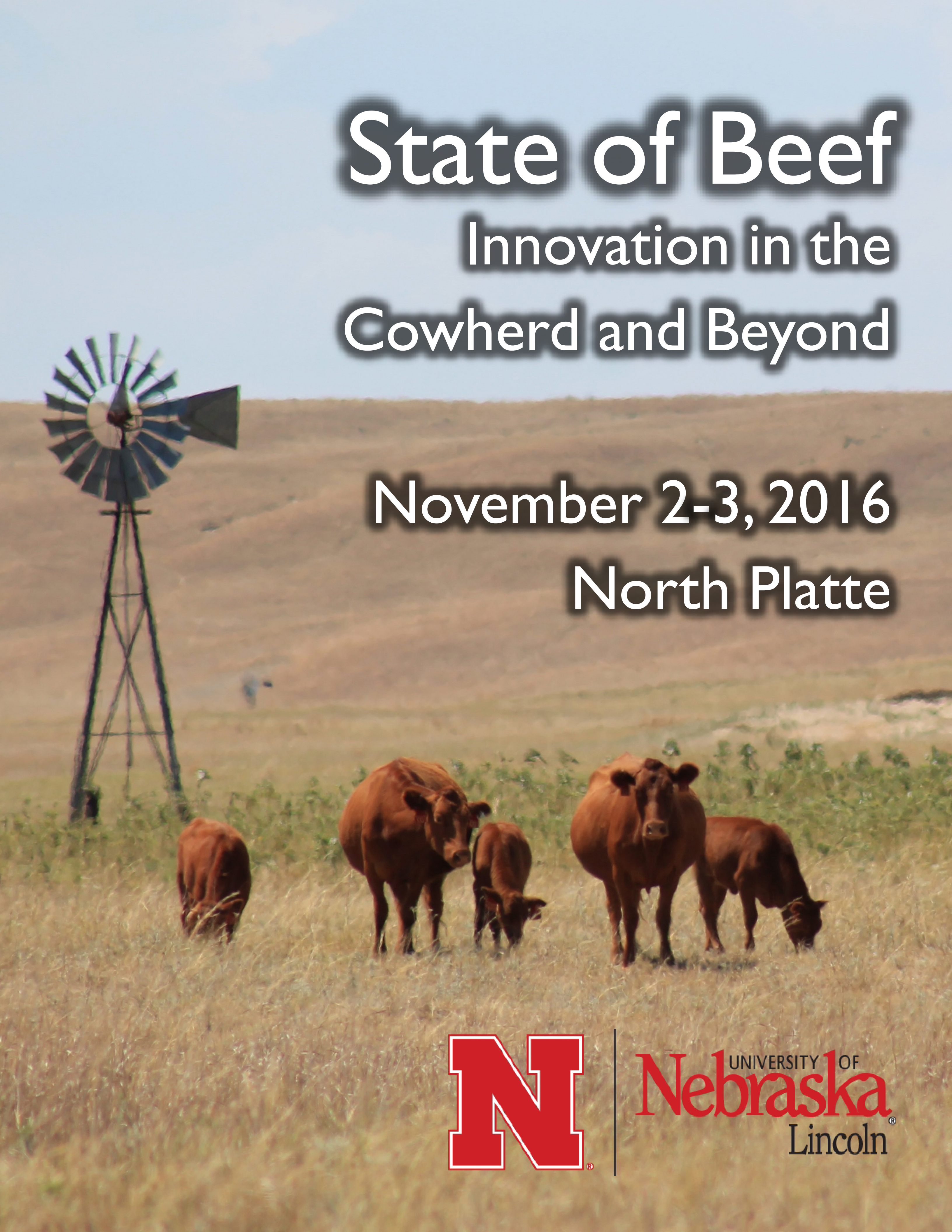

State of Beef

Innovation in the Cowherd and Beyond

November 2-3, 2016
North Platte

University of Nebraska Lincoln

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The State of Beef Conference

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The State of Beef Conference

November 2 and 3, 2016
Sandhills Convention Center
Quality Inn and Suites
North Platte, Nebraska

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NEBRASKA AGRICULTURE FACTS

A cooperative effort of the Nebraska Department of Agriculture; USDA, NASS, Nebraska Field Office; Nebraska Bankers Association
February 2016

Nebraska's Top National Rankings

1st	Beef and veal exports, 2014 – $1,128,700,000
	Cash receipts from meat animals, 2014 – $13,885,411
	Commercial red meat production, 2015 – 7,470,600,000 lb
	Commercial cattle slaughter, 2015 – 6,575,100 head
	All cattle on feed, Jan 1, 2016 – 2,520,000 head
	Great Northern beans production, 2015 – 763,000 cwt
	Irrigated acres of cropland, 2012 – 8,225,973 acres
	Popcorn production, 2012 – 353,711,118 lb
2nd	All cattle and calves, Jan. 1, 2016 – 6,450,000 head
	Pinto bean production, 2015 – 1,878,000 cwt
	Proso millet production, 2015 – 3,298,000 bushels
	Light red kidney bean production, 2015 – 298,000 cwt
	Bison, Dec. 31, 2012 – 23,152 head
3rd	Corn for grain production, 2015 – 1,692,750,000 bushels
	Corn Exports, 2014 – $1,212,400,000
	Cash receipts from all farm commodities, 2014 – $24,942,122,000
4th	Cash receipts from all livestock and products, 2014 – $4,531,158,000
	Cash receipts from all crops, 2014 – $10,410,964,000
	Beef cows, Jan. 1, 2015 – 1,786,000 head
	Land in farms and ranches, 2014 – 45,200,000 acres (92% of the state's total land area)
	Alfalfa hay production, 2015 – 3,400,000 tons
	Grain sorghum production, 2015 – 23,040,000 bushels
	Soybean production, 2015 – 305,660,000 bushels
	All dry edible beans production, 2015 – 3,117,000 cwt
5th	Agricultural exports, 2014 – $7,262,200,000
	Soybean exports, 2014 – $1,728,600,000
	All hay production, 2015 – 6,360,000 tons
6th	Harvested acres of principal crops, 2015 – 19,175,000 acres
	All hogs and pigs on farms, Dec. 1, 2015 – 3,300,000 head
	Sugar beet production, 2015 – 1,329,000 tons
7th	Sunflower production, 2015 – 1,329,000 tons
	Commercial hog slaughter, 2015 – 7,934,000 head
8th	Oat production, 2015 – 2,680,000 bushels
	Winter wheat production, 2015 – 45,980,000 bushels

Nebraska Ag Facts

- ❑ Cash receipts from farm marketings contributed almost $25 billion to Nebraska's economy in 2014 and 5.9% of the U.S. total.
- ❑ Nebraska's ten leading commodities (in order of importance) for 2014 cash receipts are cattle and calves, corn, soybeans, hogs, wheat, dairy products, chicken eggs, hay, dry beans, and sugar beets.
- ❑ Every dollar in agricultural exports generates $1.27 in economic activities such as transportation, financing, warehousing, and production. Nebraska's $7.2 billion in agricultural exports in 2014 translate into $9.2 billion in additional economic activity.
- ❑ Nebraska's top five agricultural exports in 2014 were soybeans and soybean meal, corn, beef and veal, feeds and fodder, and hides and skins.
- ❑ Nebraska had 49,100 farms and ranches during 2014; the average operation consisted of 921 acres.
- ❑ In 2014, Nebraska ranked second in ethanol production, with 25 operating plants having production capacity of 2.125 billion gallons and used 43% of the state's 2014 corn crop.
- ❑ Livestock or poultry operations were found on 49% of Nebraska farms.
- ❑ The top five counties ranked by agricultural sales in 2012 were Cuming, Custer, Dawson, Lincoln, and Phelps.
- ❑ In 2011, Nebraska was eighth nationally in certified organic cropland acres (129,858) and eighth in certified organic pasture acres (53,174).
- ❑ 1 in 4 Nebraska jobs are related to agriculture.
- ❑ The average age of a Nebraska principal operator was 55.7 in 2012.
- ❑ From 2007 to 2012, Nebraska experienced a 5% increase in number of farms and a 10% increase in number of new farmers.

Nebraska's Natural Resources

- ❑ From east to west, Nebraska experiences a 4,584 ft elevation difference and the average annual precipitation decreases by 1" every 25 miles, allowing Nebraska to have a diverse agricultural industry from one side of the state to the other.
- ❑ If Nebraska's aquifers were poured over the surface of the state, the water in those aquifers would have a depth of 37.9 feet.
- ❑ Nearly 24,000 miles of rivers and streams add to Nebraska's bountiful natural resources.
- ❑ There are nearly 23 million acres of rangeland and pastureland in Nebraska – half of which are in the Sandhills.

Source: USDA NASS, Lincoln,, NE, (402) 437-5541

The State of Beef Conference
November 2 and 3, 2016
North Platte, Nebraska

Schedule and Proceedings Contents

WEDNESDAY, NOVEMBER 2

8:45 CT Vendor Booths Open

9:30 Welcome: Kelly Bruns, UNL West Central Research & Extension Center Director

10:00 MARKET OUTLOOK

Randy Blach, CattleFax 5

10:40 GENETIC SELECTION FOR MORE PROFITABLE COW-CALF ENTERPRISES: TACKLING INPUT COSTS

Matt Spangler, University of Nebraska-Lincoln 15

11:20 HEALTH CONSIDERATIONS FOR THE CALF, SETTING UP FOR SUCCESS

Jerry Stokka, North Dakota State University 23

Noon Lunch and Visit Vendors

1:20 TECHNOLOGY FOR THE COW-CALF PRODUCER REVISITED

Karla Jenkins, UNL Panhandle Research and Extension Center 31

2:00 OPTIMUM MANAGEMENT FOR BACKGROUNDING SYSTEMS

Jim MacDonald, University of Nebraska-Lincoln 35

2:40 Break and Visit Vendors

3:00 STRATEGIES FOR BREEDING HIGH-RISK BEEF FEMALES

Rick Funston, UNL West Central Research and Extension Center 41

3:40 DECISION SUPPORT TOOLS

Randy Saner, UNL Extension Educator 57

4:20 PANEL — WHAT ARE BREED ASSOCIATIONS DOING FOR THE COMMERCIAL CATTLEMAN? 61

Moderator: Matt Spangler

Panel Members: Dan Moser, American Angus Association

Shane Bedwell, American Hereford Association

Chip Kemp, American Simmental Association

5:20 Wrap-up

5:35 Cash Bar, Social, Visit Vendors

6:15 Dinner

7:00 Bull Pen Sessions

THURSDAY, NOVEMBER 3

7:45 CT Visit Vendor Booths

8:45 NEW FEEDLOT RESEARCH AND WHAT IT MEANS TO THE COW-CALF AND STOCKER SEGMENTS

Galen Erickson, University of Nebraska-Lincoln 63

9:25 ENSURING END PRODUCT QUALITY: MANAGEMENT CONSIDERATIONS

Ty Schmidt, University of Nebraska-Lincoln 75

10:05 Break and Visit Vendor Booths

10:20 INCLUDING RISK MANAGEMENT AS PART OF A MARKETING PLAN FOR COW-CALF PRODUCERS

Aaron Berger, University of Nebraska-Lincoln 77

11:00 BEEF INDUSTRY PANEL 81

Moderator: Galen Erickson

Panel Members: Marcine Moldenhauer, Meat Link Management

John Schroeder, Darr Feedlot

Dave Weaber, Delhaize Group

12:20 Wrap-up and have a safe trip home!

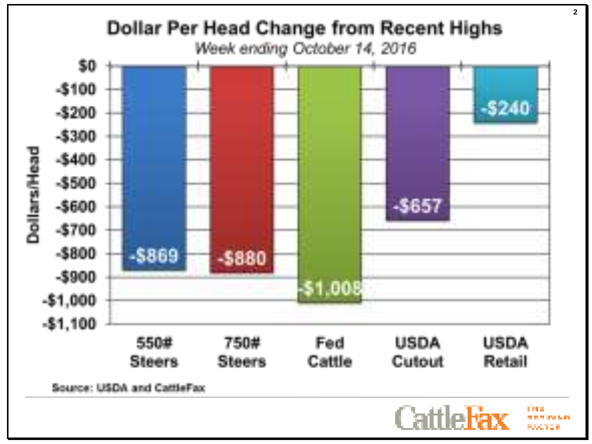
THANK YOU FOR ATTENDING THE 2016 STATE OF BEEF CONFERENCE

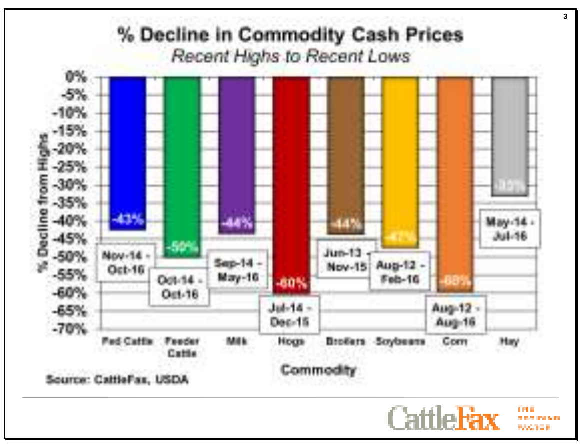
EXTENSION

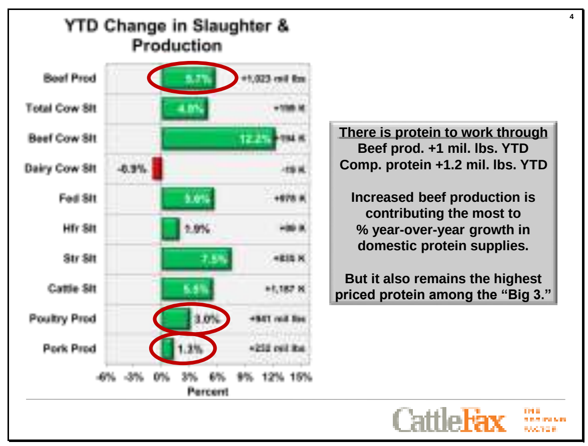
ON THE COVER: Cattle at the University of Nebraska Gudmundsen Sandhills Laboratory, near Whitman. Photo taken by Jacqueline Musgrave.

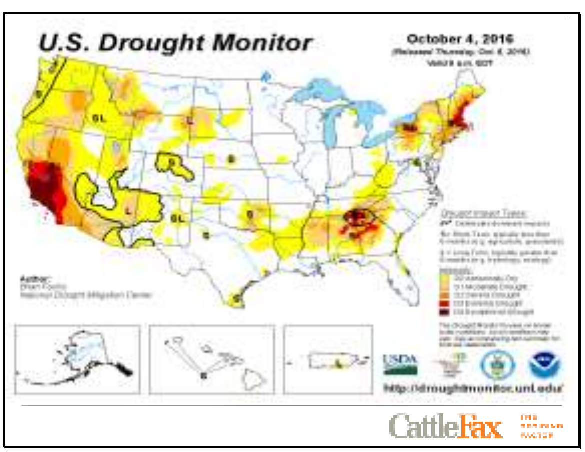
MARKET OUTLOOK

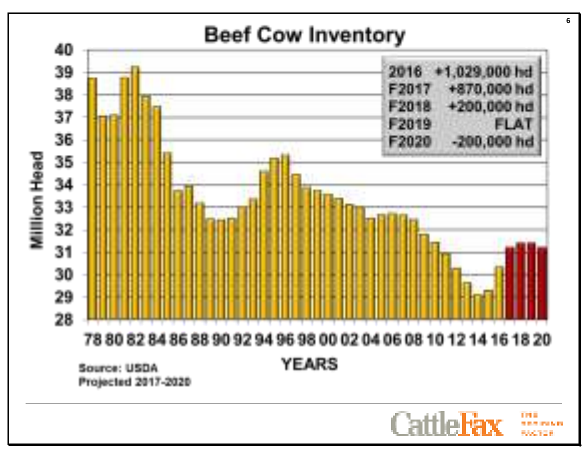
Randy Blach, CattleFax

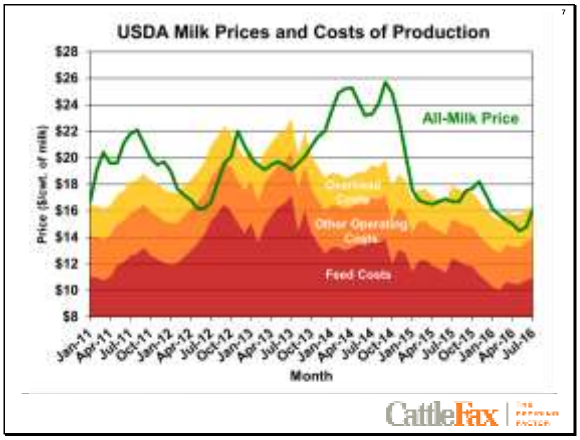


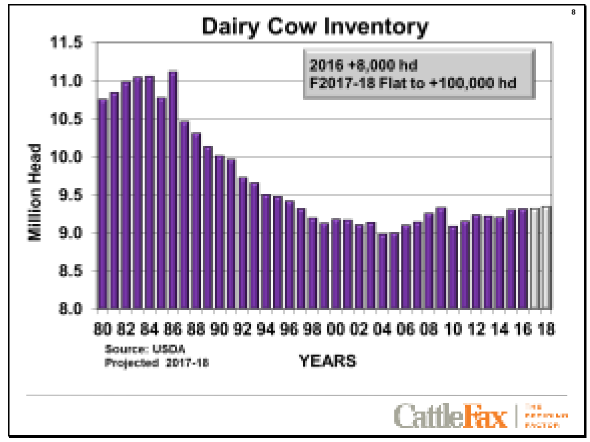


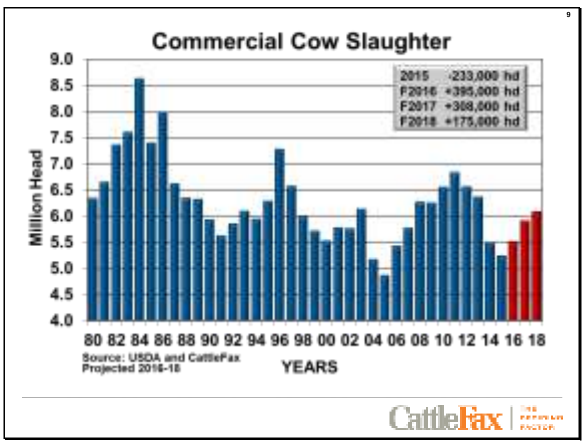


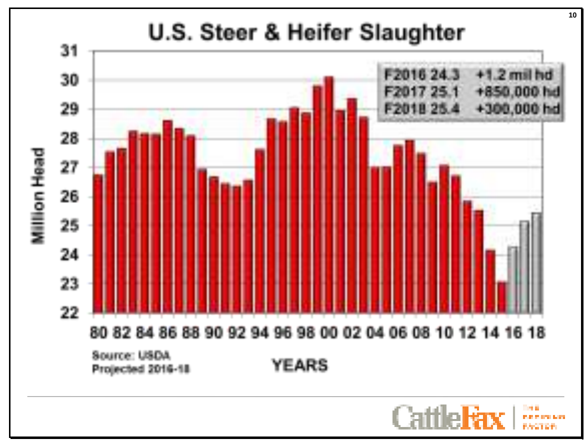


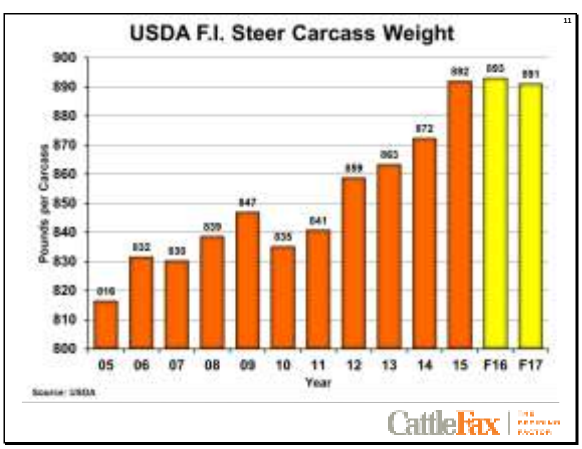


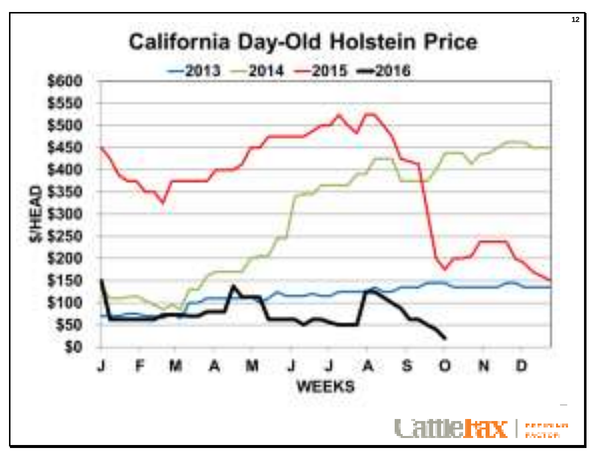

7
USDA Milk Prices and Costs of Production
All-Milk Price
Overhead Costs
Other Operating Costs
Feed Costs
Price ($/cwt. of milk)
Month
CattleFax

