calf heifers are able to be individually penned at calving to allow for bonding time and ensure adequate colostrum intake by the calf. If utilizing lower-end square footage recommendations for under roof confinement, a creep or refuge area that only calves have access to should be considered.

If new facilities are not being constructed and adaptations to existing structures and lot are being made, bunk space is often the limiting factor. If using a fence-line bunk system, plans should be made for 24 inches of linear bunk space per gestating cow, and up to 36 inches per cow-calf pair to include a calf at side that may consume feed. If utilizing bunks where cows and calves can eat from both sides simultaneously, 48-60 inches of linear bunk space should be allotted depending on cow size. As with any cow-calf system, best management practices include separating fist-calf heifers from the remainder of the herd and dividing young and old cows into separate groups if feasible. If facilities restrict the ability of group separation, then increasing bunk space may be necessary to ensure that subordinate cows have ample access to the feed needed to support their current stage of production.

## Calving and health

In a similar manner to yardage, calving and health considerations may be heavily dependent on the type of management system that is in place. Drylotting vs. "under-roof" confinement, as well as duration of confinement will play a role in how cow-calf health should be monitored. From a calving perspective, confinement offers better opportunities to monitor, catch, and provide assistance to cows during parturition. Because 80% of calves lost at birth are "normal," but likely die due to delayed calving, the ability to more easily intervene during labor is likely of significant monetary impact. Moreover, as cows with increased calving difficulty (dystocia) have a delayed interval between calving and resumption of estrous cycles, better assistance at calving may help better maintain a yearly calving interval in some herds. However, more post-natal intervention may be required by the producer when calving in a confined space. In a 2001 study, Kjaestad and Simensen reported reduced mothering, dam/calf bonding, and colostrum intake as calving area decreased from pasture, to a calving pen, to a "cubicle". Moreover, as parturition is viewed by many as an "athletic" event, some producers question if confinement results in less "fit" cows which actually increases the risk of dystocia. This is highly speculative, but a hypothesis that may warrant further research as more cows are maintained in smaller areas for longer stretches of time.

In terms of herd health, a hot topic in regards to confinement is how such a practice may impact calf scours. In a survey conducted by the USDA and Kansas State University (2000), results suggested that calving in confinement was associated with an increased risk of calf sickness. Particularly as calves can contract a multitude of pathogens that cause scours within the first 3 weeks of life, cleanliness of calving facilities is paramount. With this being said, intensive management can often prevent a scours outbreak. Frequent cleaning and bedding of the calving area will help minimize pathogen load; however, with high stocking density it can be difficult to clean and bed adequately to maintain a sanitary environment for newborn calves. Separating pairs from pregnant cows can be helpful, but moving pairs from a centralized gestation/calving area can still allow significant pathogen build-up in the gestation/calving area. The Sandhills Calving System (Roybal, 2007) works on the premise that calves born into a "pathogen-free" environment will maintain better health. Thus, cows that have yet to calve are moved to a new pasture/paddock on a weekly basis to avoid pathogen build-up. In a confinement system, this scheme becomes more challenging, but modified Sandhills Systems can be implemented and combined with increased cleaning and bedding to dramatically reduce scour risk.

Finally, as with any confinement setting, foot and leg issues should be considered and measures taken when possible to reduce impact. Cows and calves in confinement should be monitored regularly for footrot, hairy heel warts, and lameness. Because infectious diseases such as respiratory disorders can spread more readily in confined spaces animals should be monitored closely for those conditions as well.

## Feeding

Perhaps the most attractive component of extended confinement is the ability to better control feed costs and intake. In some instances, managing through confinement fosters a better opportunity to control access to baled forage or implement utilization of a TMR to control feed delivery and reduce waste. Depending on baling and storage method, grinding and feeding forage using a TMR can reduce waste from 25% to as little as 5% (perhaps less). Mixing and grinding machinery may represent an increased equipment cost, but if forage is limited or of poorer quality, grinding and mixing may facilitate the development of more economical rations. While use of a TMR may allow for incorporation of various other cost-effective feeds into the ration, it is important to maintain a forage-base in the diet of at least 0.5% of the cow's body weight on a dry matter basis to maintain proper rumen health. It should be noted that this minimum proportion of forage in the diet will be at least double the minimum amount of forage in traditional feedlot rations. If designing a new facility, larger bunk or more bunk space may be considered to allow for delivery of increased volume. If using existing bunks, multiple daily feed deliveries may be necessary.

In the scenario that confinement of cattle is completely under roof, at least during the winter months, it is expected that providing a wind break and a more comfortable environment may slightly reduce energy requirements for maintenance. However, more research is needed to fully elucidate how dramatic those alterations in energy requirements may be. In a year-round dry lot scenario, when compared to cows that were allowed to graze for 6 months of the year, Anderson et al. (2013) reported that annual cash (feed) costs for cows in confinement was approximately $62 more than cows allowed on pasture ($519 vs. $457 for drylot confinement and pasture cows, respectively). It should be noted that these figures include pasture rental rates but do not include fixed costs of the facility in the dry lot scenario. However, using partial budgeting, creep feed costs were reduced and adding the value of manure of the drylot cows resulted in a net cost/pair/year of $580 vs $557 for drylot and pasture cows, respectively.

## Economic considerations for equipment and facilities

Costs per unit and net returns in cow-calf production are highly dependent on production levels. Production levels vary for a number of reasons including quality or genetics of cattle, weather, input levels, and management. As such, any alterations to management should consider changes to expected production levels. For example, altering how cows and calves are managed could lead to varying differences in weaned calf percentages and/or calf weaning weights. These differences could be short-lived or last for a number of years. Considering changes to expected production levels can help producers examine the financial risk that is directly related to production risk of the enterprise. Note, for budgeting purposes, if production levels reflect production variability due to management as opposed to the quality of cattle produced, values should be held constant.

Beef cow herds are capital-intensive enterprises and should be viewed as other capital investments. Like other assets there is an initial investment followed by a stream of future earnings that provides a return on the original investment. The same rationale can follow for an investment in a system to manage beef cows. The decision to make an investment in equipment and/or facilities can be treated as a straight-forward capital budgeting problem. Capital budgeting can help in the planning process by determining if an investment is worth the capital expenditure. Capital requirements for equipment and/or facilities can vary greatly and will warrant considerable attention as an input in this process.

It is well known that production costs for cow-calf producers fluctuate considerably over time and year-to-year swings can be extreme. Some of this variability across time is due to macro-economic factors that producers have limited ability to manage. While producers might not be able to influence overall market conditions, they do have control of costs at the farm-level.

How cows are managed can have an impact, to varying degrees, on operating and fixed costs. Operating costs are the costs associated with actual production and include items such as feed, labor, and utilities. Fixed costs are costs that are incurred after a facility is built or equipment is installed regardless of continued use of a particular facility or piece of equipment. Fixed costs—depreciation, interest, repairs, taxes, and insurance on buildings and equipment — are functions of construction cost and expected useful life. Fixed costs, as a percentage of total costs can vary considerably depending on how facilities and/or equipment are utilized.