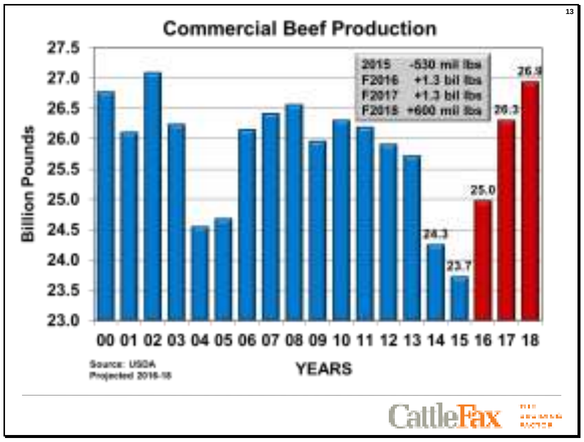

8
Dairy Cow Inventory
2016 +8,000 hd
F2017-18 Flat to +100,000 hd
Million Head
Source: USDA
Projected 2017-18
YEARS
CattleFax

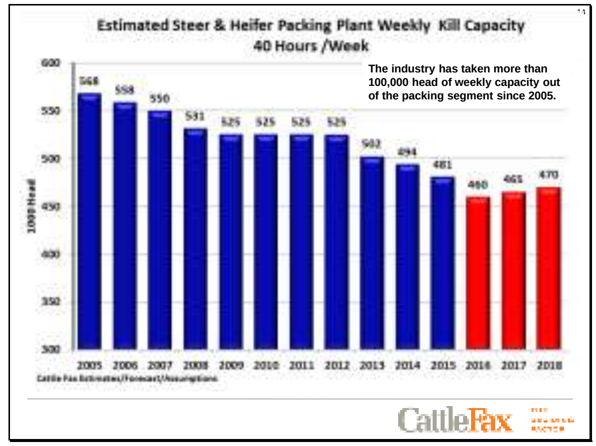

9
Commercial Cow Slaughter
2015 -233,000 hd
F2016 +395,000 hd
F2017 +308,000 hd
F2018 +175,000 hd
Million Head
Source: USDA and CattleFax
Projected 2016-18
YEARS
CattleFax

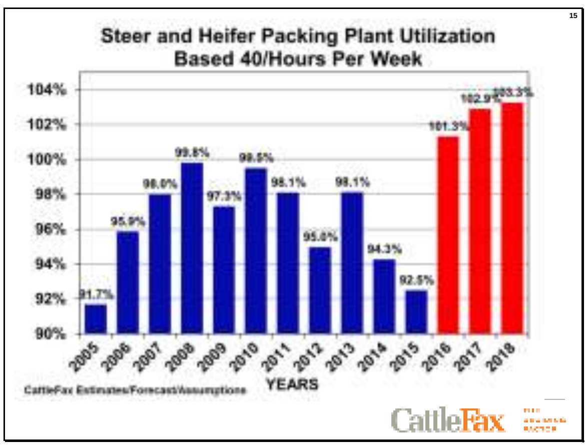

10
U.S. Steer & Heifer Slaughter
F2016 24.3 +1.2 mil hd
F2017 25.1 +850,000 hd
F2018 25.4 +300,000 hd
Million Head
Source: USDA
Projected 2016-18
YEARS
CattleFax

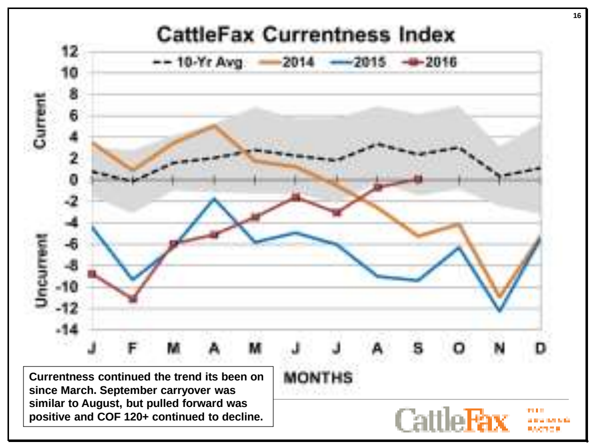

11
USDA F.I. Steer Carcass Weight
Pounds per Carcass
Year
Source: USDA
CattleFax

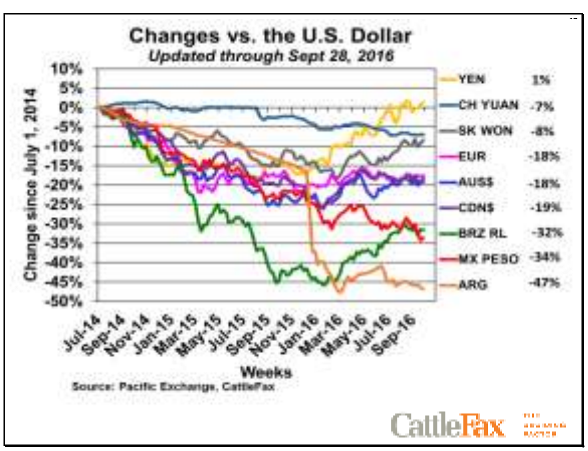

12
California Day-Old Holstein Price
2013
2014
2015
2016
$/HEAD
WEEKS
CattleFax

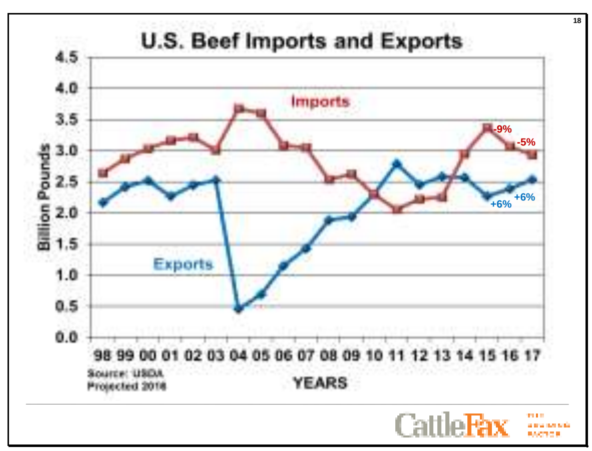

Commercial Beef Production
2015 -530 mil lbs
F2016 +1.3 bil lbs
F2017 +1.3 bil lbs
F2018 +600 mil lbs
Billion Pounds
YEARS
Source: USDA
Projected 2016-18
CattleFax

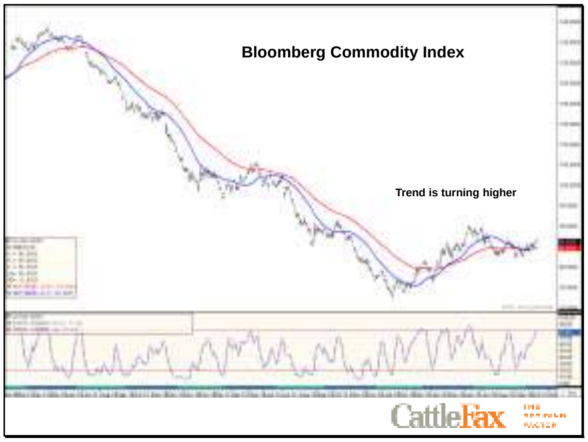

Estimated Steer & Heifer Packing Plant Weekly Kill Capacity
40 Hours /Week
The industry has taken more than 100,000 head of weekly capacity out of the packing segment since 2005.
1000 Head
CattleFax


Steer and Heifer Packing Plant Utilization
Based 40/Hours Per Week
YEARS
CattleFax Estimates/Forecast/Assumptions
CattleFax

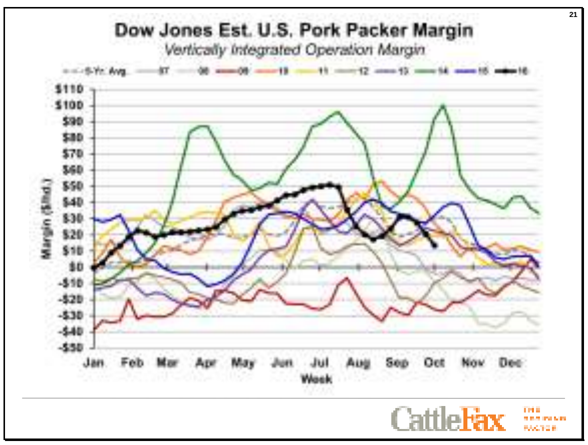

CattleFax Currentness Index
10-Yr Avg
2014
2015
2016
Current
Uncurrent
MONTHS
Currentness continued the trend its been on since March. September carryover was similar to August, but pulled forward was positive and COF 120+ continued to decline.
CattleFax

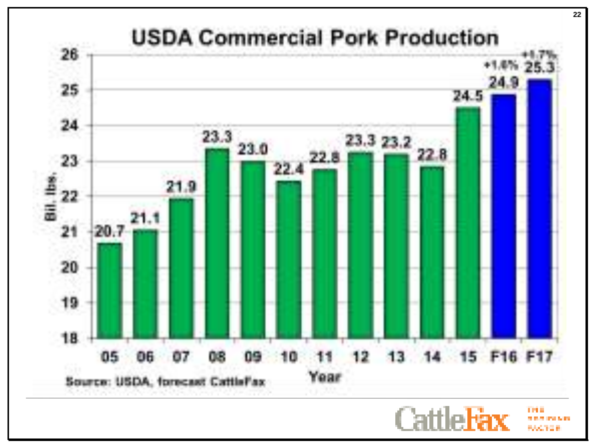

Changes vs. the U.S. Dollar
Updated through Sept 28, 2016
YEN 1%
CH YUAN -7%
SK WON -8%
EUR -18%
AUS$ -18%
CDN$ -19%
BRZ RL -32%
MX PESO -34%
ARG -47%
Change since July 1, 2014
Weeks
Source: Pacific Exchange, CattleFax
CattleFax

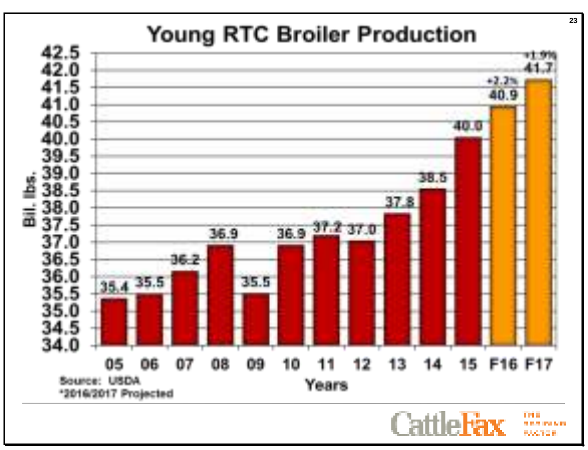

U.S. Beef Imports and Exports
Imports
Exports
Billion Pounds
YEARS
Source: USDA
Projected 2016
CattleFax

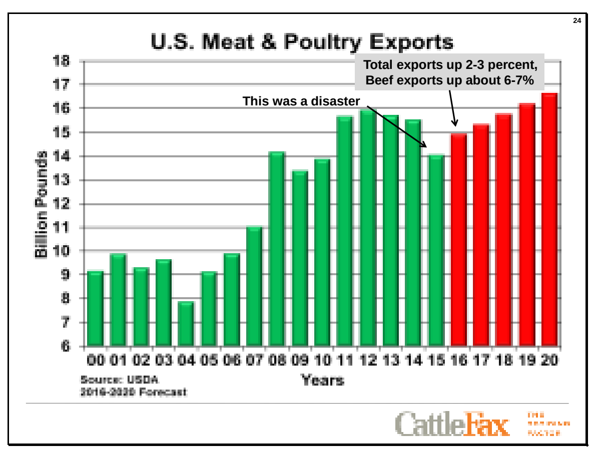

Bloomberg Commodity Index
Trend is turning higher
CattleFax

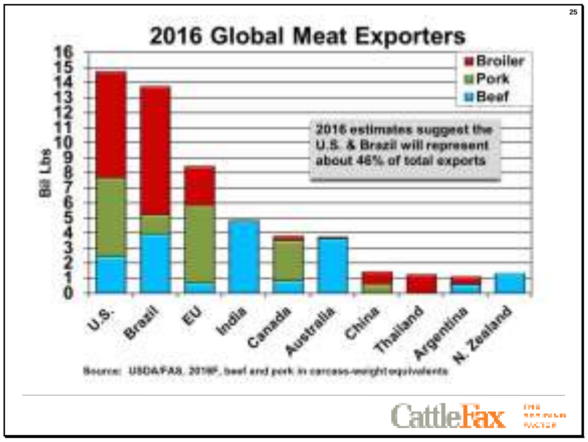

Hide and Offal Value
$17
$16
$15
$14
$13
$12
$11
$10
$9
$8
$7
$6
$5
Value ($/cwt.)
Jan-05 Jul-05 Jan-06 Jul-06 Jan-07 Jul-07 Jan-08 Jul-08 Jan-09 Jul-09 Jan-10 Jul-10 Jan-11 Jul-11 Jan-12 Jul-12 Jan-13 Jul-13 Jan-14 Jul-14 Jan-15 Jul-15 Jan-16 Jul-16 Jan-17
Week
Source: USDA
CattleFax

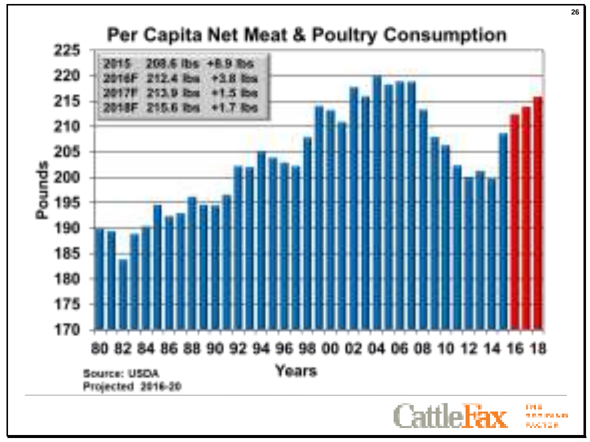

21
Dow Jones Est. U.S. Pork Packer Margin
Vertically Integrated Operation Margin
Margin ($/hd.)
$110
$100
$90
$80
$70
$60
$50
$40
$30
$20
$10
$0
-$10
-$20
-$30
-$40
-$50
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Week
CattleFax

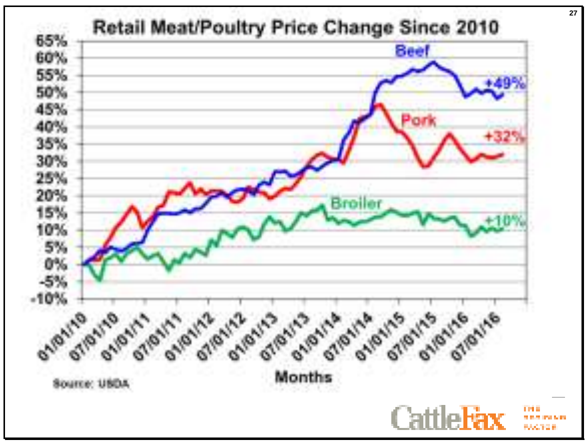

22
USDA Commercial Pork Production
Bil. lbs.
26
25
24
23
22
21
20
19
18
20.7
21.1
21.9
23.3
23.0
22.4
22.8
23.3
23.2
22.8
24.5
+1.6%
24.9
+1.7%
25.3
05 06 07 08 09 10 11 12 13 14 15 F16 F17
Year
Source: USDA, forecast CattleFax
CattleFax

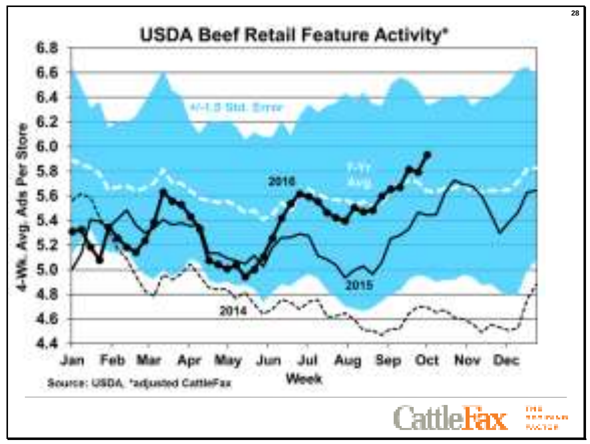

23
Young RTC Broiler Production
Bil. lbs.
42.5
42.0
41.5
41.0
40.5
40.0
39.5
39.0
38.5
38.0
37.5
37.0
36.5
36.0
35.5
35.0
34.5
34.0
35.4
35.5
36.2
36.9
35.5
36.9
37.2
37.0
37.8
38.5
40.0
+2.2%
40.9
+1.9%
41.7
05 06 07 08 09 10 11 12 13 14 15 F16 F17
Years
Source: USDA
*2016/2017 Projected
CattleFax

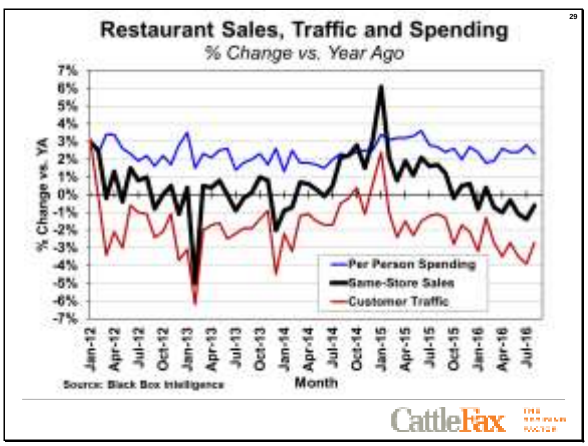

24
U.S. Meat & Poultry Exports
Total exports up 2-3 percent,
Beef exports up about 6-7%
This was a disaster
Billion Pounds
18
17
16
15
14
13
12
11
10
9
8
7
6
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20
Years
Source: USDA
2016-2020 Forecast
CattleFax



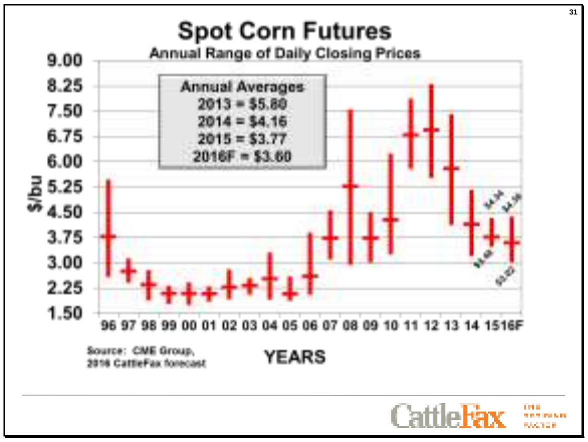


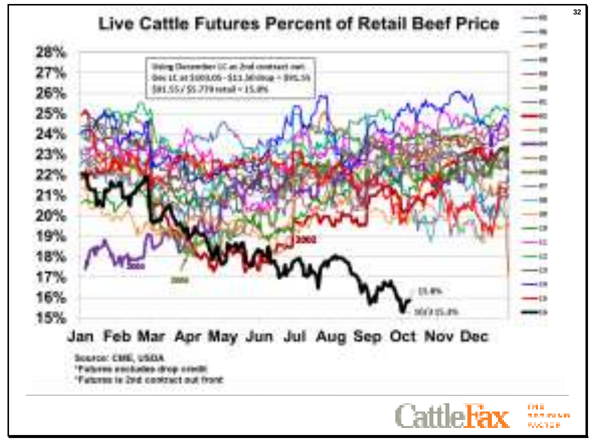


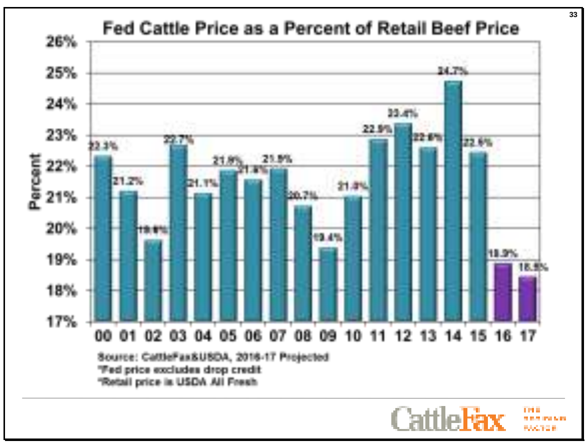


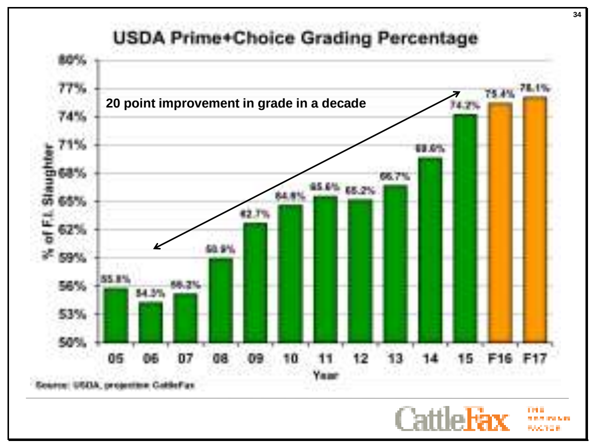


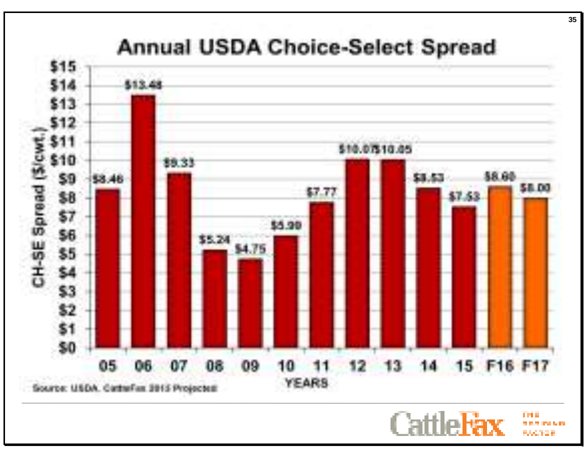
What does it all mean?


31
Spot Corn Futures
Annual Range of Daily Closing Prices
Annual Averages
2013 = $5.80
2014 = $4.16
2015 = $3.77
2016F = $3.60
$/bu
9.00
8.25
7.50
6.75
6.00
5.25
4.50
3.75
3.00
2.25
1.50
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16F
Source: CME Group, 2016 CattleFax forecast
YEARS
CattleFax

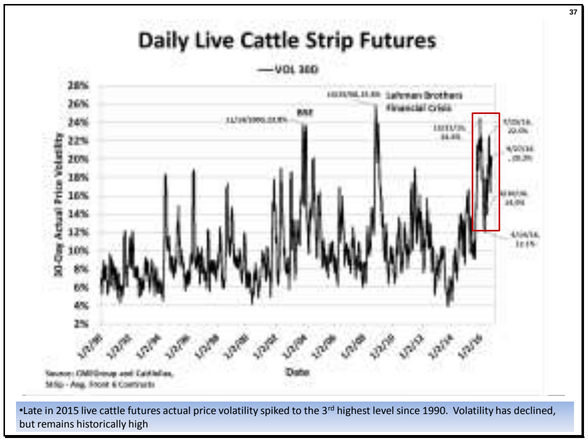

32
Live Cattle Futures Percent of Retail Beef Price
28%
27%
26%
25%
24%
23%
22%
21%
20%
19%
18%
17%
16%
15%
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Source: CME, USDA
CattleFax


33
Fed Cattle Price as a Percent of Retail Beef Price
Percent
26%
25%
24%
23%
22%
21%
20%
19%
18%
17%
22.3%
21.2%
19.6%
22.7%
21.1%
21.8%
21.6%
21.9%
20.7%
19.4%
21.0%
22.9%
23.4%
22.6%
24.7%
22.5%
18.9%
18.5%
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17
Source: CattleFax&USDA, 2016-17 Projected
*Fed price excludes drop credit
*Retail price is USDA All Fresh
CattleFax


34
USDA Prime+Choice Grading Percentage
20 point improvement in grade in a decade
% of F.I. Slaughter
80%
77%
74%
71%
68%
65%
62%
59%
56%
53%
50%
55.8%
54.3%
55.2%
58.9%
62.7%
64.6%
65.6%
65.2%
66.7%
69.6%
74.2%
75.4%
76.1%
05 06 07 08 09 10 11 12 13 14 15 F16 F17
Year
Source: USDA, projection CattleFax
CattleFax

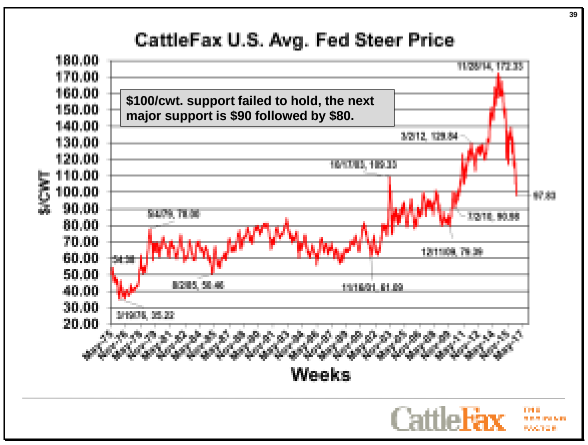

35
Annual USDA Choice-Select Spread
CH-SE Spread ($/cwt.)
$15
$14
$13
$12
$11
$10
$9
$8
$7
$6
$5
$4
$3
$2
$1
$0
$8.46
$13.48
$9.33
$5.24
$4.75
$5.99
$7.77
$10.07
$10.05
$8.53
$7.53
$8.60
$8.00
05 06 07 08 09 10 11 12 13 14 15 F16 F17
YEARS
Source: USDA, CattleFax 2015 Projected
CattleFax


36
Quarterly Range and Average CF Fed Steer Price
$/cwt
Quarter
Source: CattleFax
CattleFax

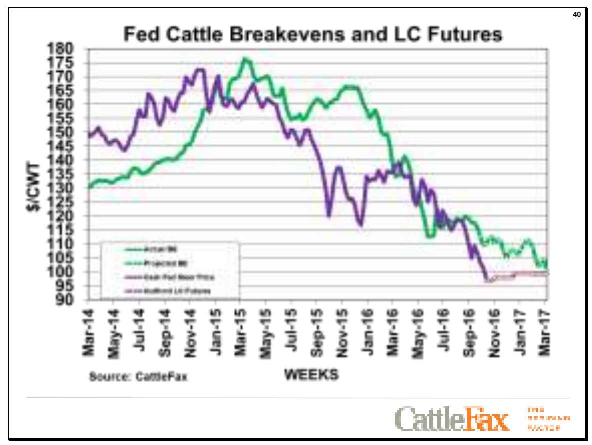


Daily Live Cattle Strip Futures
VOL 30D
30-Day Actual Price Volatility
Lehman Brothers Financial Crisis
BSE
Date
Source: CMEGroup and CattleFax, Strip - Avg. Front 6 Contracts
•Late in 2015 live cattle futures actual price volatility spiked to the 3rd highest level since 1990. Volatility has declined, but remains historically high

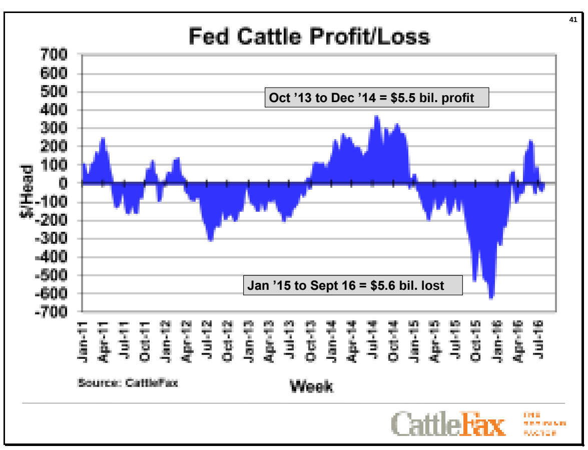
COT Non-Commercial Net Long Position and Live Cattle Spot Price
NC_NET
SPOT_PRICE
Contracts
Live Cattle Price $/lb
Weeks
Source: CFTC COT - Futures Only
CattleFax



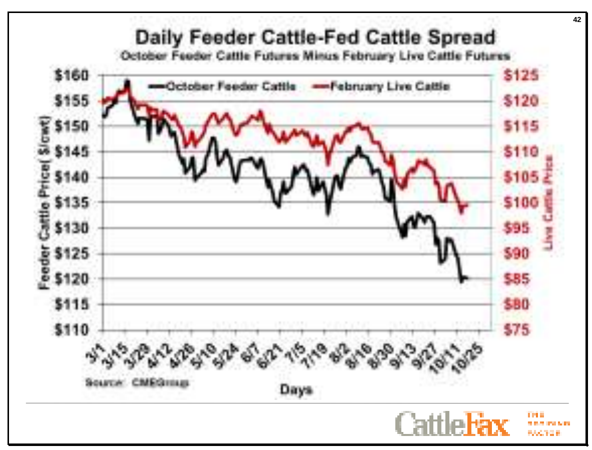
CattleFax U.S. Avg. Fed Steer Price
$100/cwt. support failed to hold, the next major support is $90 followed by $80.
11/28/14, 172.33
3/2/12, 129.84
10/17/03, 109.33
5/4/79, 78.90
7/2/10, 90.98
12/11/09, 79.39
8/2/85, 50.46
11/16/01, 61.09
3/19/76, 35.22
97.83
$/CWT
Weeks
CattleFax



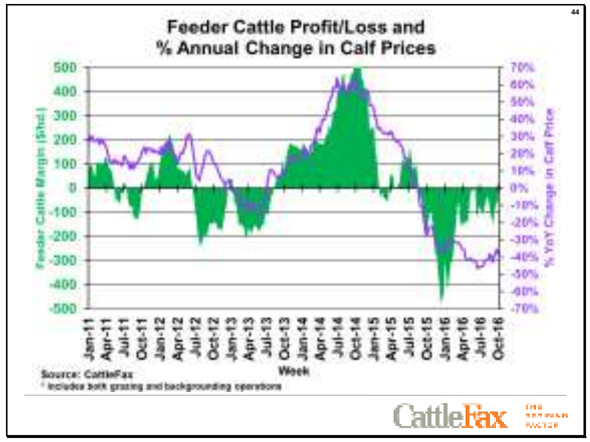
Fed Cattle Breakevens and LC Futures
$/CWT
WEEKS
Source: CattleFax
CattleFax



Fed Cattle Profit/Loss
Oct '13 to Dec '14 = $5.5 bil. profit
Jan '15 to Sept 16 = $5.6 bil. lost
$/Head
Week
Source: CattleFax
CattleFax

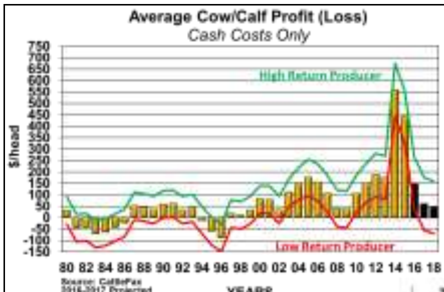


Daily Feeder Cattle-Fed Cattle Spread
October Feeder Cattle Futures Minus February Live Cattle Futures
October Feeder Cattle
February Live Cattle
Feeder Cattle Price($/cwt)
Live Cattle Price
Days
Source: CMEGroup
CattleFax

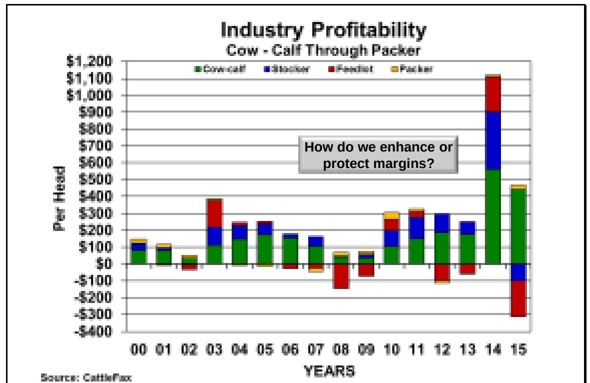


How Much is a Bred Cow Worth?

550-lb. Calf Price	% Chng vs. 2014	Bred Cow at 1.5x	Bred Cow at 1.65x
$100	-58%	825	$908
$110	-54%	$908	$998
$120	-50%	$990	$1089
$130	-46%	$1073	$1180
$140	-42%	$1155	$1271
$160	-33%	$1320	$1452
$180	-25%	$1485	$1634
$200	-17%	$1650	$1815
$220	-8%	$1815	$1997
$240	0%	$1980	$2178



	Cash Cow Costs	Total Cow Cost (includes: depr., RTM)
High Return Producer	$429.00	$554.00
Avg. Return Producer	$650.00	$775.00
Low Return Producer	$864.50	$989.50



The U.S. will continue to be the largest beef producing country. The total U.S. herd will be nearly 8 mil head larger by 2018-2019 than it was in 2014.
The Australian herd is expanding rapidly now, Brazil will continue to grow.

The U.S. will continue to grow pork and poultry production and be a major player in global pork and poultry trade.

The global slowdown that has crippled export markets the last two years is beginning to look a little more positive.

Currency wars will continue to be front and center as world markets try to kick start there economies.

Grain producers will experience prices that are near breakeven production cost for the next several years.

Most agriculture markets have declined 45-60 percent from the highs earlier in this decade. This price decline should be buying back demand.

NOTES

Proceedings, State of Beef Conference
November 2 and 3, 2016, North Platte, Nebraska

GENETIC SELECTION FOR MORE PROFITABLE COW-CALF ENTERPRISES: TACKLING INPUT COSTS

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Introduction

Steep increasing genetic trends for growth traits (weaning and yearling) and mature cow weight can be seen in many breeds but perhaps more alarming are those producers that have dramatically increased the genetic potential for milk production in their cow herds. Although it seems logical that profit (Revenue – Expense) should drive our selection decisions, it is hard to rationalize phenotypic changes overtime that can be seen in the U.S. cowherd. In order to actually select for increased profit, knowledge of environmental constraints, genetic antagonisms, and the selection tools that have the potential to measure profit are critical.

Sire selection does not need to be overwhelming or complex. Centuries of work by geneticists and statisticians have allowed for the development of tools that help producers make decisions regarding which bull(s) to use; do not ignore them. The key questions that every rancher needs to answer are:

1) What are my breeding/marketing goals?
2) What traits directly impact the profitability of my enterprise?
3) Are there environmental constraints that dictate the level of performance that is acceptable for a given trait in my enterprise?

Once these three questions are answered, sire selection becomes much simpler. The answers to these questions inherently lead a producer to the traits that are economically relevant to their enterprise. We call these traits Economically Relevant Traits (ERT).

Environmental Constraints

The development of an obtainable breeding objective begins by clearly identifying environmental constraints and marketing goals. Table 1 illustrates levels of production that are suited for differing production environments.

If feed resources are limited in a stressful environment then selection for increased output (high growth, milk, and red meat yield) could have negative impacts on the ability of cows to be successful breeders without the need for large quantities of harvested feed. The beginning of a profitable breeding objective is identifying what the environment will allow you to produce, at least until we have tools to apply direct selection to traits of adaptation.

Table 1. Matching genetic potential for different traits to production environments[1]

Production Environment		**Traits**					
Feed Availability	**Stress[2]**	**Milk**	**Mature Size**	**Ability to store energy[3]**	**Resistance to stress[4]**	**Calving ease**	**Lean yield**
High	Low	M to H[5]	M to H	L to M	M	M to H	H
	High	M	L to H	L to H	H	H	M to H
Medium	Low	M to H	M	M to H	M	M to H	M to H
	High	L to M	M	M to H	H	H	M
Low	Low	L to M	L to M	H	M	M to H	M
	High	L to M	L to M	H	H	H	L to M

[1] Adapted from Gosey, 1994.
[2] Heat, cold, parasites, disease, mud, altitude, etc.
[3] Ability to store fat and regulate energy requirements with changing (seasonal) availability of feed.
[4] Physiological tolerance to heat, cold, internal and external parasites, disease, mud, and other factors.
[5] L = Low; M = Medium; H = High.

Crossbreeding

At a meeting in 2016 it hardly seems fit to even mention crossbreeding. Commercial producers who have not yet adopted it are a burden to the beef industry. However, it is an excellent example of selection for profitability. We know that the two primary benefits of crossbreeding are complementing the strengths of two or more breeds and heterosis, neither of which create trait maximums. If we think about it simplistically, crossbreeding for a trait like weaning weight leaves us with a calf crop that is better than the average of the parental lines, not better than both parental lines. Crossbreeding, if done correctly, seeks to optimize many traits through complementing breed strengths and produce animals that are better than the average of the parental lines that created them. The best tool that the commercial cattleman ever had is based on optimization, not the production of extremes.

Genetic Correlations

All traits that might be included in a breeding objective are not independent of each other. Sometimes this is beneficial as we see a favorable correlated response, and other times these genetic correlations pit revenue against cost. A good example of this comes from the suite of weight traits. Depending on the targeted marketing endpoint either weaning weight (WW), yearling weight (YW) or carcass weight (CW) become a source of revenue and all are related to a major factor influencing the cost of production, mature cow weight (MW). Table 2 illustrates the genetic correlations between MW and WW, YW, and CW, respectively.

Table 2. Genetic correlations between mature cow weight (MW) and weaning weight (WW), yearling weight (YW), and carcass weight (CW).

	WW[1]	YW[1]	CW[2]
MW	0.62	0.45	0.81

[1] Estimates from Northcutt and Wilson, 1993.
[2] Estimate from Nephawe et al., 2004.

Other similar estimates between MW and WW have been shown in the literature ranging from 0.65 to 0.82 in Red Angus field data (Williams et al., 2009). The same authors estimated the genetic correlation between postweaning gain and MW to range between 0.48 and 0.59. This is particularly relevant in the context of producers that sell some portion of calves but also keep back their own replacement females. Care should be given not to focus solely on the revenue portion, sale weight, but rather optimizing input costs associated with mature weight and revenue sources from calf sale weight. The mature sale weight, CW, shows a strong and positive relationship with MW and again care should be taken to optimize selection between the two.