Producers assessing the economic situation presented by altering management of their beef cow herd will want to base the analysis on the most likely assumptions. The resulting analysis may then be evaluated in relation to the risks associated with not being able to precisely predict the future. Any investment return is a function of both revenue and costs so consideration of production levels (e.g., weaned calf percentages, calf weaning weights, etc.) and operating and fixed costs corresponding to the lifespan of the investment is needed.

## Conclusion

The changing landscape of beef production has given way to new managerial considerations for cow-calf producers. Adapting longer periods of confinement to better utilize available forage resources and control feed costs may be an economically viable opportunity for producers. However, inherent risks associated with herd health and proper space must be keenly addressed to ensure potential gains in feed expenditures are not offset due to other production measures. Ultimately, producers are encouraged to evaluate all opportunities as the best scenario will be highly individualized and dependent on multiple factors.

## References

Anderson, V. L., B. R. Ilse, and C. R. Engel. 2013. Drylot vs. pasture beef cow/calf production: 3 year progress report. Personal communication. Online summary found at: http://www.ag.ndsu.edu/CarringtonREC/documentsnew-1/video-handouts/2013/field-day-2013/drylot-vs-pasture-handout/view. Accessed 01/10/2014.

Kjaestad, H. P., and E. Simensen. 2001. Cubicle refusal and rearing accommodations as possible mastitis risk factors in cubicle-housed dairy heifers. Acta. Vet. Scand. 42(1):123-130.

Roybal, Joe. 2007. Sandhills calving system aids in fighting scours. Beef Magazine. http://beefmagazine.com/cowcalfweekly/sandhills-calving-system-scours. Accessed 01/07/2014.

# ISU Feedlot Monitor – v3

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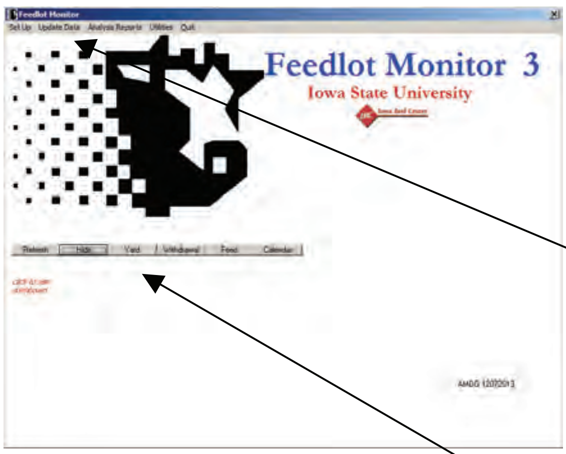
Versions of the ISU Feedlot and Cost Monitoring Software have been in place since 1982 and the latest version is now available upon request from the Iowa Beef Center. Although the mechanics of computer operation tend to take most of the attention of what is presented, this software has given a face to a long time philosophy held by the Iowa Beef Center that cattle feeding operations need to objectively measure, monitor and react appropriately to livestock and financial performance on a continuous basis in order to better manage the events of tomorrow from known current and historical data. This software provides an affordable means to compile cattle feeding financial and performance information and to assist in the interpretation of what is occurring.

The updated version allows for the same feed to beef focus as previous versions. Therefore feeding period summaries, projections, closeouts, itemized account records and custom feeding invoice statements are still standard. The provision to allow for individual animal monitoring and projections as is necessary for heifer and bull development has been made. Along with this feature, animal health issues have a greater focus with the new release giving an opportunity to track drug inventories as one would do with a feed inventory and allow processing and treatment protocols to be imported from a consultant. Cost and income channels are more flexible in terms of defining and recording the production inputs and outputs being tracked. Environmental issues dealing with nutrient excretion, weather and manure logistics are easy to tie in and report on to satisfy some of the DNR / EPA reporting requirements. Finally, the renewed interest in benchmarking has been addressed with the ease of compiling and reporting closeout data via the internet.

Access to the new Feedlot Monitor software is possible by contacting the Iowa Beef Center at 515 294 2333. Cost is $600 for new users and $200 for existing users to upgrade. Look for information, demonstrations, troubleshooting guides and program add-ons to appear on the Iowa Beef Center website (www.iowabeefcenter.org) in time.




**Five primary areas**

- SetUp - use to define inventories and identify frequently used inputs.
- Update Data – use to provide routine data.
- Analysis Reports – use to generate summary reports, edit and evaluate data.
- Utilities – Use to import, export, archive and clear data.
- Dashboard – quick reference to compiled data.

## Example Feeding Period Output

| Period | DoF | Wt | ADG | F:G | AFI | DMI | % DM | Intake%BWt | $Feed | $Total | $Int. | L-Brk | C-Brk | NEg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 07/15-07/19 | 5 | 764 | 2.49 | 7.2 | 31.7 | 17.9 | 56.6 | 0.92 | 2.38 | 0.74 | 0.95 | 0.05 | 148.73 | 260.59 | 0.49 |
| 07/20-08/02 | 19 | 820 | 3.99 | 5.6 | 41.1 | 22.3 | 54.2 | 1.13 | 2.91 | 0.60 | 0.74 | 0.03 | 143.68 | 250.54 | 0.52 |
| 08/03-08/16 | 33 | 891 | 5.07 | 5.1 | 44.8 | 26.0 | 57.9 | 1.28 | 3.15 | 0.57 | 0.67 | 0.03 | 137.56 | 240.25 | 0.57 |
| 08/17-08/30 | 47 | 967 | 5.39 | 4.7 | 45.7 | 25.2 | 55.1 | 1.23 | 2.82 | 0.57 | 0.67 | 0.03 | 132.07 | 232.42 | 0.66 |
| 08/31-09/13 | 61 | 1012 | 3.24 | 5.9 | 34.2 | 18.9 | 55.1 | 0.87 | 1.95 | 0.71 | 0.88 | 0.04 | 130.10 | 229.61 | 0.66 |
| 09/14-09/27 | 75 | 1081 | 4.93 | 5.2 | 46.5 | 25.8 | 55.5 | 1.15 | 2.54 | 0.58 | 0.69 | 0.03 | 126.26 | 223.79 | 0.66 |
| 09/28-10/11 | 89 | 1148 | 4.81 | 5.5 | 48.0 | 26.7 | 55.5 | 1.13 | 2.46 | 0.61 | 0.72 | 0.03 | 123.15 | 219.88 | 0.66 |
| 10/12-10/25 | 103 | 1215 | 4.78 | 5.8 | 50.0 | 27.8 | 55.5 | 1.13 | 2.41 | 0.63 | 0.74 | 0.03 | 120.54 | 216.46 | 0.66 |
| 10/26-11/08 | 117 | 1271 | 4.02 | 6.4 | 46.2 | 25.7 | 55.5 | 1.00 | 2.11 | 0.69 | 0.83 | 0.04 | 118.94 | 214.58 | 0.66 |
| 11/09-11/22 | 131 | 1317 | 3.26 | 7.7 | 45.1 | 25.0 | 55.5 | 0.94 | 1.97 | 0.83 | 1.00 | 0.05 | 118.36 | 215.00 | 0.66 |

Performance to date    Period performance    Costs / lb gain    Breakeven Live and Carcass

Marketing signal (drop in dry matter intake, and dry matter intake as a percent of body weight)

## Example Closeout

```
Feeding Lot:  7-15h5                                       Date Fed: 07/15/2013 - 11/22/2013

DESCRIPTION                    FEED           TOTAL $    TOTAL lbs   % DM  DM/HD    $/UNIT
=========================      ==============================================================
Management: Conventional       corn           17662.6     131872     84    879.1     7.5
Facility:    open              modified        7210.3     143481     47    535.2   100.5
yearling  -females-beef        gluten          4910.7     126124     42    420.4    77.9
Head Started: 126  (767 lb)    ccds            4633.3     175876     32    446.7    52.7
Head Sold:    126  (1202 lb)   grass hay        176.3       3523     90     25.2   100.1
Mortality:   0.0%              bean stubble     793.4      52785     90    377.0    30.1
                               balancer        3827.1      24728     67    131.5   309.5
PURCHASE LOT/ SOURCE           mog              540.8      36054     55    157.4    30.0
                               hominy          5831.8      68741     90    491.0   169.7
NOTES:

ANIMAL PERFORMANCE             COST SUMMARY          $/UNIT          $/HD SOLD   TOTAL $
=========================      ==========================================================
Total Beef In:    96642 lb     feed             171.65 $/tn DM   361.80      45,586.25
Total Beef Out:   151420 lb    interest           0.14 $/hd/d     19.35       2,438.37
                               yardage            0.39 $/hd/d     52.40       6,602.40
Feeding Days:     131          records            0.00 $/hd/d      0.32          40.00
Avg Days in Yard: 134.5        cattle             1.47 $/lb     1125.12     141,765.00
ADG:              3.23 lb      __________________________________________________________
Feed/Gain:        7.97         TOTAL COST                       1558.98     196,432.02
DMI (avg):        25.76 lb
AFI (avg):        45.04 lb     INCOME SUMMARY
Final NEg:        66 Mcal      ==========================================================
      eNDF:       11 %         cattle             1.28          1538.27     193,822.00
      NFC:        45 %         __________________________________________________________
                               TOTAL INCOME                     1538.27     193,822.00
           Intake    Pulls     NET INCOME        -0.02 $/lb      -20.71      -2,610.06
1st Qrt:   1.03       0
2nd Qrt:   1.13       0
3rd Qrt:   1.14       0
4th Qrt:   1.02       0        TOTAL POUNDS FED (AF): 763184   (DM): 436403   57.2 %DM
                               $ Loss on Dead/Missing Cattle:  Head:  0   $   0.00
$ PERFORMANCE
=========================
           Feed      Total
$/Day:     2.69      3.23
$/lb Gain: 0.83      1.00

Breakeven $/cwt:   129.73
less interest:     128.12
```

Feed Use Breakdown

Animal Performance Summary

Cost Summary

Income Summary

Bottom Line

# Health and nutritional strategies for managing incoming feedlot cattle

Nicole Kenney Rambo, University of Minnesota Extension

Managing newly received cattle presents challenges from both a nutritional and health standpoint; however, information about pre-arrival management of incoming feeder cattle has become increasingly available and can be utilized to refine arrival processing protocols. Previous management, nutrition and vaccination history impacts newly arrived cattle's capabilities of coping with the stress associated with feedlot entry. Utilizing the available information to more precisely identify the disease-risk of incoming groups of cattle will assist in determining expected investments in disease prevention and intervention as well as the associated labor involved.

## Morbidity

The level of morbidity in the feedlot is a strong driver of profitability due to the cumulative costs of treatment, reductions in performance during and following sickness as well as reduced carcass quality (Smith, 1998; Reinhardt et al., 2012). Bovine Respiratory Disease (BRD) is the most common cause of sickness in the feedlot and is attributed to complex interactions between viral and bacterial pathogens. The 2011 USDA Veterinary Services Feedlot Survey estimated that 16.2% of cattle placed in feedlots show signs of BRD at some point during the feeding period (USDA, 2013). In a study of morbidity from BRD from 102 reporting feedlots, with a total of 20,136 heifers and steers, a 5.9% incidence of morbidity was reported; however, cumulative pen incidence ranged from 0 to 80% (Sanderson et al., 2008). Decreases in performance and carcass merit have been associated with reductions in carcass values of $23.23, $30.15, and $54.01 per head for cattle treated for BRD once, twice, or 3 or more times, respectively (Schneider et al., 2009).

The majority of sickness in receiving cattle is typically observed during the first 21 days following feedlot arrival (Sanderson et al., 2008). The high rate of sickness during this period is attributed to the stress associated with transport, comingling and increased exposure to pathogens. Additionally, cattle are also challenged with adapting to a new environment, social hierarchy, and diet. Minimizing the risk of BRD during receiving is critical for maximizing the productivity and profitability throughout the entire finishing phase.

## Disease risk

Although it would be ideal to implement health management strategies on an individual basis, this is simply not feasible due to the intensive nature of maintaining precise records on individual animals as they move through the production chain and implementing multiple protocols when processing large numbers of cattle. Instead, loads of cattle are designated by disease-risk; typically, into low and high-risk groups and processing procedures are adjusted accordingly.

A number of factors contribute to the potential disease-risk of a population of cattle and include source, age, distance transported, previous health management, amount of comingling, shrink and weather conditions. Typically, cattle that have been freshly weaned, transported long distances, assembled from multiple small lots from an auction barn, or simply have inadequate information available about their history are considered high-risk. Calves that have been preconditioned and yearling cattle that originate from a single source are often treated as low-risk populations. Oftentimes groups of cattle may present factors from both high and low-risk characterizations. For example, a load of cattle may originate from a certified preconditioned sale, which suggests low-risk, however they may also be hauled a long distance and have been assembled from several smaller lots of preconditioned cattle. Table 1 gives an example of an expanded disease-risk classification based on various factors. Additional factors, such as distance cattle have been transported and the potential for large changes in weather conditions during receiving may necessitate moving a group up a level in disease-risk. Furthermore, receiving protocols for low-risk calves may differ from low-risk yearlings and so forth.

**Table 1.** Example disease-risk classifications for incoming feedlot cattle

| Disease - risk | Factors |
|---|---|
| **Calves** | |
| Low | Preconditioned, single source |
| Intermediate | Preconditioned, comingled |
| High | Freshly weaned, auction sourced |
| High | No information available |
| **Yearlings** | |
| Low | Yearling, single source w/ health information |
| Intermediate | Yearling, single source |
| High | Yearling, comingled |
| High | No information available |

## Receiving protocols

Basic considerations for receiving protocols include duration of time between arrival and processing, vaccination program, metaphylactic treatment, and parasite prevention. Increased likelihood of sickness warrants greater investments in preventative measures; however, tight margins necessitate reducing unnecessary expenditures.

The duration of rest following transportation varies greatly between feedlots, ranging anywhere from 0 to 72 hours. Transportation has been shown to cause immunosuppression (Carroll and Forsberg, 2007) which may impact animal's ability to acquire adaptive immunity in response to a vaccination (Kehrli et al., 1999). As such, it may be advantageous to allow cattle traveling longer distances a greater duration of time between arrival and processing. Additionally, when the information is available, it is important to consider the total duration of travel and not simply the final shipment to the feedlot.