One potential way to mitigate these antagonisms is the use of specialized sire and dam lines. Using specialized sire and dam lines is not a new concept in beef cattle and in fact was fairly prominent in the 1970s. When Continental breeds first made an appearance in the US some four decades ago, these high growth and high yielding cattle were bred to British breed cows that were much more conservative in size and generally tended to have more fat (internally and externally). Challenges that arose included increased calving difficulty and the ability to source replacements in what was essentially a terminal based system. However, breeds have changed since then and data recoding schemes have improved to allow for additional EPD of economic relevance.

The goals of a terminal-based system revolve around the following traits: Early growth rate, calving ease direct (trait of the calf), calf survival, disease susceptibility, feed intake, meat quality, carcass composition, and male fertility. In contrast, the suite of traits of economic importance to a maternal-based system include: female fertility, maternal calving ease, longevity, moderate size, adaptation to production environment, disease susceptibility, milk production (optimal levels), maternal instinct, and temperament (optimal?). The only trait in common between the two is disease susceptibility, and many of the traits between the two are antagonistic. For instance, the genetic correlation between calving ease direct and calving ease maternal is -0.30. The genetic correlation between hot carcass weight and mature cow size is 0.8. If both systems, maternal and terminal, use the same bull battery (duel purpose) there is substantial opportunity cost given the differences in economically relevant traits between the two and the antagonisms that exists between the two. Although all the traits in the two systems above could be merged into one single breeding objective and thus one index, a fewer number of traits under selection allows for faster progress. The pork and poultry industries have this figured out.

Selection for Decreased Input

Traditionally, there have been few EPDs that could be used to directly select for decreased input costs. However, there has been one for some time, milk (maternal weaning weight). Research has shown cows with the genetic propensity to milk heavily require more energy for lactation and maintenance. The National Research Council (NRC) data shows a cow who produces 25 lbs. of milk at peak lactation requires 10% more feed energy than a cow producing

15 lbs. of milk at peak lactation. To see a 10% difference in feed energy with regards to mature weight it would require moving from a 1,000 lb. cow to a 1,200 lb. cow, or a change of 200 lbs. of body weight. Moderating mature cow size and selecting for an optimal window of milk production is beneficial when it comes to cutting costs regardless of your production environment given that milk production has been estimated to explain 23% of the variation in maintenance requirements (Montano-Bermudez et al., 1990). However, in limited feed environments females with high maintenance energy requirements may also have difficulty maintaining an acceptable body condition score and rebreeding. Nugent et al. (1993) determined with limited nutrient availability, breeds with a high genetic potential for milk production had longer anestrous periods, which lead to lower conception rates during a fixed breeding season. Other researchers have concluded selection for increased milk production past an adequate threshold is not economically or biologically efficient if the marketing endpoint was at either weaning or slaughter (van Oijen et al., 1993). While the lactation requirements may be intuitive, cows with a higher milk yield also tend to have increased visceral organ mass this increasing energy requirements even when the cow is not lactating (Solis et al., 1988).

Other selection tools exist for decreasing input costs including mature weight EPDs and more recently the Maintenance Energy EPD published by the Red Angus Association of America (Evans, 2001; Williams et al., 2009). The study by Williams and others clearly depicts selection for immature weights is occurring thus increasing MW. Furthermore, the study illustrates without accounting for this prior selection in the development of ME predictions, and inherent bias is created.

Bio-economic Index Values

Hazel (1943) summarized the need to formalize a method of multiple trait selection in the opening paragraph of his landmark paper on the topic of selection indexes:

> *The idea of a yardstick or selection index for measuring the net merit of breeding animals is probably almost as old as the art of animal breeding itself. In practice several or many traits influence an animal's practical value, although they do so in varying degrees. The information regarding different traits may vary widely, some coming from an animal's relatives and some from the animal's own performance for traits which are expressed once or repeatedly during its lifetime....These factors make wise selection a complicated and uncertain procedure; in addition fluctuating, vague, and sometimes erroneous ideals often cause the improvement resulting from selection to be much less than could be achieved if these obstacles were overcome.*

Although Hazel's contribution was groundbreaking, the US beef industry was slow to adopt a tool that had the potential to greatly simplify sire selection and place emphasis on that which is economically important. Economic indices are the preferred tool for multiple trait selection. A bio-economic index (I) is simply a collection of EPDs that are relevant to a particular breeding objective, whereby each EPD is multiplied by an associated economic weight (a). For example, the economic index value I can be written as:

$$\mathbf{I = EPD_1a_1 + EPD_2a_2 + EPD_3a_3 + ... + EPD_na_n}$$

where EPDs 1, 2, and 3 are multiplied by their corresponding economic weight and summed.

Consequently, a high index value does not necessarily mean an animal excels in all EPD categories given that superiority in trait can compensate for inferiority in other traits depending on how the EPDs are weighted in the index. A high index value should be thought of as excelling in the ability to meet a breeding objective. It is important to note before proper use of an index can be ensured, a breeding objective must be clearly identified. For example, the use of an index such as the American Angus Association's Dollar Beef ($B) in an enterprise that retains replacement heifers can lead to adverse effects, given that sire selection pressure has been placed on terminal traits via $B.

Table 3. Breed association selection indexes, market progeny endpoints and breeding system[1]

Breed	Index Name	Progeny Endpoint	Breeding System[2]
Angus	$W (Weaning)	weaned feeder calves	A
Angus	$EN (Maintenance Energy)	replacement heifers	M
Angus	$F (Feedlot)	live fed cattle	T
Angus	$G (Grid)	beef carcasses sold on a CAB grid	T
Angus	$B (Beef)	beef carcasses from retained ownership sold on a CAB grid	T
Charolais	TSPI (Terminal Sire Profitability Index)	beef carcass sold on grid	T
Gelbvieh	$Cow	replacement heifers	M
Gelbvieh	EPI (Efficiency Profit Index)	feedlot efficiency	T
Gelbvieh	FPI (Feeder Profit Index)	beef carcass sold on grid	T
Hereford	BMI$ (Baldy Maternal Index)	beef carcass sold on grid; replacement heifers retained	A
Hereford	BII$ (Brahman Influence Index)	beef carcass sold on grid; replacement heifers retained	A
Hereford	CHB$ (Certified Hereford Beef Index)	beef carcass sold on CHB grid	T
Hereford	CEZ$ (Calving Ease Index)	matings to replacement heifers	M
Limousin	MTI (Mainstream Terminal Index)	beef carcasses sold on grid	T
Red Angus	HerdBuilder	beef carcass sold on grid; replacement heifers retained	A
Red Angus	GridMaster	beef carcasses sold on grid	T
Simmental	API (All Purpose Index)	beef carcasses sold on grid; replacements retained	A
Simmental	TI (Terminal Index)	beef carcasses sold on grid	T

[1] Adapted from Weaber fact sheet available at www.eBEEF.org.
[2]T=terminal, A=all-purpose, M=maternal

An example of an all-purpose index (often called maternal in the beef industry because it contemplates the retention of females) that compares the importance of different weight traits comes from the Beefmaster breed. Ochsner et al. (2017) developed a maternal selection index for use by Beefmaster breeders. The index assumed Beefmaster bulls would be bred to British based cows and heifers and that heifers would be retained in the system and all cull heifers and steers would be sold at weaning. Six objective traits (the economically relevant traits we wish to improve) were considered for the maternal index including calving difficultly direct (CDd), calving difficulty maternal (CDm), 205-day weaning weight direct (WWd), 205-day maternal growth (WWm), mature weight (MW) and heifer pregnancy (HP). Results showed decreasing CDd, CDm and MW while increasing WWd, WWm and HP would increase profitability of the operation. Mature weight was the primary driver receiving 49.2% of the emphasis, implying that for the assumed parameters decreasing MW will do the most to improve profitability of operations with a maternal objective. Weaning weight direct was the second highest priority objective trait receiving 27.2% of the emphasis. These two traits are antagonistic to each other relative to the breeding objective, but since the genetic correlation between them is not unity progress can be made in both traits simultaneously.

Implications

Trends are rarely flat, as an industry we have measured ourselves by steep lines in one direction or the other. From a seedstock perspective this may have been perceived as necessary in order to differentiate themselves (either as breeders or as breeds) from others in the market place. Clearly identifying your production environment and realistic production goals given the environment is critical. Selection for profit will require more effort, detailed financial records, and a structured breeding objective that builds a cow herd based on optimum values and not extremes. One final thought, extremely low maintenance cows will push the lower threshold of what is biologically possible for weight and produce virtually no milk. High output cows will represent the other extreme, weigh more than most mature bulls and milk heavier than the best Holstein. Both excel in some measure of the profit equation (i.e. lowest cost or highest revenue) but neither promises to be profitable.

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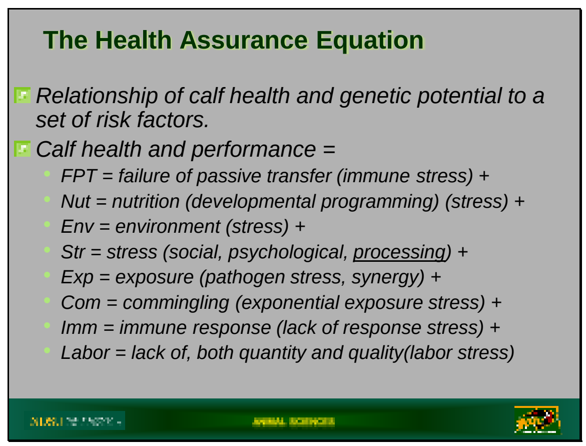
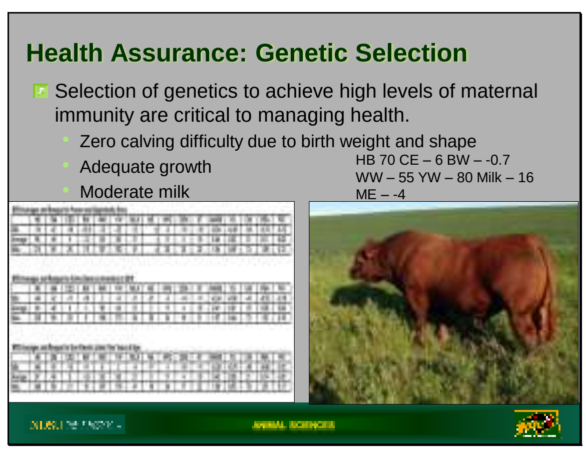
NOTES

Proceedings, State of Beef Conference
November 2 and 3, 2016, North Platte, Nebraska

HEALTH CONSIDERATIONS FOR THE CALF, SETTING UP FOR SUCCESS

Jerry Stokka, DVM, North Dakota State University





Health Assurance: Genetic Selection

Progeny Summary – 7 year old home raised

Males Females CI BirthWt WeanWt YearWt MPPA
2 3 374 99 (4) 99 (4) 103 (1) 99.23

HB – 93 CE – 13 BW – -4.7
WW – 32 YW - 48 Milk – 11
ME – -7

HB – 118 CE – 12 BW – -3.7 WW – 47 YW – 79 Milk – 14 ME – -3

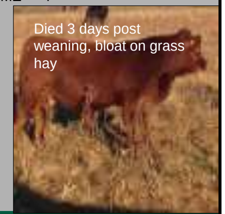
Health Assurance: Genetic Selection

Progeny Summary – 7 year old home raised

Males Females CI BirthWt WeanWt YearWt MPPA
5 0 367 99 (5) 106 (5) 113 (1) 104.62

HB – 88 CE – 8 BW – -1.9
WW – 38 YW – 69 Milk – 18
ME – -4

HB – 84 CE – 8 BW – -1.5
WW – 58 YW – 90 Milk – 15
ME – -4



Health Assurance: Molecular Genetic Technology

- Identifies parentage and verifies animal identity
- Clarifide Plus for Dairy
  - Wellness trait index
    - Mastitis
    - Metritis
    - Displaced abomasum
    - Ketosis
    - Retained Placenta
    - Lameness

Health Assurance: BRD and Heritability

- BRD is moderately heritable, and may be possible to reduce the incidence of BRD through genetic selection.
  - Variation in the BRD phenotype and immune system traits suggested herd health improvement may be achieved through genetic selection.
    - Cockrum RR, Speidel SE, Salak-Johnson JL, Chase CC, Peel RK, Weaber RL, Loneagan GH, Wagner JJ, Boddhireddy P, Thomas MG, Prayaga K, DeNise S, Enns RMJ Anim Sci. 2016 Jul;94(7):2770-8. Genetic parameters estimated at receiving for circulating cortisol, immunoglobulin G, interleukin 8, and incidence of bovine respiratory disease in feedlot beef steers.

Health Assurance: Genetic Effect - Heterosis

- Cows producing crossbred calves had greater immunoglobulin concentrations in the milk than cows producing purebred calves (Bos taurus X Bos indicus).
  - Sire of fetus effect on dam's lactation.
  - Heterosis of the fetus influences maternal production of colostral immunoglobulins.

Vann et al J.An.Sci. 1996

Health Insurance/Assurance: Genetic Effect - Crossbreeding

- **Antibody and cell-mediated immune responses and survival between Holstein and Norwegian Red × Holstein Canadian calves.**
- Results suggest that crossbreeding could improve resistance to certain diseases in dairy **calves**, resulting in decreased input costs to producers for **crossbred calves** compared with purebred **calves**.
  - Cartwright SL, Begley N, Schaeffer LR, Burnside EB, Mallard BA. J. Dairy Sci. 2011 Mar;94(3):1576-85.

Application: Genetic Management

- Cull Heavy
- Sell Out
- Start Over?



Health Assurance: Nutrition


Health Assurance: Nutrition

- Developmental Programming
  - Runt piglets.
    - The lower preweaning growth of runt pigs cannot be entirely explained based on their lower birth weight, nor do they show full postnatal compensatory growth.
  - Effects of uterine crowding are analogous to the detrimental effects of nutritional restriction in gestating sows on fetal myogenesis, birth weight, and postnatal growth.
    - The biological basis for prenatal programming of postnatal performance in pigs G. R. Foxcroft, W. T. Dixon, S. Novak, C. T. Putman JAS 2006

Health Assurance: Developmental Programming

Table 1. Parturition parameters of beef cows that were fed control or control plus supplementation from d 201 to 270 of gestation

	Diet			
Variable	CON[1]	SUP[1]	SEM[2]	P-value
Gestation length, d	277	276	1.1	0.43
Second stage labor length, min	48	57	15	0.66
Calving ease[3]	1.87	1.44	0.36	0.39
Colostrum weight, g	614	837	95	0.10
Colostrum IgG, mg/mL	119.1	130.2	6.6	0.23
Colostrum IgG, g	79	107	14	0.18

[1]Maternal diets; CON (n = 15), control group consuming basal diet; SUP (n = 12), supplemented group consuming basal diet + DDGS at 0.30% BW.
[2]SEM for n = 12.
[3]Calving ease score (1 = no assistance; 5 = caesarian section).

Health Assurance: Developmental Programming

Table 5. Blood parameters in offspring of beef cows that were fed control or control plus supplementation from d 201 to 270 of gestation

	CON[1]		SUP[1]			P-value		
Variable	0 h	24 h	0 h	24 h	SEM[2]	Diet	Time	Diet × time
pH	7.38	7.52	7.34	7.44	0.41	0.11	0.002	0.71
Hemoglobin, g/L	125.0	112.8	131.6	122.2	4.6	0.07	0.02	0.75
IgG, mg/dL	380	3150	300	3790	270	0.21	<0.001	0.21
Protein, g/dL	4.15	5.85	4.22	6.45	1.8	0.05	<0.001	0.12

[1]Maternal diets; CON (n = 15), control group consuming basal diet; SUP (n = 12), supplemented group consuming basal diet + DDGS at 0.3% BW.
[2]SEM for n = 12.

Application

- Genetic selection and Nutrition during pregnancy are critical risk factors to managing for health


Colostrogenesis, Colostrum & Transfer

Colostrogenesis

- Transfer of immunoglobulins (Ig's) from maternal circulation to mammary secretions (colostrum) begins several weeks prior to parturition (calving).
  - 500 g/week
  - IgG1 concentrations in colostrum 5-10X that of circulation.
- Rapidly declines immediately at parturition.

–Tizzard IR, Veterinary Immunology 2000
–Brandon, MR et al. Aust J exp bio 1971

Passive Transfer & CMI

- Maternal cells in colostrum cross intestinal barrier and become systemic.
- Transfer of live maternal cells from colostrum to neonatal calves enhanced responses to antigens against which the dams had previously responded (BVDV), but not to antigens to which the dams were naïve.
- Cell-mediated immune transfer to neonates can be enhanced by maternal vaccination.
  – Archambault et al AJVR 1988
  – Donovan et al. Am J Vet Res 2007;68:778-782

Risk of Disease & Failure of passive transfer (FPT)

- Calves with inadequate immunoglobulin concentrations at 24 hours of age were 3.2-9.5 times more likely to become sick and 5.4 times more likely to die prior to weaning.
- Levels <u><800mg</u> of IgG/dl are considered inadequate.
  – Wittum, TE, Perino, LJ AJVR Sep 1995

Risk of Disease and Partial FPT

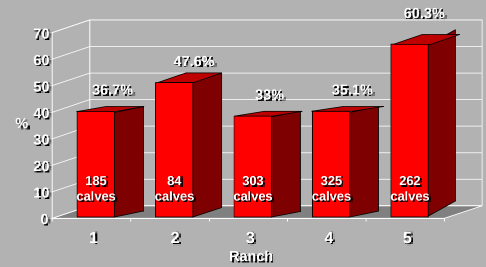
- <u>Calves with serum IgG1 levels up to 2500 mg/dl were 1.5X more likely to get sick before weaning and 2.4X more likely to die before weaning than calves with higher IgG1 levels.</u>
  - Dewell, RD., Hungerford, LL., Keen, JE., Grotelueschen, DM., Rupp, GP., Griffin, DD., 2002 Proceedings AABP

Relationship between Serum IgG Values and BRD in Calves

- 2 groups of 93 Holstein calves, severe BRD with 82% morbidity and 39% mortality
- Mortality
  - BRD deaths, the mean IgG was 1267 mg/dl
  - Surviving calves, the mean IgG was 2698 mg/dl
- Calves with lower IgG had
  - Higher morbidity
  - Were treated earlier
  - Were treated more frequently

Davidson, et al, JAVMA 179:7 (1981) 708-710

Immunoglobulins
5 Ranches, %<1500 mg/dl



Unpublished data,Grotelueschen & Hudson 1993

Colostrum Replacements/Supplements

- Serum IgG concentrations from calves fed natural colostrum averaged 2720 ± 1020 mg/dl with total serum protein 6.2 ± 0.7
- Serum IgG concentrations from calves fed 2 packages of colostrum replacements averaged 1690 ± 620 with total serum protein 5.6 ± 0.5
  - Land O' Lakes colostrum replacement

Foster et al, Serum IgG and total protein.. JAVMA 2006 229:1282-1285

Calving Stress & Environmental Stress

Health Assurance: Calving Stress

- In Herefords, increased calving difficulty was associated with a decrease in calf IgG1 levels (P<.05).
- Calves from Hereford lines selected for performance had lower IgG1 concentration than calves from the randomly selected control line.
  - Muggli,N.E.; Hohenboken,W.D.; Cundiff,L.V.; Kelley,K.W. JAS 1984 pp39-48

Health Assurance: Colostral Absorption & Calving Stress

- Decreased IgG1 absorption from colostrum was associated with respiratory acidosis (stress).
- Acidosis was frequently observed in calves that experience dystocia.
  - Besser,T.E.; Szenci,O.; Gay,C.C. JAVMA 1990 pp1239-1243

Mothering ability

Impact of Mothering Ability

- The presence of dams in the first hours of life and only at the time of first colostrum feeding (the most important part of received colostrum) can increase serum gamma -globulin concentrations of calves
- Mean serum gamma -globulin concentration in calves nursed in presence of dams was greater on days 2, 14 and 28.
  - Lotfollahzadeh,S.; et al. Journal of the Faculty of Veterinary Medicine, University of Tehran

Impact of Artificial Mothering

Table 2. Description of newborn heifer calves either artificially mothered by verbal and physical stimulation or handled with minimal stimulation (not mothered) before and after colostrum feeding

Item	Treatment group: Not mothered (n = 20)	Treatment group: Mothered(n = 21)	*Pval*
Prefeeding sample (0 h)			
Total protein (g/dL)	4.5 ± 0.3 (3.9 to 5.0)	4.6 ± 0.2 (4.0 to 5.1)	0.18
IgG (mg/mL)	0.3 ± 0.1 (0.2 to 0.5)	0.2 ± 0.1 (0.2 to 0.6)	0.38
Postfeeding sample (24 h)			
Total protein (g/dL)	**5.3 ± 0.2 (4.9 - 5.6)**	**5.4 ± 0.3 (4.9 - 6.0)**	**0.10**
IgG (mg/mL)	**13.9 ± 2.9 (8.0 - 19.8)**	**15.0 ± 2.5 (10.4 - 18.8)**	**0.21**
AEA of IgG	**36.4 ± 6.8 (21.8 - 47.4)**	**36.7 ± 4.3 (30.6 - 45.0)**	**0.86**

Haines, DM, Godden, SM, J. Dairy Sci. 94 :1536–1539

Health Assurance: Transportation & Environment Stress

Health Assurance: Pre-partum Stress

- Maternal stress (5 min restraint stress of pregnant sows in the last five gestational weeks) resulted in significant decreased serum immunoglobulin G (IgG) concentrations in suckling piglets at 1 and 3 days of age.
- Immunosuppressive effect on T and B cells.
- Morbidity and mortality were significantly increased during the suckling period.
  - Tuchscherer, M. et al Vet Imm and Immunopath 2002 86;195-203.

Health Assurance: Transportation Stress

- Exposing cows to repeated transportation stress during gestation altered their calf's physiological response to stress, and these alterations could have a profound influence on the calf's ability to adapt to stress.
  - Lay DC, et al. Effects of prenatal stress on suckling calves. JAS 1997 75:3143-3151

Health Assurance: Heat Stress

- Calves born to cows exposed to heat stress during the last 6 wk of gestation and fed their dams' colostrum have compromised **passive** and cell-mediated immunity compared with calves born to cows cooled during heat stress. Thus, heat stress negatively affects the ability of the calf to acquire **passive** immunity, regardless of colostrum source.
  - **Effect of heat stress during late gestation on immune function and growth performance of calves: isolation of altered colostral and calf factors.**
    - Monteiro AP, Tao S, Thompson IM, Dahl GE **J Dairy Sci.** 2014 Oct;97(10):6426-39.

Health Assurance: Cold Stress

- Severe dystocia (Calving Difficult Score 3) resulted in lower calf rectal temperature, reduced serum cortisol, and increased serum glucose which could affect the ability of the calf to withstand cold stress. Minor dystocia did not cause and timely cesarean delivery prevented the physiological aberrations encountered in severe dystocia.
  - Effects of severity of dystocia on cold tolerance and serum concentrations of glucose and cortisol in neonatal beef calves.
    - Bellows RA1, Lammoglia MA Theriogenology. 2000 Feb;53(3):803-13.

Health Assurance: Maternal Nutritional Stress

- Extra inputs supplied to meet requirements
- Genetic selection to reduce need for extra inputs, $EN, ME

Health Assurance: Nutrition Stress & Calf Health

	Condition Score 2	3	4	5	6	Significant Level
Interval from calving to standing (min)	--	59.9(8)*	63.6(30)	43.3(35)	35.0(1)	0.24
Colostrum prod. (ml)	750.0(1)	1525.0(2)	1111.5(13)	1410.9(11)	--	0.19
Calf serum IgG_1 (mg/dl)	1787.6(1)	1998.1(8)	2178.8(33)	2309.8)34)	2348.9(1)	0.23
Calf serum IgM (mg/dl)	159.5(1)	145.9(8)	157.2(33)	193.1(34)	304.1(1)	0.05

* Numbers in parentheses are the number of observations.

Source: K. Odde

Health Assurance: Impact of Inadequate Maternal Immunity

- Growth performance was impacted in calves with inadequate colostral intake/absorption due to its effect on neonatal morbidity(sickness).
- Neonatal morbidity(1st 28 days) resulted in a 35 pound reduced weaning weight.

- **Wittum TE, Perino LJ AJVR Sep. 1995**

Health Assurance: Far Reaching Impact of Inadequate Maternal Immunity

Calves with inadequate colostral intake/absorption were at much greater risk of illness or death <u>post weaning</u>.

- **Wittum TE, Perino LJ AJVR sep. 1995**

Health Assurance: Far Reaching Impact of Maternal Immunity

- Animals fed 4 L of colostrum at birth produced significantly more milk compared with those fed 2 L.
- Calves fed 4L had an advantage of 550 kg of actual milk produced per cow over the first two lactations.
- The direct economic return to the producer was approximately $160 per cow in additional milk produced over two lactations.
  - Faber, SN, et al The Professional Animal Scientist 2005

ANIMAL SCIENCES

Health Insurance

- Vaccination – High Quality Control
  - Necessary
    - Based on risk
  - Effective
    - Science
  - Safe
    - Limited local and systemic reactions

ANIMAL SCIENCES

Health Insurance

- Calves
  - Respiratory virus vaccination, 2 doses prior to weaning
    - IBR, BRSV, PI3, BVDV
    - Coronavirus?
  - Repiratory bacterial vaccination
    - *Mannheimia hemolytica, Pasteurella multocida?, Histophilus somni ?, Mycoplasma bovis ?*
  - Clostridial vaccination, 2 doses prior to weaning
    - *Clostridium chauvoei, Cl. septicum, Cl. novyi, Cl. sordellii*, and *Cl. Perfringens* types C and D

ANIMAL SCIENCES

Summary

- Health Assurance/Insurance
  - The Health Equation
- Health Assurance
  - Genetics
    - Selection pressure
  - Nutrition
    - Developmental programming
  - Colostrogenesis
    - Passive transfer
  - Stressors
    - Handling
    - Weather
    - Bio-security
- Health Insurance
  - Vaccination

ANIMAL SCIENCES

Proceedings, State of Beef Conference
November 2 and 3, 2016, North Platte, Nebraska

TECHNOLOGY FOR THE COW-CALF PRODUCER REVISITED

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Introduction

Cow-calf producers are frequently looking for ways to produce their calf crop more efficiently. While many new products and technologies are constantly being evaluated and released, it often seems proven technologies of the past are underutilized by today's producers. Possibly, misinformation and lack of information cause these efficiency improvements to be overlooked. One of these proven technologies is the use of growth implants. Approximately 90% of the cattle in the finishing sector receive growth implants (USDA, 2013). However, less than 30% of nursing calves receive growth implants (Rogers et al. 2015).

Growth Implants for Nursing Calves

Administering growth implants to suckling calves has been shown to increase gains by 4-6% by weaning which could translate into 15-30 lb extra weight to sell. No adverse effects have been shown on reproduction when heifer calves were implanted once between 2 months of age and weaning (Selk, 1997). However, bulls should not be implanted. Growth implants for nursing calves typically cost around $1.50/implant. Depending on the value of the calf, this can result in an addition $25-$40, which is a decent return on the investment.

Misinformation may be one of the most common reasons cow/calf producers choose not to administer growth implants to nursing calves. Many producers have concerns that implanted calves bring less at the sale barn than non-implanted calves. While heavier calves do generally bring less per pound, the overall price of the calf is usually higher when there is more weight to sell. Many factors impact the bidding price at the sale barn. These include size of the lot, fleshiness of the calves, whether they are mixed lots containing both steers and heifers, geographic region, needs of the bidders, and other factors that could change on any given day. A study was conducted by Rogers et al. (2015) evaluating whether implanting actually impacted the price of weaned calves at the auction barn. This study used multiple regression analysis to account for the many variables which can impact calf price at the sale barn so implanted and non-implanted prices could be statistically compared. The researchers evaluated 27,746 lots of calves and determined that there were no differences between the sale price of implanted and non-implanted calves (Table 1). Producers who are not administering growth implants prior to weaning need to consider selling those calves to a non-hormone treated specialty program for a premium to offset the loss of pounds available to sell from forgoing the implant.

Table 1. Effect of implant status on the sale price of beef calves marketed through a livestock video auction service from 2010 to 2013. (Adapted from Rogers et al. 2015)

Implant Status	No. of Lots	Least Squares Means ±SEM of sale price/cwt	Regression Coefficient	P-value
2010				
Implanted	2,123	114.99±0.22	0.08	0.53
Not implanted	5,355	114.91±0.20	0.00	
2011				
Implanted	2,126	141.45±0.40	0.16	0.39
Not implanted	4,882	141.28±0.37	0.00	
2012				
Implanted	1,940	163.07±0.35	0.11	0.64
Not implanted	4,429	162.96±0.30	0.00	
2013				
Implanted	1,997	162.05±0.50	-0.13	0.12
Not implanted	4,894	162.45±0.48	0.00	

Proper Implant Strategies

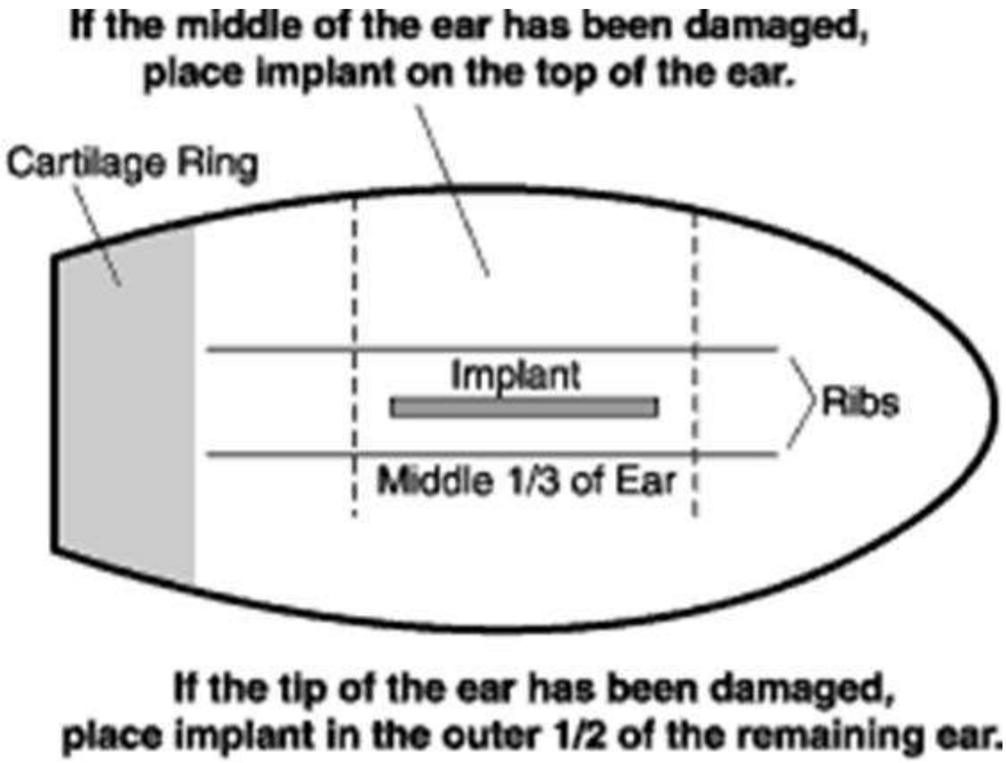
Producers also have concerns that if they implant the nursing calf, it will not respond to an implant given by the backgrounder who buys the weaned calf, thereby making the calf less attractive to the backgrounder or stocker operator. Given properly, a nursing calf should receive the weakest dose of an implant making it more responsive to the approved implant for the next segment of the industry. The only approved implants for nursing calves are Ralgro and Synovex C. There are several options available for growing cattle after weaning including Revalor G for grass cattle and Synovex H or S for calves not intended for reproduction. A low plane of nutrition is not an ideal diet for implanted cattle. Therefore, backgrounding cattle that are being fed just above maintenance should not be implanted. Once cattle are moved to a higher plane of nutrition, such as spring grass, an implant would be more effective. Growth promoting implants have been shown to increase pasture cattle gains by 10-30% (Duckett and Andrae, 2001; Capper and Hayes, 2012).

More options are available for finishing cattle including initial and terminal implants. The system cattle are in, the payout of the implant, and the overall goals of the operation need to be considered when selecting an implant program. However, traditionally, administering growth implants to finishing cattle results in 15-25% more gain with 8-12% more efficiency (Elam and Preston, 2004).

Proper Implant Delivery and Handling

Producers should always read and follow label directions when administering growth implants. In addition to administering the correct dosage for the animal in each production segment, implants should be administered in the middle 1/3 of the ear (Figure 1). A sharp clean needle should be inserted just under the skin between the veins in the ear and the needle should be wiped with disinfectant after each use. Abscessed implants can result in lost performance (Spire et al. 1999). Care should also be taken not to crush the implants and getting each pellet placed in the ear for best results.

Figure 1. Diagram of proper growth implant administration



Impact of Growth Implants on Hormone Content of Beef

Probably one of the biggest misconceptions about growth implants is that they have a large impact on the hormone content of the meat. While consumers may choose to select meat labeled as not receiving additional hormones, producers need to be paid a premium for the lost gain. It is also insightful if producers understand how little growth implants impact the end product so they can educate consumers. All meat contains some hormone because animals naturally produce it. To put this in perspective, a 3 oz. serving of meat from a non-hormone treated animal contains about 1.3 nanograms of estrogen while that same serving of meat from a hormone treated animal contains about 1.85 nanograms of estrogen. This is only about 0.5 nanogram difference. Conversely, a daily birth control pill will contain anywhere from 20,000-50,000 nanograms of estrogen depending on the type. Additionally, a non-pregnant woman produces 480,000 nanograms of estrogen per day. Therefore, any additional hormone from implanted beef is minute in comparison.

Conclusion

Growth implants are an underutilized technology in the cow/calf sector and to an extent, stocker operations. Growth implants improve gain and efficiency and typically result in $20-40 return on roughly $1.50 spent. Utilizing this technology improves efficiency without having a detrimental effect on consumer health or the environment.

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Capper, J.L. and D.J. Hayes. 2012. The environmental and economic impact of removing growth-enhancing technologies from U.S. beef production. J. Anim. Sci. 90:3527-3537.

Duckett, S.K. and J.G. Andrae. 2001. Implant strategies in an integrated beef production system. J. Anim. Sci. 79(E-Suppl.):E110-E117.

Elam, T.E., and R.L. Preston. 2004. "Fifty Years of Pharmaceutical Technology and Its Impact on the Beef We Provide to Consumers." Accessed August 31, 2011. http://www.feedstuffsfoodlink.com/Media/MediaManager/whitePaper-summary.pdf.

Rogers, G.M., M.E. King, K.L. Hill, T.E. Wittum, and K.G. Odde. 2015. The effect of growth-promoting implant status on the sale price of beef calves sold through a livestock video auction service from 2010 through 2013. Prof. Anim. Sci. 31:443-447.

Selk, G. 1997. Implants for suckling steer and heifer calves and potential replacement heifers. Pages 957:40-50 in Proc. Impact Implants Perf. Carcass Value Beef Cattle. Oklahoma Agric. Exp. Stn., Oklahoma State Univ. Stillwater.

Spire, M. F., D. A. Blasi, J. S. Drouillard, and J. M. Sargeant. 1999. Implant quality assurance:detection of abscessed implants and their effect on feedlot performance of beef heifers.Kansas State University, Cattlemen's Day Report, Report of Progress 831:124.

USDA. 2013. The use of growth-promoting implants in U.S. feedlots. APHIS Veterinary Services Info Sheet. July 2013.

Proceedings, State of Beef Conference
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OPTIMUM MANAGMEMENT FOR BACKGROUNDING SYSTEMS

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Diversity of Backgrounding Systems

I always tell students that I have the best job description in the world. I work in beef cattle production systems, which means I can conduct research on any topic that I want, as long as it is related to beef cattle, and I call it a system. Similarly, my mentor, Terry Klopfenstein, liked to say that every producer has a unique system, so our research programs will never be relevant to every producer. I preface my comments this way to acknowledge that it is impossible for me to describe optimum management for each backgrounding system. Each system is uniquely complex, and dynamic. Nevertheless, our goal is to provide information that is useful in decision making. This paper will attempt to present information on critical issues relevant to optimizing backgrounding systems.

Systems Analysis: Begin with the End in Mind

The overarching goal for most backgrounding systems is to utilize forage resources to add weight to growing calves. There are many macro-level benefits to our beef production system that result from backgrounding programs. For example, yearling cattle increase the amount of beef produced per cow exposed, a critical measure of efficiency in the system. Griffin et al. (2007) demonstrated that long-yearlings produce 50 pounds more carcass weight compared to calf-feds while consuming 77% as much feed during the finishing period. Additionally, backgrounded cattle are marketed at different times during the year, so our beef supply is extended.

For the individual producer, there are two critical pieces of information that need to be identified. First, what product is being marketed? System optimization (which is hopefully related to maximum profit) may differ for a cow/calf operator who is backgrounding through the winter months, a stocker cattle operator who is marketing to the feedlot, or an integrated operator who owns the calf from weaning until it is marketed to the packing plant. Our research program evaluates the system from weaning through the end of the feedlot phase and data tend to be interpreted for the producer who owns the cattle for that entire duration. However, we recognize that cattle may change ownership at various points in the system.

The second critical piece of information relates to the resources necessary to run the system. Since many backgrounding systems are based on a set forage resource, it is critical to first think about optimizing the use of the forage. Forages obviously vary greatly in both quality and price. When evaluating different forage options, it is beneficial to compare their cost per unit of energy. This can be accomplished by converting the price to $/lb on a dry-basis, and dividing by the TDN content (Table 1). While this process does not include the cost of processing and delivering harvested forage, it does illustrate that traditional grazed forages (summer range) has become expensive in Nebraska.

Table 1. Feed ingredient prices expressed as a function of their energy content.

Item	$/unit	$/ton (DM)	TDN, %	$/lb TDN
Sandhills range, stocker	$39.40/month[1]	$191.03[2]	63	0.1516
Grass hay	$70/ton	$77.78	55	0.0707
Grazed corn residue	$20/acre	$22.22[3]	55	0.0202
Baled corn residue	$60/ton	$66.67	43	0.0775
Corn silage	$31.98/ton[4]	$84.15	70	0.0601
Cracked corn	$2.83/bushel	$117.52	83	0.0708
Modified distillers grains	$52.25/ton	$104.50	108	0.0484

[1]Cornhusker Economics for North Region, published February, 2016.
[2]Assumes 550 lb steer consuming 2.5% of BW
[3]Assumes 225 bushel/acre corn harvest and 8 lb/bushel forage availability
[4]Assumes 225 bushel/acre corn harvest, $2.38/bushel corn price, and 38% DM silage harvest. Based on the economic analysis of Klopfenstein and Hilscher (2016).

Understanding the Nutritional Requirements of a Growing Calf

Beef cattle acquire amino acids for growth from dietary protein that escapes rumen degradation (rumen undegradable protein; RUP), and from microbial cells that are flushed from the rumen into the small intestine (bacterial crude protein; BCP). The amount of BCP that is produced is a function of dietary intake, and diet fermentability. Together, the RUP and BCP that are absorbed into the small intestine are known as metabolizable protein (MP). Young, growing calves have a high requirement for MP relative to their body weight because they are depositing muscle at a rapid rate. However, their dry matter intake is less compared to their older counterparts, and their diet may be less fermentable. As a result, BCP supplies a smaller proportion of their MP requirements compared to older cattle. From a practical standpoint, this means that growing calves benefit from RUP (or bypass protein) supplementation. Historically, RUP sources have been expensive or difficult to source. Distillers grains changed that. For example, we have established a response curve to distillers grains supplementation for growing calves grazing corn residue (Figure 1). At times when distillers grains prices are high, it is logical to substitute distillers grains with alternative supplemental feeds. Tibbitts et al. (2016) addressed this question by feeding corn, corn and urea, distillers grains, and Soypass (nonenzymatically browned soybean meal) to determine the need for supplemental RUP. All supplements provided equal energy so that the gain response was due to protein. Neither the corn, nor the corn and urea provided similar gains to the distillers grains or the Soypass (Table 2). Hilscher et al. (2016) added increasing amounts of Empyreal (high protein corn gluten meal) and Soypass to determine the optimum amount of supplemental RUP in silage-based diets. They observed a linear increase in ADG, and a linear improvement in feed converstion with increasing amounts of RUP (Table 3). While all diets need to be appropriately formulated for all nutrients, for many backgrounding situations, the largest return to supplement will be by providing RUP.