The development of a successful vaccination program is dependent on both the efficacy of vaccines and timing of vaccination. Unfortunately, feedlot arrival is a less than desirable time for vaccination. Immunosuppressed cattle will not respond as favorably to vaccines and may be unable to develop the full immunity normally afforded by vaccination. Additionally, time is required to build adaptive immunity in response to vaccination and cattle will be immediately challenged with new and increased pathogen loads upon arrival. Ultimately, pre-arrival management is the best tool for developing immunity. Preconditioning programs, which aim to increase an animal's health status before they are shipped from the ranch of origin through more intensive health and nutritional management, have been shown to decrease the likelihood of BRD during receiving (Step et al., 2008). As such, preconditioned cattle are less likely to receive as many vaccinations at feedlot arrival, although most protocols call for all cattle to be vaccinated against IBR and oftentimes BVD type I and II. Recommendations for moderate to high-risk cattle are a 5 way respiratory vaccines (IBR, BVD type I and II, BRSV, PI3) as well as a clostridial vaccination, and vaccinations for *Mannheimia haemolytica* and *Pasturella multocida*.

A lot of emphasis is placed on the vaccination history of cattle prior to feedlot entry; however, the question should not simply be whether or not cattle were vaccinated but instead focus on the effectiveness of the vaccination program. Vaccine handling, time of administration, nutritional status of calves at time of vaccination as well as the amount of stress at time of vaccination all contribute to the effectiveness of a vaccination program. Oftentimes cattle that come through the sale barn are marketed as "having their shots"; however, these cattle are still typically classified as moderate to high-risk.

Metaphylaxis, mass treatment of cattle to prevent an expected disease outbreak, through both long-acting injectables and feed grade antibiotics has been shown to decrease respiratory disease and improve growth performance in groups of high-risk cattle (Nickell and White, 2010). Metaphylaxis is very frequently recommended for high risk cattle but generally not recommended for low risk cattle (Terrell, 2012). The decision to include a metaphylactic treatment for intermediate risk cattle will be dependent on their risk factors. Returning to the example of preconditioned, comingled cattle, transported a long distance, it may be beneficial to consider including a metaphylactic treatment especially if large changes in weather are anticipated.

## Interaction of nutrition and health

The nutrition and health status of feeder cattle are very closely inter-related. Poor nutritional status will impact an animal's ability to mount an immune response and sick cattle typically have reduced feed intakes. When first arriving at the feedlot, cattle will have been withheld from feed and water for varying durations of time dependent on the marketing channels and shipping distance. Even short periods of feed restriction negatively impact ruminal fermentation and ruminal capacity for nutrient absorption (Zhang et al., 2013). Stimulating intake is the main priority for newly arrived cattle; oftentimes, this is accomplished through provision of long stem highly-palatable hay at arrival. Although hay will serve to stimulate intake and establish normal gut fill, it is not nutrient dense enough to provide adequate nutrition. A number of various "step-up" programs, which transition cattle from high-roughage low-energy diets to concentrate-based high-energy diets, have been implemented successfully. Special considerations should be given to ensuring vitamin and mineral requirements of receiving cattle with low feed intakes are met.

## Conclusion

Ultimately, the development of receiving protocols is a complex and individualized process that requires close communication between feedlot operators, consulting veterinarians and nutritionists. The ability to vary receiving protocols will vary by feedlot and is highly dependent on good record keeping practices and well-trained personnel.

## References


Carroll, J. A., and N. E. Forsberg. 2007. Influence of stress and nutrition on cattle immunity. Veterinary Clinics of North America: Food Animal Practice. 23(1): 105-149.

Kehrli, M., J. Burton, B. Nonnecke, and E. Lee. 1999. Effects of stress on leukocyte trafficking and immune responses: Implications for vaccination. Adv. Vet. Med. 41: 61-81.

Nickell, J. S., and B. J. White. 2010. Metaphylactic antimicrobial therapy for bovine respiratory disease in stocker and feedlot cattle. Veterinary Clinics of North America: Food Animal Practice. 26(2): 285-301.

Reinhardt, C., M. Hands, T. Marston, J. Waggoner, and L. Corah. 2012. Relationships between feedlot health, average daily gain, and carcass traits of angus steers. The Professional Animal Scientist. 28(1): 11-19.

Sanderson, M. W., D. A. Dargatz, and B. A. Wagner. 2008. Risk factors for initial respiratory disease in united states' feedlots based on producer-collected daily morbidity counts. The Canadian Veterinary Journal. 49(4): 373.

Schneider, M. J., R. G. Tait, W. D. Busby, and J. M. Reecy. 2009. An evaluation of bovine respiratory disease complex in feedlot cattle: Impact on performance and carcass traits using treatment records and lung lesion scores. Journal of Animal Science. 87(5): 1821-1827.

Smith, R. A. 1998. Impact of disease on feedlot performance: A review. J. Anim. Sci. 76(1): 272-274.

Step, D., C. Krehbiel, H. DePra, J. Cranston, R. Fulton, J. Kirkpatrick et al. 2008. Effects of commingling beef calves from different sources and weaning protocols during a forty-two-day receiving period on performance and bovine respiratory disease. J. Anim. Sci. 86(11): 3146-3158.

Terrell, S. P. 2012. A Survey to Describe Current Feeder Calf Health and Well-being Program Recommendations made by Feedlot Veterinary Consultants in the United States and Canada.

USDA. 2013. Types and costs of respiratory disease treatments in U.S. feedlots. USDA: APHIS: VS, CEAH, National Animal Health Monitoring System.Fort Collins, CO.

Zhang, S., R. I. Albornoz, J. R. Aschenbach, D. R. Barreda, and G. B. Penner. 2013. Short-term feed restriction impairs the absorptive function of the reticulo-rumen and total tract barrier function in beef cattle. Journal of Animal Science. 91(4): 1685-1695.

# Effect of heifer calving date on longevity and lifetime productivity

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## Introduction

Longevity and lifetime productivity are important factors in profitability of the beef cow herd. Therefore, a concern for many producers is the productivity and longevity of the individual cow in their herd. The 2007-08 survey from National Animal Health Monitoring System (NAHMS) reported that the largest percentages of cows (33%) are culled because they do not become pregnant during the breeding season. It also reported that 15.6% of all culled cows leave the herd before 5 years of age, and an additional 31.8% leave the herd between 5 and 9 years of age. Research has reported that it takes 5 calves to pay for the development costs and annual maintenance of a replacement heifer (E.M. Mousel, Unpublished data). Therefore, to be sustainable, producers need to manage their herd to reduce the number of cows that are culled at a young age.

One such management practice is to ensure heifers conceive early in their first breeding season. According to research by Patterson et al., (1992) heifers that calve prior to 24 months of age have increased lifetime productivity compared to heifers that calve after 24 months of age. Additionally, if heifers breed early in their first breeding season they will calve early in the calving season and have a longer post-partum interval, which should increase their chance of rebreeding and continually calving early. This management practice is not only beneficial to the dams, but also the calves. Heifers born in the first part of the calving season have been reported to have heavier weaning weights; more had reached puberty prior to the breeding season; and had greater pregnancy success. Steers born early in the calving season had heavier hot carcass weights and greater carcass values (Larson and Funston, 2009; Funston et al., 2011). Therefore, the objective of this study was to determine the effect of a heifer calving date on longevity and lifetime productivity.

## Materials and methods

### *Data populations*

Two separate populations were evaluated in this study. The first population included data collected from producers involved in South Dakota Integrated Resource Management groups. The second population included heifers and their respective calves over a twenty-one year period of time (1980 to 2000) at the USMARC. Each population was then limited to only heifers that had conceived through natural service during their first breeding season. This left the first population to include 2,195 heifers and the second population to include 16,469 heifers. These heifers were then sorted into 21 day calving groups. The first breeding season that a heifer was recorded as open, they were considered culled for reproductive reasons, which ended their longevity and lifetime productivity. Heifers that were removed from the herd, yet still recorded as pregnant were censored from the data analysis the year they left the herd.

### *Statistical analysis*

Influence of calving group on longevity within each population was determined using survival analysis (PROC LIFETEST) in SAS. The impact of calving group on weaning weight was determined using the general linear model (PROC GLM) in SAS. The model included the effects of calving group, herd, year, calving group by year, and calving group by herd.

## Results

### *Longevity*

Heifers that calved with their first calf during the first 21 d period of the calving season had increased ($P < 0.01$) longevity compared to heifers that calved in the second 21 d period, or later (Figure 1 and 2). There are numerous differences in the circumstances surrounding these two heifer data sets. Most notably is the accumulation of data from South Dakota heifers that encompasses a variety of heifer selection criteria, heifer development programs, and overall reproductive management from multiple cow-calf operations. Conversely, the data from the USMARC represents heifer reproduction data under a common management program.

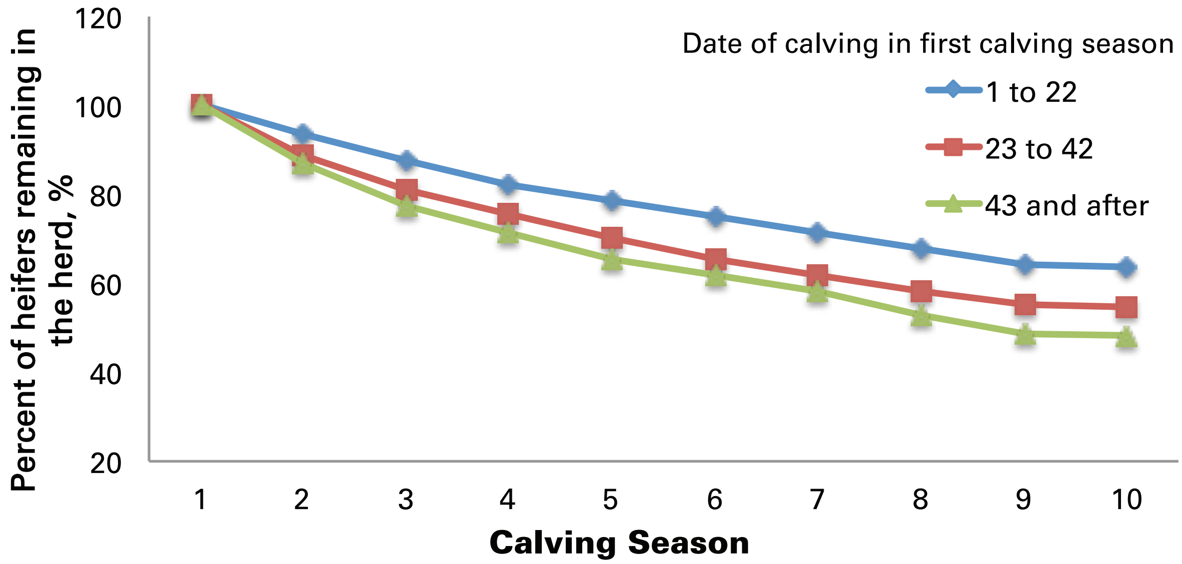


**Figure 1.** Influence of calving date in first calving season on longevity within the USMARC heifers. (P<0.01).

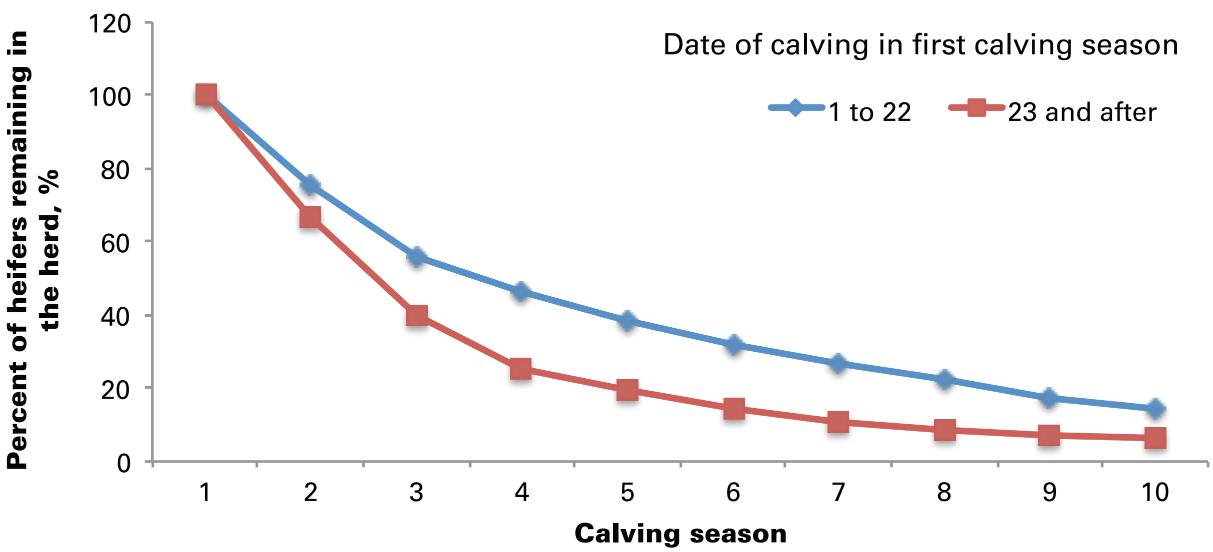


**Figure 2.** Influence of first calving date in first calving season on longevity within the South Dakota heifers (P<0.01)

Although the objective of this investigation was not to directly compare the two data sets, it is worth noting that the percentage of heifers remaining in the herd varied greatly between heifers evaluated at the USMARC and commercial heifers in South Dakota. Of the heifers that calved with their first calf in the first 21 d period of the calving season at the USMARC, 63.7% of them were still in the herd after 10 calving seasons while only 14.3% of South Dakota heifers remained after 10 calving seasons. It is not immediately clear why so few South Dakota heifers remained in the herd after 10 calving seasons compared to the USMARC; although differences in breed type, climate between South Dakota and south central Nebraska, selection criteria, heifer development program, nutrition program, and overall management likely contribute heavily. The substantial differences between heifer groups, locations, and management programs in these data sets clearly support the notion that there is a positive relationship between early calving heifers and longevity in the herd.