Figure 1. Effect of distillers grains supplementation on ADG of steer calves grazing corn residue. Adapted from Welchons and MacDonald, 2017

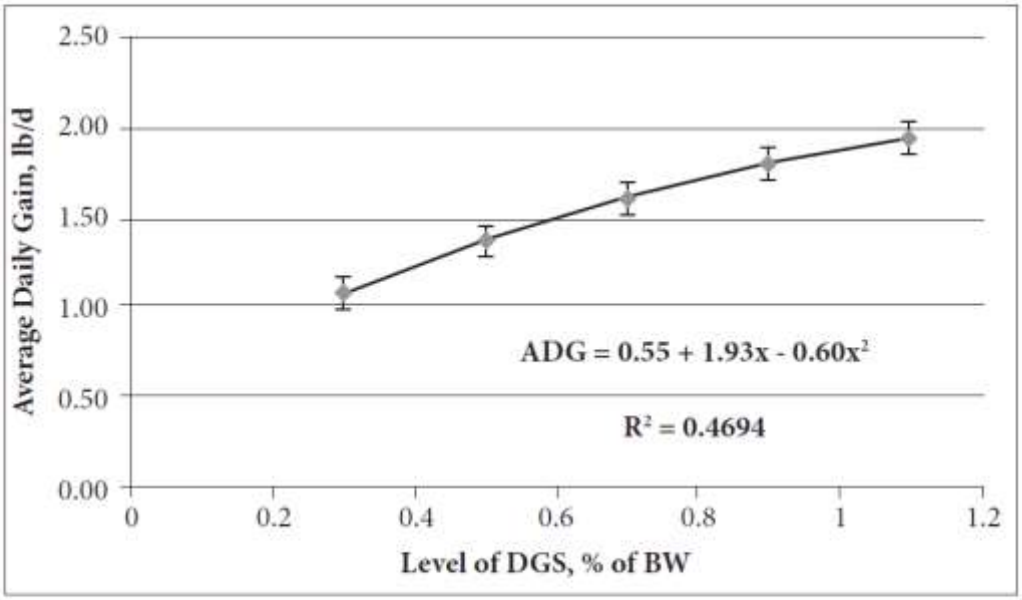

Table 2. Comparison of ADG response to protein and energy supplements for calves grazing irrigated corn residue[1]

	No Suppl.[2]	Corn[3]	Corn/ Urea[4]	DDGS[5]	Soypass[6]	SEM	*P*-value
Initial BW	516	516	516	516	516	3.5	0.1
Ending BW	504[a]	539[b]	559[c]	629[d]	640[e]	4.9	< 0.01
ADG	- 0.18[a]	0.31[b]	0.53[c]	1.32[d]	1.48[e]	0.06	< 0.01
Suppl. DMI, lb/d[7]	-	3.75	3.23	3.0	3.5	-	-
TDN, %	-	83	78	104	90	-	-
TDN intake lb/d	-	3.11	2.52	3.12	3.15	-	-
DIP balance, g/d	-144	-253	7	-161	-1	-	-
MP balance[8]	-19	126	93	144	258	-	-

[a-e] Means within a row with differing superscripts are different.
[1]Adapted from Tibbitts et al., 2016.
[2]Calves did not receive suppl. throughout feeding period.
[3]Suppl. contained 3.75 lbs. DM, whole corn.
[4]Suppl. contained 4 lbs. DM, 89% whole corn, 6% molasses, 5% urea.
[5]Suppl. contained 3 lbs. DM, dried distillers grains + solubles.
[6]Suppl. contained 3.5 lbs. DM, 60% soy-pass + 40% soybean meal.
[7]Suppl. was formulated to provide 3.12 lbs. TDN intake, which is the TDN amount supplied by 3.0 lb. dried distillers grains + solubles. This formulation requires differing DM amounts.
[8]Metabolizable protein balance to achieve the observed ADG for each treatment.

Table 3. Effects of increasing RUP in silage based growing diets on steer performance

	Treatments[1]					*P - value*	
Item	0%	2.5%	5.0%	7.5%	10%	Lin.	Quad.
Initial BW, lb	595	597	597	596	600	0.98	0.60
Ending BW, lb	791	824	855	842	868	< 0.01	0.88
ADG, lb	2.51	2.91	3.31	3.15	3.43	< 0.01	0.82
Feed:Gain	6.74	6.26	5.71	5.52	5.35	< 0.01	0.57

[1]Adapted from Hilscher et al. (2016). All cattle were fed 88% corn silage with a combination of RDP and RUP supplements to achieve either 0, 2.5, 5.0, 7.5, or 10% supplemental RUP (% of diet DM). The RUP source was a blend of Soypass + Empyreal in the final diet.

Supplementation: Added Cost or Profit Center?

Supplementation strategies that are put into place to increase production rather than correct a deficiency must return a profit. Therefore, backgrounding programs which employ protein and energy supplementation must understand compensatory gain. In short, the principles of compensatory gain suggest that cattle which exhibit lower ADG during a backgrounding phase will make it up during the subsequent growing or finishing phase. From a practical standpoint, it likely means that there must be more weight to sell in order to pay for the cost (purchase, delivery, labor) of providing the supplement. In the future, it may not be as simple as predicting compensatory gain. For example, Rolfe et al. (2012) supplemented yearling steers grazing Sandhills native range 0.6% BW modified distillers grains. Daily gain during the grazing season increased by nearly 50% (1.36 vs 2.03 lb/d for unsupplemented and supplemented steers, respectively), but the unsupplemented steers tended to compensate during the finishing phase (3.99 vs. 3.83 for unsupplemented and supplemented heifers, respectively; $P = 0.07$) such that there was no difference in the weight of carcasses sold. While additional weight did not pay for the cost of supplement, supplemented steers were still more profitable. Additionally, they estimated that each pound of distillers grains replaced 0.65 pounds of forage. If the price of grazed forage continues to increase in relation to the cost of distillers grains, it may be profitable to use supplement to increase stocking rates in addition to increasing ADG.

While there is not strong evidence for supplementation on summer grass, unless stocking rates are increased, there is strong evidence that supplementation during the winter period is beneficial. Gillespie-Lewis et al. (2016) evaluated both winter and summer supplementation strategies while spayed heifers (475 lbs) grazed corn reside through the winter, and then grazed Sandhills range through the summer. Heifers received either 2 or 5 pounds of distillers grains (DM-basis) while grazing corn residue, and then received either no supplement, or distillers grains supplemented at 0.6% BW while grazing range. Both winter and summer supplementation resulted in compensation in the subsequent growing phase. However, the magnitude of compensation was different. During the summer, heifers which had received 2 pounds of distillers grains compensated by 37% compared to heifers receiving 5 pounds of distillers grains. In the finishing phase, heifers receiving no supplement compensated 85% compared to heifers receiving distillers grains at 0.6% BW. As a result, winter supplementation increased hot carcass weight whereas summer supplementation did not. In an economic evaluation of the system, winter supplementation increase profitability (Table 4) whereas summer supplementation tended to reduce profitability.

Table 4. Effect of winter dried distillers grains (DDG) supplementation on system ADG and profitability[1]

Item	2 lb DDG	5 lb DDG
Winter ADG, lb	0.55	1.41
Summer ADG, lb	1.39	1.06
Feedlot ADG, lb	3.96	4.16
Final BW, lb	1,231	1,313
System Profit, $/hd	-9.64	46.26

[1]Adapted from Gillespie et al., 2014.

ADG: More is Better, or All Things in Moderation?

A logical question concerning winter supplementation is: how much gain should be targeted? Bondurant et al. (2016) supplemented 3, 5, or 7 pounds of distillers grains (DM-basis) to spayed heifers grazing corn residue. Gains increased from approximately 1.5 pounds/day to 2.0 pounds per day with increasing supplementation. In the first year of the two-year project (2012), subsequent ADG during the grazing period was quite low (0.5 to 0.8 pounds/day). While there was compensation, treatments did not maintain their weight difference at the end of the grazing period. Perhaps this illustrates the even the best-laid plans can go wrong at times. However, in the second year of summer grazing (2013), treatments responded as expected with compensation with increasing winter supplementation. In the second year, there was a linear increase in hot carcass weight with increasing amounts of supplementation, supporting the concept of increased supplementation during the winter period. Gillespie-Lewis (2015) conducted a sensitivity analysis where corn price and distillers grains price (as a % of corn price) was altered using an analysis of 6 combined experiments. Feeding distillers grains at a level that targeted 1.4 lb of ADG improved profitability, regardless of the price of corn ($3, $5, or $7/bushel), or the relationship of the price of distillers grains and corn (distillers grains priced at 80%, 95%, or 110% the price of corn). Within the data we have available, it appears that targeting 1.5 to 2.0 pounds of day during the winter period maximizes profitability of the system (weaning through finish) in most economic scenarios.

Conclusions

While each backgrounding system is unique, there appears to be tremendous opportunity to target up to 2 lb of ADG from weaning until spring grazing when the calf is approximately one year of age. Utilizing forage resources and supplements that are inexpensive per unit of TDN, such as grazed corn residue, makes this system even more advantageous. Supplementation of bypass protein is especially important in growing calves, which is why distillers grains have worked so well in backgrounding situations. Summer supplementation prior to entering the feedlot appears to be less beneficial unless stocking rate is increased to take advantage of forage replacement effects of supplementation.

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STRATEGIES FOR BREEDING HIGH RISK BEEF FEMALES

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Introduction

Managing replacement heifers after breeding is equally as important as pre-breeding management. After breeding, nutrient demands of the growing heifer increase to include advancing fetal growth, overcoming stress from calving, and first lactation. Failure to become pregnant after the birth of the first calf is a primary reason for culling in a beef cattle operation. The economic consequences of non-pregnant two-year-old cows can be very costly. Nutrition is the primary management factor that influences the postpartum interval (PPI) and subsequent pregnancy rates. Feed also represents the single largest expense in a cow-calf operation. Finding the optimum reproductive rate for a given production environment can be a fine balance, particularly with the first calf heifer. This review discusses management strategies to optimize second calf pregnancy rates in primiparous heifers.

Concepts

Postpartum interval

From calving until the cow conceives is a critical time in her production cycle. Minimizing this period maximizes reproductive and economic efficiency of a beef cattle operation. Factors affecting the postpartum interval (PPI) have been reviewed (Casida, 1971; Inskeep and Lishman, 1979; Short et al., 1990; Yavas and Wallon, 2005) and include nutrition, suckling, parity, season, breed, dystocia, disease, and presence of a bull. Postpartum interval is longer in primiparous than multiparous cows (Dunn and Kaltenbach, 1980)and even if calving occurs before the mature cow herd, fewer primiparous cows resume estrus by the beginning of the breeding season than mature cows (Stevenson et al., 2003).

Cows in estrus early in the breeding season have more opportunities to become pregnant during a limited time. A short breeding season for replacement heifers allows the last heifers to calve with more days to achieve a positive energy balance before the first day of their second breeding season. An extended breeding season for replacements may set up a heifer to not have calved before the next breeding season begins. A shorter breeding season makes for a shortened calving season, creating a more uniform calf crop that is more valuable at weaning. To have a successful, short breeding season, cattle must conceive early in the breeding season.

Minimizing the PPI is limited by uterine involution, which is the time needed for reproductive tract repair so another pregnancy can be established. However, uterine involution is generally completed by the time the inhibitory effects of suckling and negative energy balance allow for the first postpartum ovulation. Size differences between the previously pregnant and non-pregnant uterine horn can still be distinguished up to 4 weeks postpartum (Sheldon, 1994), but size may not reflect when cellular changes occur. Prior to day 20 postpartum, fertilization rates and pregnancy rates are very low, but not zero, and sperm transport may be a barrier to fertilization (Short et al., 1990). Malnutrition, disease, and calving difficulty can delay uterine involution in beef cows.

Body condition score (BCS)

Body condition can greatly affect net income on a cow-calf operation because it correlates to several reproductive events such as PPI, services per conception, calving interval, milk production, weaning weight, calving difficulty, and calf survival (Kunkle et al., 1994; Table 1). Body condition score (1=emaciated to 9=obese) generally reflects nutritional management; however, disease and parasitism can contribute to decreased BCS even if nutrient requirements are met.

Table 1. Relationship of body condition score (BCS) to beef cow performance and income

BCS	Pregnancy Rate, %	Calving Interval, d	Calf ADG, lb	Calf WW, lb	Calf Price, $/cwt	$/Cow Exposed[a]
3	43	414	1.60	374	96	154
4	61	381	1.75	460	86	241
5	86	364	1.85	514	81	358
6	93	364	1.85	514	81	387

[a] Income per calf × pregnancy rate.
Data from Kunkle et al. (1994).

Nutritional management

The relationship of nutrition to successful beef cattle reproduction has been reviewed (Wetteman et al., 2003; Randel, 1990; Hess et al., 2005). Hess and coworkers (2005) summarized the following key findings:

1. Prepartum, more than postpartum, nutrition determines postpartum anestrus length.
2. Inadequate dietary energy during late pregnancy lowers reproduction even if dietary energy is sufficient during lactation.
3. A BCS ≥ 5 will ensure adequate body reserves for postpartum reproduction.
4. Reproduction declines further when lactating cows are in a negative energy balance.

Nutrient demands during late gestation include both heifer and fetal growth. Fetal birth weight increases 60% during the last 70 days of gestation (Bauman and Currie, 1980). Providing adequate dietary energy and protein to meet this demand is a key step to adequate body condition at calving. The importance of prepartum protein and energy on reproductive performance has been consistently demonstrated (Table 2; Randel, 1990). Reproduction has low priority among partitioning of nutrients and consequently, cows in thin BCS often don’t rebreed.

In addition to impacting subsequent cow reproduction, nutrient intake during gestation impacts dystocia, calf health, and calf survival (Table 3; Bellows, 1995). Dams receiving inadequate protein and energy produce calves more susceptible to cold stress, weak, and slow to suckle, increasing the risk for passive transfer failure (Sanderson and Chenoweth, 2001).

Table 2. Effect of pre- or postpartum dietary energy or protein on pregnancy rates in cows and heifers

Nutrient and time	Adequate	Inadequate
	Percent Pregnant	
Energy level precalving[a]	73	60
Energy level postcalving[b]	92	66
Protein level precalving[c]	80	55
Protein level postcalving[d]	90	69

[abcd] Combined data from 2, 4, 9 and 8 studies, respectively.
Adapted from Randel (1990)

Table 3. Effects of feed level during gestation on calving and subsequent reproduction[a]

	Gestation diet of dam	
Item	Low	High[b]
Calf birth weight (lb)	63	69
Dystocia (%)	35	28
Calf Survival (%)		
At Birth	93	91
Weaning	58	85
Scours (%)		
Incidence	52	33
Mortality	19	0
Dam Traits		
Estrus (prior to breeding season (%))	48	69
Pregnancy (%)	65	75

[a]Average of seven studies; cows and heifers combined.
[b]Diet level fed from up to 150 days precalving; low and high, animals lost or gained weight precalving, respectively.
Reprinted from Bellows (1995).

If heifers are thin at calving, achieving a positive energy balance postpartum is essential for timely return to estrus and pregnancy. Lalman et al. (1997) provided increasing amounts of energy to thin (BCS 4), primiparous heifers postpartum, decreasing PPI as dietary energy increased (Table 4). Body condition at calving also influences response to postpartum nutrient intake. Primiparous cows fed to achieve BCS 4, 5 or 6 at calving were targeted to gain either 0.9 or 0.45 kg/d postpartum (Spitzer et al., 1995). Thinner cows had a greater response to energy level on initiating estrous cycles early in the breeding season than cows with greater BCS. However, even with increased postpartum energy, the pregnancy rates of thin, primiparous cows may not be acceptable.

Table 4. Influence of postpartum diet on weight change, body condition score (BCS) change, and postpartum interval (PPI)

	Diet			
Item	Low	Maintenance	Maint./ High	High
Calving Weight, lb	835	822	826	821
Calving BCS	4.27	4.26	4.18	4.10
PPI[a], d	134	120	115	114
PPI Wt. Change[a], lb	12	40	70	77
PPI BCS Change[a]	-.32	.37	1.24	1.50

[a]Linear effect, $P < 0.01$
Adapted from Lalman et al. (1997).

Fat

Inadequate energy and poor BCS can negatively affect reproductive function. Supplemental fats have been used to increase diet energy density and avoid negative associative effects (Coppock and Wilks, 1991), sometimes experienced with cereal grains (Bowman and Sanson, 1996) in high roughage diets.

Supplemental fats may also have direct positive effects on beef cattle reproduction independent of energy contribution. Fat supplementation has been shown to positively affect reproductive function in several important tissues including the hypothalamus, anterior pituitary, ovary, and uterus. The target tissue and reproductive response appears to be dependent upon the types of fatty acids contained in the fat source. Lactating dairy cows commonly receive fat supplements, primarily to increase diet energy density. Associated positive and negative effects on reproduction have been reported (Grummer and Carroll, 1991; Staples et al., 1998). The effects of fat supplementation on beef reproduction have been reviewed (Funston, 2004) and are summarized below.

Fat supplementation prepartum. Results from feeding supplemental fat prepartum are inconclusive. However, supplementation response appears to depend on postpartum diet. Beef animals apparently have the ability to store certain fatty acids, supported by studies in which fat supplementation discontinued at calving resulted in a positive effect on reproduction. Postpartum diets containing adequate levels of fatty acids may mask any beneficial effect of fat supplementation. There appears to be no benefit, and in some cases, feeding supplemental fat postpartum can have a negative effect, particularly when supplemental fat was also fed prepartum. Fat supplementation has been reported to both suppress and increase $PGF_{2\alpha}$ synthesis. When dietary fat is fed at high levels for extended periods of time, $PGF_{2\alpha}$ synthesis may be increased and compromise early embryo survival. Hess and coworkers (2005) summarized research on supplementing fat during late gestation and concluded feeding fat to beef cows for approximately 60 d before calving may result in a 6.4% improvement in pregnancy rate in the upcoming breeding season.

Fat supplementation postpartum. Supplementing fat postpartum appears to be of limited benefit from studies reviewed by Funston (2004). Many of the studies reported approximately 5% total fat in the experimental diet, so it is not known if more or less fat would have elicited a different response (either positive or negative). If supplementing fat can either increase or decrease $PGF_{2\alpha}$ production, the amount of fat supplemented might affect which response is elicited. First service conception rates decreased from 50% in controls to 29% in young beef cows fed high linoleate safflower seeds (5% DMI as fat) postpartum (Hess et al., 2005). The same laboratory also reported (Grant et al., 2002) an increase in $PGF_{2\alpha}$ metabolite when high linoleate safflower seeds are fed postpartum and a decrease in several hormones important for normal reproductive function (Scholljegerdes et al., 2003; Scholljegerdes et al., 2004).

Summary of fat supplementation. Currently, research is inconclusive on how to supplement fat to improve reproductive performance beyond energy contribution. Most studies have attempted to achieve isocaloric and isonitrogenous diets. Several studies had only sufficient animal numbers to detect very large differences in reproductive parameters such as conception and pregnancy rate. Research on supplementing fat has resulted in varied (positive, negative, no effect) and inconsistent reproductive results. Postpartum fat supplementation appears to be of limited benefit and adding a fat source high in linoleic acid postpartum may actually affect reproduction negatively.

As is the case for any technology or management strategy that improves specific aspects of ovarian physiology and cyclic activity; actual improvements in pregnancy rates, weaned calf crop, or total weight of calf produced are dependent on an array of interactive management practices and environmental conditions. Until these relationships are better understood, producers are advised to strive for low cost and balanced rations. If a supplemental fat source can be added with little or no change in the ration cost, producers are advised to do so.

Minerals and vitamins

Minerals and vitamins are important for all physiological processes in the beef animal, including reproduction. Both deficiencies and excesses can contribute to suboptimal reproduction. Management guidelines for mineral supplementation in cow-calf operations have been provided (Olson, 2007). The increased use of grain by-products in cattle rations require traditional mineral programs be re-evaluated, making allowances for high phosphorus and sulfur contents and altered calcium to phosphorus ratios found in grain by-products. Over feeding phosphorus is costly, of potential environmental concern, and does not positively influence reproduction in beef (Dunn and Moss, 1992) or dairy cattle (Lopez et al., 2004). Inadequate consumption of certain trace elements combined with antagonistic interactions of other elements can reduce reproductive efficiency (Greene et al., 1998).

Most vitamins (C, D, E, and B complex) are either synthesized by rumen microorganisms, synthesized by the body (vitamin C), or are available in common feeds and not of concern under normal growing conditions. Vitamin A deficiency, however, does occur naturally in cattle grazing winter range or consuming low quality crop residues and forages (Lemenager et al., 1991). Drought can extend periods when low quality forages are fed and increase the need for vitamin A supplementation. The role of vitamin A in reproduction and embryo development has been reviewed by Clagett-Dame and Deluca (2002). Vitamin A supplementation before and after calving has been demonstrated to improve pregnancy rates (Bradfield and Behrens, 1968; Meacham et al., 1970).

Nutrition and calving difficulty

Feeding a balanced diet the last trimester of pregnancy decreases calving difficulty. Heifers fed diets deficient in energy or protein the last trimester experience more calving difficulty; conceive later in the breeding season; and have increased sickness, death, and lighter calf weaning weights (Table 3).

Beef producers may be concerned excessive dietary nutrients during the last trimester of pregnancy will negatively influence calf birth weight and dystocia. Providing either adequate or inadequate amounts of dietary energy and protein and their effects on calving difficulty, reproductive performance, and calf growth have been reviewed (Houghton and Corah, 1987) and are summarized in Tables 5 and 6. Reducing energy pre-partum does not affect dystocia rates, even though birth weights were altered in some experiments. Of the 9 trials summarized, 6 demonstrated increased energy intake during the last trimester did not increase calving difficulty.

In addition, beef producers may be concerned crude protein levels will influence calf birth weight and subsequent calving difficulty. Houghton and Corah (Houghton and Corah, 1987) summarized studies investigating the effects of prepartum protein intake on calving difficulty (Table 6). Reducing prepartum dietary crude protein does not decrease calving difficulty, but it may compromise calf health and cow reproductive performance.

Table 5. Summary of supplemental prepartum energy effects on calving difficulty, subsequent reproductive performance and calf growth

Study	Prepartum Supplementation[a]	Effect	Birth Wt[b]	Dystocia[b]	Other[b]
Christenson et al., 1967	HE vs LE 140 d	HE	+	+	+ Milk, + estrus activity
Dunn et al., 1969	ME vs LE 120 d	ME	+	+	
Bellows et al., 1972	HE vs LE 82 d	HE	+	nc	nc weaning weight
Laster and Gregory, 1973	HE vs ME vs LE 90 d	HE	+	nc	
Laster, 1974	HE vs ME vs LE 90 d	HE	+	nc	
Corah et al., 1975	ME vs LE 100 d	ME	+	nc	+ estrus activity,+ calf vigor, + weaning weight
Bellows and Short, 1978	HE vs LE 90 d	HE	+	nc	+ estrus activity, + pregnancy rate, - postpartum interval
Anderson et al., 1981	HE vs LE 90 d	HE	nc		nc milk, nc weaning weight
Houghton et al., 1986	ME vs LE 100 d	ME	+	nc	+ weaning weight

[a]HE = high energy (> 100 % NRC); ME = moderate energy (approximately 100 % NRC); LE = low energy (< 100 % NRC)

[b] + = increased response; nc = no change

Adapted from Houghton and Corah (1987)

Table 6. Summary of studies on feeding supplemental protein during gestation on calving difficulty, subsequent reproductive performance and calf growth

Study	Supplementation[a]	Effect	Birth Wt[b]	Dystocia[b]	Other[b]
Wallace & Raleight, 1967	HP vs LP for 104-137 d Prepartum	HP	+	DEC	+ cow weight, + conception rates
Bond & Wiltbank, 1970	HP vs MP throughout Gestation	HP	nc		nc calf survivability
Bellows et al., 1978	HP vs LP for 82 d Prepartum	HP	+	+	+ cow weight, + cow gain, + weaning wt, DEC conception rate
Anthony et al., 1982	HP vs LP for 67 d Prepartum	HP	nc	nc	nc postpartum interval
Bolze, 1985	HP vs MP vs LP for 112 d Prepartum	HP	nc	nc	nc weaning weight, nc milk, nc conception rate, DEC postpartum interval

[a]HP = high protein (over 100% NRC); MP = moderate protein (approximately 100% NRC); LP = low protein (under 100% NRC)
[b] + = increase, nc = no change, DEC = decrease
Adapted from Houghton and Corah (1987)

Excess protein and energy

Caution should be used with feeding excess nutrients before or after calving. Not only is it costly, but cows and heifers with BCS > 7 have lower pregnancy rates and more calving difficulty than beef females with BCS 5 to 6. Excess protein and energy can negatively impact pregnancy rates. Overfeeding protein during the breeding season and early gestation, particularly if energy is limiting, may be associated with decreased pregnancy rates (Elrod and Butler, 1993). This decrease in fertility may result from decreased uterine pH during the luteal phase of the estrous cycle in cattle receiving high levels of degradable protein. The combination of high levels of degradable protein and low dietary energy in early-season grasses may contribute to lower conception rates. Negative effects of excess rumen degradable protein on reproduction are well documented in dairy literature (Ferguson, 2001).

Effects of supplementing feedstuffs high in undegradable intake protein (UIP) during late gestation and/or early postpartum have improved reproduction in cows grazing low quality forages (Hawkins et al., 2000; Mulliniks et al., 2011); however, when considering the broader set of data, results are inconclusive and may be dependent on the UIP level (Kane et al., 2004) and energy density of the diet (Martin et al., 2007). Further research is needed to understand how UIP stimulates or inhibits reproductive processes and under what conditions.

A recent study (Mulliniks et al., 2012) challenges dogma regarding BCS required at calving for successful conception rates. Retrospectively, 2 and 3-yr old cows were grouped by BCS 30 days before calving into 3 groups whose average BCS were 4.3 (n=186), 5.0 (n=108) and 5.8 (n=57). Days to lowest body weight, days to first postpartum ovulation, and pregnancy rate were similar among BCS groups. Cows studied by Mulliniks and colleagues (2001) were managed as one group before and after calving so BCS manipulation before calving did not impact the results. In contrast, other studies (Spitzer et al., 1995; Ciccioli et al., 2003) used prepartum ration changes to achieve desired BCS differences at calving.

Interpretation of this study (Mulliniks et al., 2012) must be tempered with the knowledge that dams of these heifers were successfully managed in the same production system for 10 years. Cows had access to sufficient grazing resources demonstrated by similar body weight changes even in years when precipitation was limiting. Implications of this observation across a wide variety of management systems is unknown; however, when considered with recent demonstrations of successful moderate heifer development systems (Funston and Larson, 2011; Roberts et al., 2009) it does question the common solution of providing more feed (and cost) to correct all young cow reproductive deficiencies.

Management Considerations

Breeding to pregnancy diagnosis

Many heifer development systems for spring calving herds rely on drylot development before shifting to pasture grazing. The transition from a drylot diet to grazing may come at the end of an AI program, the same time as early embryonic development. Stress during this transition may impact embryonic mortality.

If heifers must be moved after AI, consideration should be given to when the move occurs. Transportation stress impacts pregnancy rates. Mean conception date was earlier when heifers were transported 300 miles 1 to 4 days after AI compared with 8 to 12 or 29 to 33 days after AI (Harrington et al., 1995). Additional studies in heifers (Yavas et al., 1996) and cows (Merrill et al., 2007) investigated transportation one hour before or after AI and 14 days after AI. Concentrations of cortisol increased with AI and with transportation 14 days after AI, but pregnancy rates were not affected.

Nutritional stress can also reduce embryo quality and survival. Changing from a gaining or maintenance diet pre-insemination to 80% of maintenance for 6 days to 2 weeks post insemination produced developmentally delayed embryos (Bridges et al., 2012) and lower embryo survival and pregnancy rates (Dunne et al., 1999) occurred. Embryonic loss is greatest during early gestation with most losses occurring from day 8 to 16 corresponding with the time period between when the embryo reaches the uterus and maternal recognition of pregnancy (Diskin et al., 2012). Pregnancy rate to AI through the second service was higher in heifers gaining weight for 21 days after AI compared with heifers either maintaining or losing weight (Arias et al., 2012). Heifers maintaining or losing weight post AI had similar pregnancy rates.

Grazing is a learned behavior and it has been suggested grazing experience during development may improve yearling heifer performance (Olson et al., 1992). Increased energy required for grazing and the novelty of new surroundings and feedstuffs could combine to create a short term energy deficit for heifers transitioning from drylot to pasture. Weight loss was 1.6 ± 0.08 kg/day the first week on spring pasture for drylot-developed heifers (Salverson et al., 2005). Pregnancy rate was similar compared with range-developed heifers; however the breeding season did not begin until after an adaption period. A heifer development system that included a post-weaning grazing period reduced the number of steps taken on the first day of turnout compared with heifers developed in a dry lot (Perry et al., 2012). Drylot-developed heifers receiving supplementation the first month of grazing following AI had higher pregnancy rates than non-supplemented heifers (Perry et al., 2012). Supplementation on pasture did not increase AI pregnancy rates when heifers were developed on range compared with heifers receiving no supplement or drylot-developed (Perry et al., 2012). Improving heifer ADG on summer pasture has traditionally received minimal consideration in heifer development systems. Heifers with less gain (little to no supplement) during winter development had greater gains on summer pasture compared with heifers with higher gain (or supplemented) during winter development (Funston and Larson, 2011; Lemenager et al., 1980; Short and Bellows, 1971).

Pregnancy detection

Early pregnancy detection should not be overlooked as a management tool for producers. In addition to traditional palpation, increasing availability of ultrasound and commercial serum pregnancy tests provide more options for producers and veterinarians (Lucy, 2012). Pregnancy can be accurately detected with ultrasound as early as 25 days post breeding, but speed and accuracy will be improved by waiting until day 30 or later (Fricke and Lamb, 2005). Heifers conceiving early in the breeding period will have greater lifetime productivity (Lesmeister et al., 1973) in the herd and should be a priority to keep if drought or market conditions require herd reduction.

Pregnancy diagnosis to calving

Continued gain is needed through calving for heifer and fetal growth, particularly for more moderate development systems. Body weight and BCS at pregnancy diagnosis and 90 days pre-calving should be used to monitor development. Forage intake in pregnant heifers decreases as gestation advances (Patterson et al., 2003), which could impact gain and energy intake during the third trimester. Recommendations have been made for heifers to achieve 85% of mature weight and a BCS 5 to 6 by calving (Bolze and Corah, 1993). However, heifers developed to 53% of mature body weight at breeding that reached 77% of mature body weight at calving had pregnancy rates through 4 calving seasons ranging from 92 to 96 % (Funston and Deutscher, 2004). While dietary restriction during early heifer development may reduce cost and capitalize on compensatory gain, continued restriction during subsequent winter (gestation) periods will increase the proportion of non-pregnant heifers and reduce herd retention rate (Roberts et al., 2009; Endecott et al., 2012). Two-year old heifers failing to rebreed weighed less at calving and breeding than those that became pregnant the second time (Endecott et al., 2012).

Calving difficulty

First-calf heifers experience more calving difficulty compared with the mature cow. Bellows (1995) indicated cows experiencing calving difficulty will take longer to resume estrus than cows not experiencing calving difficulty.

Time of intervention, or when obstetrical assistance is needed, also affects resumption of estrus. Dams provided early assistance had a higher percentage in estrus by the beginning of the breeding season, increased fall pregnancy rate and improved calf gains compared to late assistance dams (Table 7; Bellows et al., 1988; Doornbos et al., 1984) as soon as possible.

Table 7. Effect of time of calving assistance[a] or duration of labor[b] on dam breeding and calf performance

Item	Time of Assistance/Duration of Labor	
	Early/Short	Late/Prolonged
Postpartum interval, (d)[a,b]	49	51
In estrus at beginning of breeding season	91[c]	82[d]
Services/conception[a,b]	1.15	1.24
Fall pregnancy (%)[a,b]	92[e]	78[f]
Calf average daily gain (lb)[a]	1.74[c]	1.63[d]
Calf weaning weight (lb)[a]	422	387

Adapted from [a]Bellows et al. (1988) and [b]Doornbos et al. (1984)
[c,d] Means differ $P < 0.10$.
[e,f] Means differ $P < 0.05$.

Stimulating Estrus

Ionophores

Ionophores can influence reproductive performance during the postpartum period (Sprott et al., 1988). Cows and heifers fed an ionophore exhibit a shorter PPI provided adequate energy is provided in the diet (Table 8; Randel, 1990). This effect is more evident in less intensely managed herds with a 60 to 85 day PPI. Pregnancy rates, if measured, generally were not different in the studies summarized by Randel (1990); however, in most cases the number of observations was relatively low. In a more recent study replicated over 2 years and 12 pastures, monensin was provided to crossbred cows early postpartum reducing days to conception and increasing calving percentage compared with cows not receiving monensin (Bailey et al., 2008). Adding an ionophore may also reduce feed costs through reduced intake and improved feed efficiency on lower quality forages and improved rate of gain with higher quality feedstuffs offered ad libitum (Sprott et al., 1988).

Table 8. Effect of ionophore feeding on postpartum interval (PPI) in beef cows and heifers

Study	Ionophore (PPI, d)	Control (PPI, d)	Difference (d)
1	30	42	12
2	59	69	10
3	67	72	5
4	65	86	21
5	92	138	46

Adapted from Randel (1990)

Calf removal

Suckling stimulus negatively affects estrous activity during the postpartum period; however, animals in a positive energy balance and adequate BCS generally overcome this negative stimulus prior to the breeding season. Calf removal, either temporary or permanent, can increase the number of cows returning to estrus during the breeding season (Randel, 1990; Williams, 1990). Some synchronization programs remove calves for 48 hours (Smith et al., 1979), which can induce estrus in postpartum cows and first calf heifers. It is important to provide the calves a clean, dry pen with grass hay and water during this separation.

Induction of estrus with hormones

An intravaginal insert (CIDR), containing progesterone, can shorten the PPI provided nutrition and BCS are adequate (Day, 2004; Perry et al., 2004). A number of protocols for synchronization of estrus and ovulation incorporate a progestin and have resulted in pregnancies in previously non-cycling females (Stevenson et al., 2003b). Ovulation induction with gonadotropin releasing hormone was limited in primiparous cows until BCS were ≥ 5 (Stevenson et al., 2003a).

Bull Exposure

Bull exposure requires exposing cows to surgically altered bulls not capable of a fertile mating. Reproductive performance of postpartum cows in response to bull exposure has been reviewed (Fiol and Ungerfeld, 2012) and is summarized in Table 9. Exposure length, proximity, timing of exposure, and nutritional status have impacted response. Primiparous cows exposed to bulls at 15, 35 or 55 days postpartum had shorter PPI than non-exposed cows, but PPI was similar regardless of the date exposure began (Berardinelli and Joshi, 2005). The PPI was reduced in cows exposed to as many as 1 bull per 29 females (Burns and Spitzer, 1992). Exposure to androgenized steers (Ungerfeld, 2009) or cows (Burns and Spitzer, 1992) will produce similar results.

Table 9. Summary of studies evaluating reproductive performance (resumption of cyclic activity and pregnancy rates) in postpartum cows exposed to males (EXP) or isolated from males (ISO)

Exposure type[a] and length (d)	Cyclic activity (%)		Pregnancy (%)		Reference
	EXP	ISO	EXP	ISO	
ASE/DPC (20 d)	---	---	58.5	50.0	Ungerfeld, 2010
BE/DPC (60 d)	81[b]	41[c]	67	63	Berardinelli *et al.*, 2001
BE/DPC-EPB (63 d)	87[b]	19[c]	87[b]	56[c]	Anderson *et al.*, 2002
BE/DPC-EPB (60 d)	85.1[b]	31.3[c]	66.3[b]	51.5[c]	Berardinelli *et al.*, 2007
BE/DPC (35 d)	100[b]	70.4[c]	85[b]	60[c]	Tauck and Berardinelli, 2007
BE/DPC (50 d)	82[b]	38.5[c]	54.5[b]	15.4[c]	Gokuldas *et al.*, 2010
BE/FCB (42 d)	86[b]	76[c]	58	77	Tauck and Berardinelli, 2007
TBU (64 d)	15	33	89.5[b]	55[c]	Tauck and Berardinelli, 2007

[a]ASE: androgenized steers exposure; BE: bull exposure; DPC: direct physical contact; EPB: excretory products of bulls; FCB: fence-line contact with bulls; TBU: treatment with bull urine.
[b,c] Different letters in the same row and for each experiment differ, $P<0.05$.
From Fiol and Ungerfeld (1997)

Summary

The interaction of nutrition and reproduction in young beef cows has been studied extensively. Diets that meet the high nutrient demands of late gestation and early lactation require attention and monitoring. Adequate nutrition will limit calving difficulty, increase calf health and vigor, and allow for a timely second pregnancy. Heifers that conceive in a short breeding season will have more time to achieve positive energy balance before the second breeding season. A BCS of 5 or 6 should be achieved by calving and maintained through the breeding season to minimize PPI. Several interventions can assist in shortening the PPI but none take the place of timely nutritional management. Advances in our understanding of nutrition and reproduction interactions may provide opportunities for strategic supplementation to optimize reproduction for a given production system.

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NOTES

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DECISION SUPPORT TOOLS

Randy Saner, Extension Educator, Nebraska Extension

Table 1. Smart phone applications available to beef producers. Many of these apps will also work on a tablet as well. Apps listed here are available at ITunes or Google Play for Android. Please note this is not a complete list.

Application	Created by	Costs	Description
AI Cowculator	University of Florida/Zoetis	Free	Assists in decision to AI or purchase a natural service sire
BCI Pregnancy Analytics	Kansas State University	Free	Allows animal and pregnancy information to be entered chute-side
Cattle Market Mobile	Grainger Software	Free	Provides current cattle prices, gestation calculator, calf estimated price calculator
Farm and Ranch Recordkeeping	University of Nebraska[1]	Free	Keeps a record of farm receipts and expenses
GrassSnap	University of Nebraska[1]	Free	Photo monitors grasslands
Land Lease Calculator	University of Nebraska[1]	Free	Collects information that might be charged for ag land leases
Livestock Heat Stress	USDA MARC	Free	Provides heat stress forecast maps for livestock
Mobile Cattle Tracker	University of Nebraska[1]	$9.99	Collects and accesses cattle records when they are needed
NUBeef - Anatomy	University of Nebraska[1]	$4.99	Visual and text information about muscles and bones of the beef carcass
NUBeef - BCS	University of Nebraska[1]	$.99	Assist in managing nutrition programs for beef cattle
NUBeef-cowQlate	University of Nebraska[1]	$.99	Collection of calculators for ag producers.
Teat and Udder scoring	University of Nebraska[1]	$.99	Visual and text information about the conformation of a beef cow's teats and udder.