Additionally, average longevity for USMARC heifers that calved in the 1st, 2nd, and later 21 d period was 8.2 ± 0.3, 7.6 ± 0.5, and 7.2 ± 0.1 yr, respectively (Figure 3). Average longevity for South Dakota heifers that calved in the 1st or later 21 d period was 5.1 ± 0.1 and 3.9 ± 0.1 yr, respectively (Figure 4). Furthermore, longevity of USMARC heifers that calved with their first calf during the first 21 d period of the calving season was 7% greater than heifers that calved with their first calf during the second 21 d period of the calving season; and 12% greater than heifers that calved with their first calf in the third 21 d of the calving season. Similarly, longevity of South Dakota heifers that calved with their first calf during the first 21 d period of the calving season was 24% greater than heifers that calved with their first calf during the second 21 d period of the calving season. Not only does this suggest that there are significant differences in longevity and likely; profitability of replacement heifers based on ability to get pregnant early in the breeding season and thus calve early in the calving season; but also that there can be a tremendous amount of variation in how pronounced the differences are. Therefore, the effect of the ability of first calf heifers to calve early in the calving season on longevity of those heifers in the cowherd may be more pronounced in some heifer groups more than others.

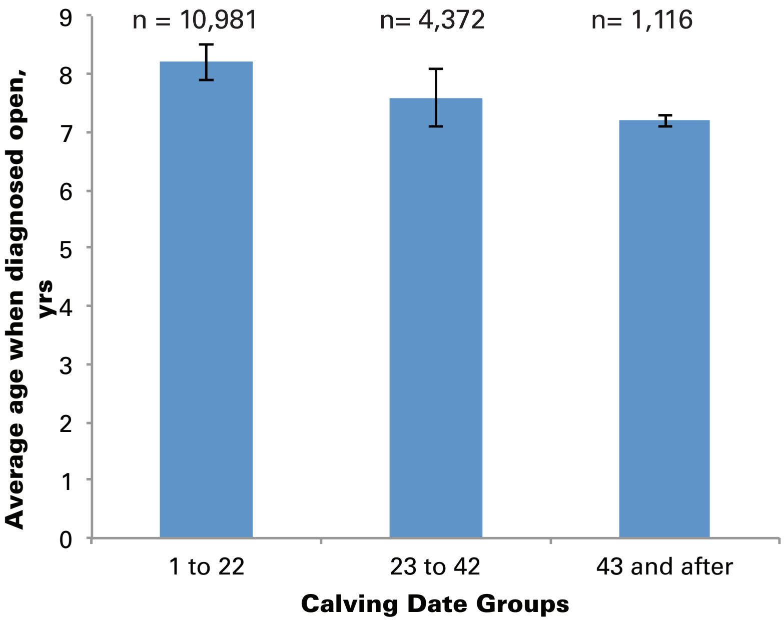


**Figure 3.** Influence of calving date in first calving season on when heifers were diagnosed open within the USMARC heifers (P<0.01).

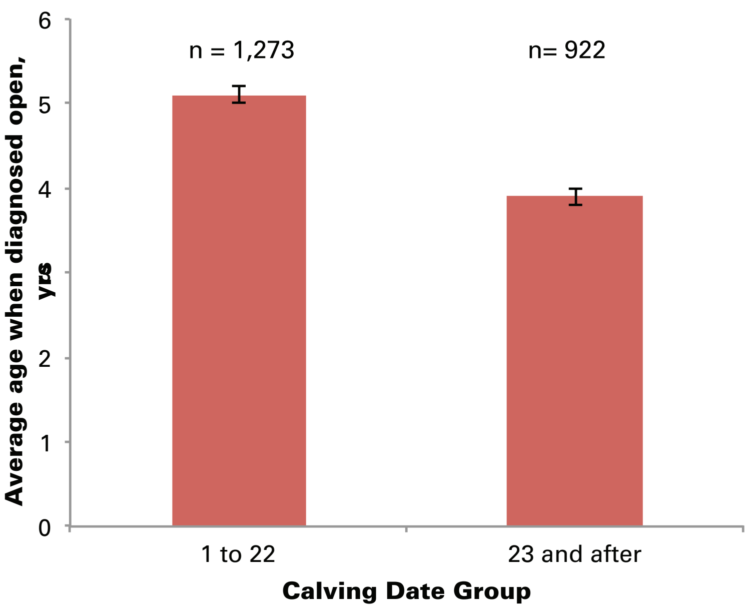


**Figure 4.** Influence of calving date in first calving season on when heifers were diagnosed open within the South Dakota heifers (P<0.01).

## Productivity

Calving period of USMARC heifers influenced ($P \leq 0.03$) weaning weight of the 1st, 2nd, 3rd, 4th, and 5th calf; but did not influence the weaning weight of the 6th ($P = 0.24$), 7th ($P = 0.30$), 8th ($P = 0.30$), or 9th ($P = 0.37$) calf (Figure 5). This test was not performed on South Dakota heifers because no weaning weight data was available. Calving period influenced total kilograms weaned and mean weaning weight ($P < 0.01$), with heifers that calved during the 1st period having increased total kilograms weaned (898 ± 5.4 kg) and mean weaning weight (206 ± 0.3 kg) compared to heifers calving in the 2nd or later period, and heifers calving during the 2nd period having increased total kilograms weaned (768 ± 8.2 kg) and mean weaning weight (194 ± 0.5 kg) compared to heifers calving later (718 ± 16 kg and 174 ± 1.1 kg).

Shorter postpartum intervals of early calving females play a major role in calf weaning weight in managed beef production systems with a common weaning date; because earlier born calves are older and generally are heavier at time of weaning. There were no differences however, in postpartum interval x 21 d calving period detected in the USMARC heifer groups (data not shown). It is not immediately clear from the data collected in this study how calving period influences weaning weights early in the female's reproductive life but not later in her reproductive life. It is likely that females that have longer reproductive lives wean more calves and thus have a higher lifetime weaning weight average. The higher lifetime weaning weight averages could be more pronounced earlier in the female's lifetime because a higher percentage of her contemporaries that did not have their first calf in the first 21 d of the calving season period drop out of the herd earlier and at a faster rate. Thus the contemporaries would have a lower lifetime weaning weight average. Later in the females life however, lifetime weaning weight average of the contemporary group catches up as their dropout rate declines.

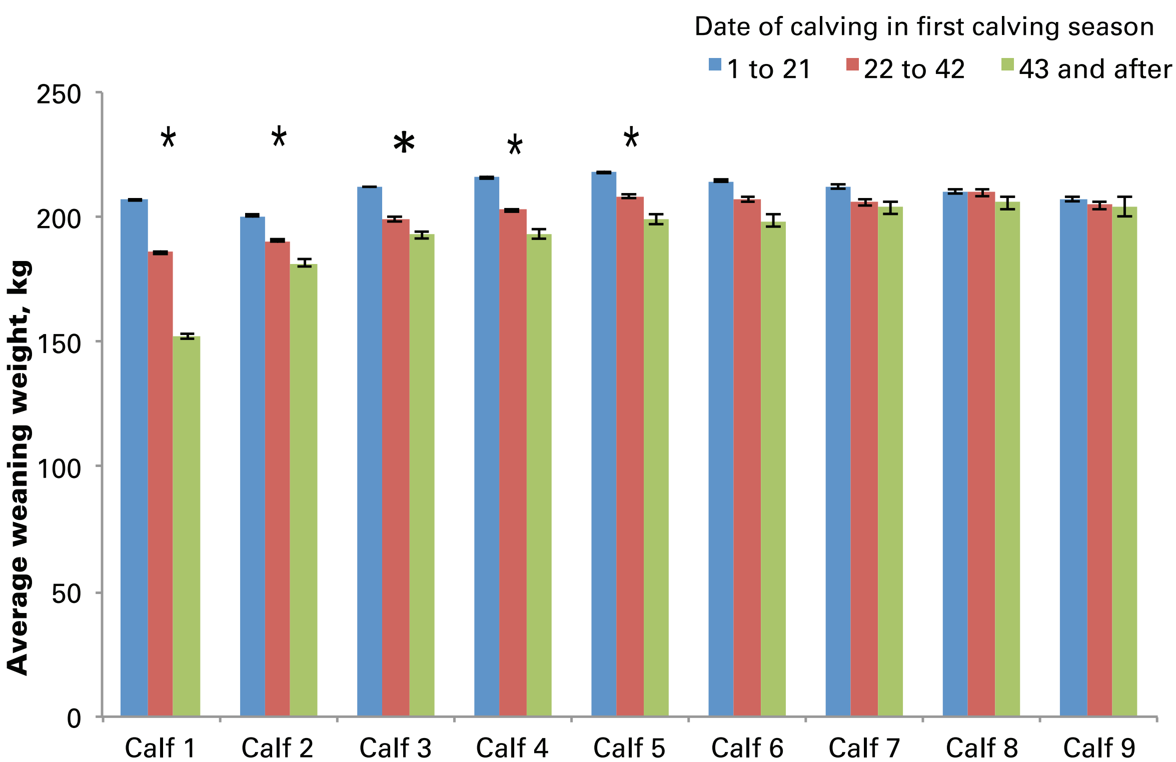


**Figure 5.** Influence of calving date in first calving season on average weaning weight of calves born to USMARC heifers (*P<0.03).

## Discussion

Identifying the heifers that calve early in the calving season may be the simplest method to improve longevity and profitability. Many previous studies have shown the relationship between calving early in the calving season and increased longevity in cattle (Deutscher et al. 1991, Patterson et al. 1992, Arthur et al. 1993). Longer postpartum intervals and higher rebreeding rates of early calving females are generally attributed to increased longevity. Consequently, the tendency of cow-calf operators is to select the oldest and largest heifers to improve the chances of them reaching puberty early, breeding early, and calving early in the season. As heavily as this selection criteria is relied upon as a proxy for early puberty in practice; it has had variable results overall. The oldest, heaviest heifers do not always reach puberty the earliest and do not always initiate reproductive cycles the earliest in any given contemporary group; suggesting a tremendous amount of genetic variation, environmental effects, or both. Given the variation in genetics and/or environmental effects, can we thus select for fertility?

It is easy to assume that selecting the earliest calving heifers will improve fertility. However, the heritability of calving period is fairly low, thus it is likely that very little improvements in fertility would be made simply by selecting for those heifers that calved early in their first season (Lesmeister et al. 1973). Furthermore, the coefficient of genetic variation present in fertility is of similar magnitude to that present in production traits; however, traditional measurements of fertility such as age at puberty, calving interval, and pregnancy rate have low heritability (h2 <0.05), and recording is often poor, hindering identification of genetically superior animals (Breuel et al. 1993). Furthermore, the relatively low heritability of reproduction traits has made selection through the use of genetic technology relatively slow.

Using non-traditional measurements of fertility such as Antral follicle count can be used as an indicator of fertility in beef females (Cushman et al. 2009); additionally, interval to commencement of luteal activity postpartum (Royal et al. 2002) and interval from calving to postpartum ovulation (Darwash et al. 1997) have shown significant promise in identifying high fertility in dairy females. Selection indices for fertility based on these criteria (and others) have been developed in dairy industry (Miglior et al. 2005). Similar indices have been suggested for fertility in beef females (VanRaden 2005); although the majority of selection work in the beef industry has focused on production; sometimes at the detriment of fertility.

Therefore, the use of genetic markers for fertility are the most likely to generate any real advancements in selection tools. It is relatively unclear at this time whether we will be able to identify genetic markers for fertility. However, it is likely that a heifer's age at first calving may be the best phenotypic indicator of fertility and likely is a promising population to use for finding genetic markers for fertility.

## Conclusion

Heifers that calved early in the calving season with their first calf had increased longevity and kilograms weaned compared to heifers that calved later in the calving season; although the relative impact may be more pronounced in some herds than others. Furthermore, heifers that calve early in their first calving season may be the best phenotypic indicator of fertility. This suggests that identifying the heifers that calve early in the calving season may be the simplest method to improve longevity and profitability in beef herds.

## References

Arthur, P.F., M. Makarechian, R.T. Berg, and R. Weingardt. 1993. Longevity and lifetime productivity of cows in a purebred Hereford and two multibreed synthetic groups under range conditions. J. Animal Sci. 71:1142-1147.

Breuel, K.F., P.E. Lewis, F.N. Schrick, A.W. Lishman, E.K. Inskeep, and R.L. Butcher. 1993. Factors affecting fertility in the postpartum cow: Role of the oocyte and follicle in conception rate. Biol. Repro. 48:655-661.

Cushman, R.A., M.F. Allan, L.A. Kuehn, W.M. Snelling, A.S. Cupp, and H.C. Freetly. 2009. Evaluation of antral follicle count and ovarian morphology in crossbred beef cows: Investigation of influence of stage of the estrous cycle, age, and birth weight. J. Anim. Sci. 87:1971-1980.

Darwash, A.O., G.E. Lamming, and J.A. Woolliams. 1997. Estimation of genetic variation in the interval from calving to postpartum ovulation of dairy cows. J. Dairy Sci. 80:1227-1234.

Deutscher, G.H., J.A. Stotts, and M.K. Nielsen. 1991. Effects of breeding season length and calving season on range beef cow productivity. J Anim Sci. 69:3453-3460.

Funston, R.N., J.A. Musgrave, T.L. Meyer, and D.M. Larson. 2011. Effect of calving period on ADG, reproduction, and first calf characteristics of heifer progeny. Proc. West. Sec. Am. Soc. Anim. Sci. 62:231-233.

Larson, D.M. and R.N. Funston. 2009. Estrous synchronization increases early calving frequency, which enhances steer progeny value. Proc. West. Sec. Am. Soc. Anim. Sci. 60:72-75.

Lesmeister, J.L., P.J. Burfening, and R.L. Blackwell. 1973. Date of first calving in beef cows and subsequent calf production. J. Anim. Sci. 36:1-6.

Miglior, F., B.L. Muir, and B.J. Van Doormaal. 2005. Selection indices in Holstein cattle of various countries. J. Dairy Sci. 88:1613.

NAHMS. 2008. Part IV: Reference of Beef Cow-calf Management Practices in the United States, 2007-08. USDA-APHIS Center for Epidemiology and Animal Health. Fort Collins, CO.

Patterson, D. J., R. C. Perry, G. H. Kiracofe, R. A. Bellows, R. B. Staigmiller, and L. R. Corah. 1992. Management considerations in heifer development and puberty. J Anim Sci. 70:4018-4035.

Royal, M.D., J.E. Pryce, J.A. Woolliams, and A.P.F. Flint. 2002. The genetic relationship between commencement of luteal activity and calving interval, body condition score, production, and linear type traits in Holstein-Friesian dairy cattle. J. Dairy Sci. 85:3071-3080.

VanRaden, P.M. 2005. An example from the dairy industry: The net merit index. In: Proceedings of the Beef Improvement Federation's 37th Annual Research Symposium and Annual Meeting, July 6-9, 2005, Billings, Montana, pp 96-100.

# Cattle market outlook: 2014 and beyond

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## Outlook overview

Cattle supplies, prospects of herd expansion, beef demand, and similar issues currently dominate many industry conversations. Some clarity and signals for the future may appear in the closely watched USDA Cattle report, due to be released January 31, 2014. However, equally important to understanding the future of the industry is consideration of the unique beef cattle market situation that has developed.

Looking at the beef cow herd, the foundation of the total cattle inventory, a distinct cycle of growth and liquidation has defined the industry. By 2014, one of the longest and most severe liquidation phases in the history of cattle cycle has reduced the U.S. cattle herd to its lowest level in over fifty years - well below the trough of the previous cycle. Recent cattle cycles have become much less pronounced, with shorter periods of increase and more prolonged phases of decrease. Much of this deviation from historical trends can be attributed to abnormal weather (leading to increased variability in stocking rates), decreases in the available land base, production being impacted by replacement rates, and input and output price variability and volatility (which affects producer's foresight of prices). Future cattle cycles will likely not have as much in common with past cycles and investment strategies will need to be tailored to meet this unknown, or emerging, new pattern.

## Cow-calf outlook

Cow-calf producers have a growing incentive for herd expansion with strong profit prospects and an improved forage situation. Though 2013 was another year of herd reduction, improving forward returns may provide the period of herd stabilization (with little or no growth) that often occurs in first year of herd expansion. Most herd expansions in the past have included one to two years of minimal or modest herd growth before accelerating for two to three years.

The ultimate question becomes, given the uncertainty experienced the last several years, what level of return will be required to encourage producers to begin rebuilding the cowherd? In other words, what level of annual return would motivate producers to assume risk in retaining more heifers and/or investing in additional cows? The Livestock Marketing Information Center (LMIC) estimates cow-calf returns over cash costs (including pasture rent) based on typical production and marketing practices. The estimated numbers are designed to serve as a barometer for returns, thus actual returns may vary considerably. Preliminary LMIC forecasts for 2014 suggest returns may set a new record high, exceeding $300 per cow, as the uptrend in calf and cull animal sale prices are expected to significantly out-pace production costs.

## Backgrounding/stocker outlook

Backgrounding/stocker producers (including cow-calf producers retaining calves) continue to see enhanced market signals to add additional weight to calves and feeder cattle. Information from the feeder cattle futures market combined with basis forecasts can be utilized to garner value of gain projections to help guide retained ownership and backgrounding/stocker decisions. Currently, there are some historically high values of gain, which are expected to remain given current projections. Of course these projections do not take into consideration costs of adding additional weight and producers need to compare that to the value of gain.

## Feedlot outlook

The feedlot sector continues to have excess capacity concerns and the longer the industry delays rebuilding the cattle herd the greater the issue of tight feeder cattle supplies will be in the future. Basically, there is fixed amount of bunk space available while the calf crop and the associated feeder cattle supply have dwindled. This particular mismatch continues to be a pinch point for the feedlot industry.

Data from the Iowa State University Estimated returns for Finishing Yearling Steers, a monthly barometer of cattle feeding returns, estimated positive net returns for closeouts the last few months of 2013, breaking a long streak of monthly losses. Computed cattle "crush" margins (crush margin = live cattle – feeder cattle - corn) based on futures market prices suggests returns could be well above breakeven levels in the coming months reflecting a moderation in feed costs and strong fed cattle prices. After May, margins may tighten if current futures market prices for cattle and corn prove to be a true prediction.

## Beef production

Beef production in 2013 decreased 0.8 percent with a 1.5 percent decrease in slaughter being offset by a 0.8 percent increase in carcass weights. Cattle slaughter and beef production will continue to fall as the market transitions into a much tighter supply situation in 2014. Beef slaughter forecasts suggest a 6.5 to 7.5 percent year over year decrease in commercial slaughter in 2014 and a 2.5 to 4.5 percent year over year pull-down in 2015. This may be partially offset by higher carcass weights. The last several years of higher than normal increases in carcass weights have come, in part, as packers have tried to manage beef supplies in light of decreasing slaughter levels. Overall, forecasts suggest a net reduction in beef production in total and per capita in 2014 and 2015.

## Beef demand

While there is general agreement on tight supply fundamentals in 2014 and 2015, there is less certainty regarding beef demand. A quarterly All Fresh beef demand index maintained at Iowa State University indicates year over year gains in beef demand for the last 13 quarters ending in September 2013. This domestic demand strength warrants considerable appreciation. However, the next several years will put demand in relatively uncharted waters so it is impossible to know exactly what to expect. As per capita supplies are reduced to historically low levels in coming years, the willingness of some U.S. consumers to pay likely record high retail beef prices is paramount to monitor. The combination of higher prices and reduced per capita supplies will likely be met by more requests for beef quality and associated requirements for additional investment and management adjustments.

## International trade

U.S. beef exports in 2013 increased by 4.2 percent but were still 8.2% below the 2011 record export level. Higher U.S. beef prices and reduced beef production are expected to decrease U.S. beef exports in the coming years. U.S. beef export forecasts suggest a 5.5 percent year over year decrease in 2014 and a 3.3 percent year over year pull-down in 2015. However, beef exports as a percent of total production is expected to remain mostly unchanged. U.S. beef imports in 2013 increased by 1.9 percent; boosted by tightening U.S. beef supplies and higher U.S. beef values. Beef imports could increase by 11 percent in 2014 and 9 percent in 2015 with strong processing beef demand, reduced domestic beef supplies, and higher domestic beef values being the driving factors.

## Summary

The entire U.S. cattle industry is in the middle of several structural changes outlined above and in the associated presentation. These adjustments coupled with issues more external to the industry are effectively increasing the overall uncertainty of profitability for producers. This increased uncertainty will be welcomed by some producers who in turn may choose to expand their operations in coming years. Conversely, other producers uncomfortable with this uncertainty or facing favorable alternatives to cattle production will stabilize or further reduce their operations. The net impacts of these adjustments will dictate the collective make-up of the U.S. cattle industry for years to come.

Related and updated information is regularly available at: Iowa Farm Outlook & News (http://www.econ.iastate.edu/ifo/), Iowa State University Ag Decision Maker (http://www.extension.iastate.edu/agdm/), Iowa State University Estimated Livestock Returns (http://www.econ.iastate.edu/estimated-returns/), and Iowa State University Livestock Crush Margins (http://www.econ.iastate.edu/margins/).