[1]The University of Nebraska Beef Apps can alspbe found at http://beef.unl.edy/mobile-apps.
Computer decision support tools are available at
http://extension.unl.edu/statewide/westcentral/ag-economics/

Table 2. An example of how the NUBeef-cowQlate app calculates the cost of different feed sources for energy and protein. As you can see Alfalfa hay is a good buy for both protein and TDN (Total Digestible Nutrients) followed by hay and distillers grain and then cubes. Your results may vary depending on which feeds you select and your costs.

Alfalfa Hay (good 18%)	Corn	Grass Hay	Cubes	Distillers Grain
$70.00/ton	$3.10/bushel	$60.00/ton	$240.00/ton	$120.00/ton
.21 CP/lb	.70 CP/lb	.30 CP/lb	.61 CP/lb	.31/ CP/lb
.07 TDN/lb	.08 TDN/ lb	.07 TDN/lb	.18 TDN/lb	.06/ TDN/lb
.04 DM/lb	.06 DM/lb	.03 DM/lb	.13 DM/lb	.07 DM/lb

Table 3. An example of the information obtained from the BCI application.

Tag Number	Condition	Age	Days Pregnant	Breed	Calving Date	Interval
316	Over	Cow	150	Angus Hereford	2/26/2017	First 21 day interval
449	Thin	First Calf Heifer	120	Angus	3/29/2017	Second 21 day interval
515	Moderate	Heifer	110	Angus	4/8/2017	Third 21 day interval
451	Moderate	First Calf Heifer	85	Angus Hereford	5/3/2017	Fourth 21 day interval
280	Moderate	Cow	0	Angus		open

Table 4. An example of the information obtained from the Mobile Cattle Tracker app.

Dam Record	Dam Birthdate	Dam Management Group	Dam Preg check date	Dam Days Pregnant	Dam Preg check BCS	Dam Preg check wt
316	2013		10/17/2016	150	6.5	
449	2014		10/17/2016	120	4.5	
515	2015		10/17/2016	105	5	
451	2014		10/17/2016	75	5	
280	2012		10/17/2016	0	5	

Table 5. Below are some pros and cons for apps I have utilized.

Application	Pros	Cons
Mobile Cattle Tracker	▪ Keeps several records making it worth the $9.99. ▪ Sends results by e-mail to computer so you can manipulate data. ▪ Easy to use chute side.	▪ Takes time to enter because of scrolling to enter data. ▪ Days pregnant skips some of the days vet gives. ▪ Does not give approximate calf birth date.
BCI Pregnancy Analytics	▪ Type in numbers instead of scrolling, which is faster. ▪ Does nice job of sending data via e-mail. Can manipulate data on computer. ▪ Can use chute side. ▪ Gives approximate birthdate of calf for each cow checked.	▪ Must have internet and slows down as you enter more data points. Locked up during data entry for me.
NUBeef-cowQlate	▪ Good job of calculating cost per/lb protein and TDN. ▪ Also has cornstalk calculator, dry matter conversion calculator, and gestation calculator.	▪ Must know nutrient analysis of feed or book values. ▪ Shows 4 feeds at a time. ▪ Needs an e-mail feature to e-mail data.
AI Cowculator	▪ Has heat protocols for cows. ▪ Can calculate bull costs vs AI costs. ▪ Resource page.	▪ Would like it to have a scheduler for timed AI.
Cattle Market Mobile	▪ Gives current local auction prices. ▪ Has calf price calculator and a gestation calculator. ▪ Easy to use.	▪ Does not have cattle futures market.
NUBeef - BCS	▪ Helps producers learn body condition scoring as well as keeps data on cow herd	▪ Only records BCS, no other data collected.
GrassSnap	▪ Good monitor for range and grassland condition over time.	▪ Needs an e-mail option to print pictures.
Teat and Udder Scoring	▪ Good to learn how to score teats and udders.	▪ Could use larger pictures.

NOTES

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November 2 and 3, 2016, North Platte, Nebraska

PANEL: WHAT ARE BREED ASSOCIATIONS DOING FOR THE COMMERCIAL CATTLEMAN?

Dan Moser
American Angus Association

Shane Bedwell
American Hereford Association

Chip Kemp
American Simmental Association

Moderator: Matt Spangler

NOTES

Proceedings, The State of Beef Conference
November 2 and 3, 2016, North Platte, Nebraska

NEW FEEDLOT RESEARCH AND WHAT IT MEANS TO THE COW-CALF AND STOCKER SEGMENTS

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Introduction

The economic vitality of the Nebraska feedlot industry is critical to the cow-calf and overall beef industry. In Nebraska, the feedlot industry has essentially set the market for feeder cattle in the U.S. Multiple reasons make Nebraska very competitive for finishing cattle, including:

1. abundant grain supply that is often integrated into the beef operation
2. ready access to grain byproducts such as distillers grains plus solubles and corn gluten feed
3. packing capacity
4. abundant supply of high-quality feeder cattle from Nebraska and north
5. dry climate (most of the time) especially relative to other corn producing states, and
6. generally, small to medium-sized feedyards (<15,000 head capacity) spread across the entire state.

In February, 2014, Nebraska surpassed Texas with more "cattle on feed," which is a monthly picture or census of cattle in feedyards. There is seasonal variation but Nebraska has continued to have similar cattle-on-feed numbers with Texas over the past couple of years. What will be of interest is where the cattle go to be fed once some of the retention is realized in greater feeder cattle supply. With all that said, the feeding industry has experienced numerous months of large losses if the cattle were not forward priced or some type of risk protection was used to minimize losses. This is not sustainable and is reflected in the large decrease in feeder cattle price this fall. Unfortunately, each segment of the beef industry is often profitable at the expense of another segment. Currently, the retail/packing segments are profitable at the expense of the producers and feedyards. If history repeats itself, this will change and profitability will return to the feeding sector, but likely at the expense of decreased input costs for feeder cattle. This will impact the cow-calf sector.

Our feedlot program at the University of Nebraska-Lincoln focuses on numerous areas of research. We have two primary research feedyards with 100 pens at the PHREC (Panhandle Research and Extension Center) near Scottsbluff and 148 research pens at the ENREC (Eastern Nebraska Research and Extension Center, formerly ARDC) near Mead. Some of the "systems" calves from the GSL cowherd are fed and followed at WCREC in North Platte. We are blessed to be able to attract many of the brightest students to UNL for graduate research programs and benefit from a long tradition of excellence in this area. Another attribute of our program has been

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a long history of positive collaborations and interactions. Thus, this paper reflects the contributions of our group. These research areas include (not in any specific order):

1. Utilization of grain milling byproducts, and optimizing their use by feedlot cattle
2. Impact of nutrition and management on environmental challenges such as nutrient management and greenhouse gas emissions
3. Methods to improve starch utilization while decreasing acidosis which include new hybrids, grain processing, grain adaptation programs, and general biology of ruminal acidosis
4. Improving the use of underutilized and economical feed substitutes as possible such as increasing use of corn residue, primarily through silage in feedlot cattle
5. Optimizing production systems of cow to finish operations and optimizing production systems from weaning to market
6. Nutrient requirements, particularly related to protein and mineral nutrition of finishing cattle
7. Nutritional impact on food safety concerns such as pathogenic bacteria
8. Growth promotants and technologies that improve growth
9. Emerging issues such as welfare response to environmental stresses and impact of housing, natural feed additive uses, and emerging or new byproducts that develop

This paper and presentation will focus on highlighting corn silage research for growing and finishing cattle, which may also influence some cow-calf operations. As always, the annual Nebraska Beef Report (available online at http://beef.unl.edu or hard copy) provides an update on research projects that are timely and focused on the feedlot industry and other segments.

Use of corn silage in growing/finishing situations

Corn prices have been variable the past few years and were more expensive and now less expensive with bountiful production. As a result of the expensive grain times, we have initiated a few different research programs to address silage. 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. Our research for finishing cattle has focused on increasing use of corn silage as a method 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?

Corn silage inclusion for finishing

With increased 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 silage could be fed at 40 to 60% inclusion and still be economical, although feed conversion was poorer (i.e., 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 1). 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 poor weather (cold and wet; Burken et al., 2014). The second experiment was conducted over the summer with summer-fed yearlings (Burken et al., 2015). 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 2). 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 3) 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, including some of our own work. How silage is priced relative to corn grain is quite complex and will be discussed (see Klopfenstein paper below). The data suggest that shrink and applying nutrients back onto silage acres dramatically affects the economic outcomes for silage. But if manure is accounted for correctly and shrink is well managed (less than 15%), then feeding elevated amounts of silage (i.e., greater than 15%, perhaps 30 to 40% inclusion) is economical, especially for a farmer feeder.

Table 1. 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 2. 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 3. Effect of corn silage and MDGS inclusion on cattle performance and carcass characteristics with summer yearlings (Burken et al., 2015).

	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
12th-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).

Corn silage traits

I conducted a literature search for silage hybrid and beef cattle, as well as searches on kernel processing and silage. Of the first 80 articles that I evaluated (I did not go through the 20,800 results obtained in 0.7 seconds), 3 were focused on beef cattle and over 60 focused on dairy with the rest either agronomic focus, or nonsensical. Silage is well researched in dairy cattle nutrition, and less researched for beef cattle. This approach is somewhat logical if evaluating silage for finishing cattle as silage inclusion in diets is relatively low (traditionally less than 15%). However, for elevated inclusions in finishing diets and for growing programs where silages comprise the majority of the diet, research on different silage production methods, hybrids, kernel processing, storage methods, etc. are warranted and needed.

The dairy nutrition literature may not apply to beef cattle responses in many cases. The dairy cow is consuming very large amounts of feed (50 lb of DM or more). The passage rate is very high in dairy cows which can limit ruminal digestibility if particle size or grain processing is not optimized. Beef cattle will consume 50% or less of DM compared to dairy cows, which leads to much slower passage rates. These inherent differences may interact with the responses commonly observed in the dairy literature. The best example is grain processing. Finely ground dry corn has been shown to improve starch digestion in dairy cows, yet lead to acidosis and no production improvements in finishing beef cattle. The different response is presumably due to passage rate differences. With that said, here are some general statements related to corn silage traits.

1. Genetically enhanced hybrids (GMO) for agronomic traits such as herbicide tolerance or Bt tolerance that have been evaluated show clearly nutritional equivalence and no impact on performance or digestibility (Folmer et al., 2002, Vander Pol et al., 2005; Erickson et al., 2003; Grant et al., 2003).
2. Data on kernel processing of silage that has been fed to beef cattle are very limited. Numerous evaluations, including meta-analyses (Ferraretto and Shaver, 2012), have been conducted with dairy cattle (Johnson et al., 2002; Ebling and Kung, 2004). In general, kernel processing shows positive attributes for ruminal starch digestion and digestibility in general, but not greater milk yield, especially fat corrected (Ferraretto and Shaver, 2012).
3. Harvest maturity has been evaluated for impact in dairy cattle (Wiersma et al., 1993; Filya, 2004; Der Bedrosian et al., 2011; Johnson et al., 2002; Ferraretto and Shaver, 2012), and some for beef cattle (Andrae et al., 2001).
4. Hybrids and hybrid trait differences (endosperm traits and *bmr* traits) have been fairly well researched in dairy cattle (Ebling and Kung, 2004; numerous others), and some in beef cattle (Keith et al., 1981; Tjardes et al., 2000).

Harvest timing

Challenges for many producers is targeting the correct harvest window and accurately predicting whole plant silage DM at harvest. Challenges include equipment and time for the accurate harvest window, weather conditions at harvest (too wet, or quick drying conditions in the late summer), and custom harvester availability during silage harvest windows. What may be most critical are the moisture/DM contents at harvest to ensure optimum feeding. As Jim MacDonald's paper eludes to, we recently evaluated ensiling and feeding dryer silage to see if allowing for more grain (i.e., harvesting silage later at a greater DM) would improve performance when fed to both growing and finishing cattle.

Silage was harvested at either 37 or 43% DM and ensiled in silo bags. Fermentation was good in both cases based on different organic acids and pH (Table 4). While comparisons cannot be made statistically, the dryer silage had less NDF/ADF and more starch. The two silages were fed to either growing cattle (Hilscher et al., 2016a) or to finishing cattle (Hilscher et al., 2016b). Steers fed 88% corn silage-based growing diets with either DM of silage ate the same, but steers fed 37% DM silage had greater ADG and lower (better) F:G compared to steers fed dryer silage (Table 5). This was surprising as we hypothesized that with more starch and less fiber, the dryer silage would improve gain and efficiency. These same silages were fed to finishing steers at either 15 or 45% of the diet. No interactions were observed between silage inclusion and silage DM (Table 6). For finishing cattle fed either 15 or 45% silage, the DM of the silage did not impact DMI, ADG, or F:G (or any carcass characteristics). As expected and presented earlier, feeding 45% silage decreased ADG and increased F:G compared to feeding 15% silage (on a carcass-adjusted basis). Harvesting silage later (dryer) improves total yield and does impact nutrient characteristics of the silage, but appeared to not impact performance of finishing cattle and actually resulted in slightly poorer performance of growing steers fed 88% silage-based growing diets. Similar research has been observed in dairy cattle (Wiersma et al., 1993; Filya, 2004; Der Bedrosian et al.,2011; Johnson et al., 2002; Ferraretto and Shaver, 2012). Ferraretto and Shaver (2012) concluded from their meta-analysis that digestibility of corn silage (starch, fiber, and OM) was generally greatest with silages with DM between 36.1 and 40.0, which also had similar milk yield to silages fed with DM between 32 and 36. Once silage was greater than 40% DM, milk yield was lowered compared to wetter silages, despite total tract digestibility being greater for dryer silage. Based on the literature and our research with growing and finishing cattle, we suggest targeting a DM for silage between 36 and 40. Our experience is that most producers start a bit too wet or are forced to start too early due to weather, equipment availability, timing, etc. Waiting until silage is a bit dryer than traditional start times appears to enhance total yield and results in less grain yield “drag” compared to corn grain yield at maturity (i.e., black layer). The greatest challenge is still predicting whole plant silage DM while the crop is standing in the field. While grain filling markers are useful (milkline), there is still considerable variation in whole plant DM at similar milkline. Wiersma et al. (1993) observed up to 7 percentage unit differences in DM concentration across years and across hybrids at the same kernel milkline. I agree with their conclusion though that no other useful measures are available yet today as an alternative predictor of silage DM.

Table 4. Nutrient and fermentation analysis of 37 and 43 % DM silage

	37 DM		43 DM	
Item	Mean	C.V.[1]	Mean	C.V.[1]
DM[2]	37.3	(3.2)	42.7	(3.9)
CP	7.51	(3.6)	7.50	(1.2)
NDF, %	31.55	(17.5)	28.88	(5.7)
ADF, %	21.38	(15.8)	18.63	(17.9)
Starch, %	35.4	(16.7)	40.8	(5.0)
Sugar, %	2.6	(19.6)	2.5	(8.7)
pH	3.88	(1.3)	3.85	(1.5)
Lactic acid, %	3.11	(26.9)	4.14	(28.1)
Acetic acid, %	3.98	(21.5)	2.81	(27.1)
Propionic acid, %	0.51	(26.8)	0.28	(54.3)
Butyric acid, %	< 0.01	(0.0)	< 0.01	(0.0)
Total acids, %	7.61	(10.5)	7.22	(3.3)

1. C.V. = coefficient of variation and is calculated by dividing the standard deviation by the mean and is expressed as a percentage.
2. DM was calculated using weekly samples and oven dried for 48 h at 600 C.
3. All other samples are based on monthly composites, and analyzed at Dairyland Labs (St. Cloud, MN) and Ward Labs (Kearney, NE).

Table 5. Effects of delayed silage harvest on growing steer performance

	Treatments[1]			
Item	37% DM	43% DM	SEM	*P* - value
Initial BW, lb	597	597	3.8	0.92
Ending BW, lb	846	826	6.7	0.04
DMI, lb/d	18.0	17.9	0.3	0.93
ADG, lb	3.19	2.93	0.07	0.01
Feed:Gain[2]	5.63	6.11	-	<0.01

[1]Treatments: steers were fed 88% of either 37 or 43% DM corn silage.
[2]Analyzed as gain:feed, the reciprocal of F:G.

Table 6. The effects of delayed silage harvest and increased inclusion of silage on feedlot performance and carcass characteristics of yearling steers

	Treatments[1]					*P*-value		
	15 % corn silage		45% corn silage					
Variable	37% DM	43% DM	37% DM	43% DM	SEM	Int.[2]	Inclu[3]	DM[4]
Feedlot performance								
Initial BW, lb	938	942	938	942	1.1	0.77	0.87	< 0.01
Final BW[5], lb	1,353	1,375	1,325	1,334	17.4	0.69	0.04	0.49
DMI, lb/d	27.8	29.0	28.7	29.6	0.8	0.77	0.17	0.19
ADG, lb	3.89	4.05	3.61	3.69	0.21	0.75	0.04	0.55
Feed:Gain[6]	7.16	7.15	7.96	8.02	-	0.76	<0.01	0.94
Live Final BW, lb	1,393	1,425	1,387	1,405	24.4	0.75	0.54	0.41
Carcass characteristics								
HCW, lb	853	866	835	841	14.5	0.69	0.04	0.49
Dressing percentage, %	61.1	60.8	60.2	59.8	0.56	0.93	0.06	0.62
LM area, in^2	13.07	12.81	13.14	12.92	0.21	0.86	0.54	0.23
12^{th}-rib fat, in	0.52	0.55	0.51	0.51	0.04	0.51	0.28	0.65
Marbling score[7]	516	498	491	493	21.4	0.49	0.31	0.70

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

[1.] Treatments: 15% silage 37 % DM = 15% inclusion of 37% DM silage, 15% silage 43% DM = 15 % inclusion of 43 % DM silage, 45% silage 37% DM = 45 % inclusion of 37% DM silage, 45% silage 43% DM = 45 % inclusion of 43% DM silage; all diets contained 40% MDGS

[2.] Silage inclusion X Silage DM interaction

[3.] Main effect of silage inclusion comparing 15 and 45% of diet DM

[4.] Main effect of silage DM comparing 37 and 43% DM silage

[5.] Final BW calculated based on HCW / common dressing percent of 63%

[6.] F:G was analyzed as gain to feed.

[7.] Marbling score 400 = small[00], 500 = modest[00]

Use of Corn Silage in Growing Diets

Growing cattle perform well on corn silage-based diets if protein supplementation is done correctly. Recent research suggests the amount of bypass protein (rumen undegradable protein or RUP) is lower than previously estimated. The grain in silage is very wet high-moisture corn as it absorbs and becomes similar to moisture of silage and the protein is mostly degradable (RDP). The forage portion is similar to other forages in that most of the protein in the forage portion is RDP. As a result, most silage growing programs in the past have not been sufficient in protein, which limited growth potential from the energy in silage. We have recently revisited this concept. Two experiments were conducted evaluating response to bypass protein when supplemented with concentrated sources of RUP. In the first trial, up to 10% supplemental RUP was added in 2.5% unit increments (Table 7; Hilscher et al., 2016). Steers gained more per day and had better F:G as RUP supplementation increased. The responses were statistically linear, which suggests we did not reach the requirement for metabolizable protein. In a followup study (Table 8; Oney et al., 2017), up to 13% supplemental RUP was fed to growing cattle fed silage-based (85%) growing diets. Again, ADG and F:G improved linearly (based on statistics) but the response was the greatest the first 37 days with the lighter cattle responding better to RUP supplementation. The response was much less marked for ADG and not observed for F:G during the last 45 days of the growing period. To maximize the energy utilization from silage for growing calves, protein supplementation is essential, and that source needs to provide RUP. Distillers grains are the most cost-effective source of RUP available today.

Harvesting and storing high quality corn silage is crucial and a focus of our research program. With high quality corn silage and a little bit of protein calves can grow at a rate approaching 3 lb/d. Providing bypass protein (in the form of DGS) will increase that gain beyond 3.5 lb/d. More research is needed to evaluate all possible ratios of corn silage and distillers grains and the impact on growing/finishing cattle. When do cattle start to finish versus just growing requires more research work as well. In addition, kernel processing and optimizing the harvest window will help ensure optimum harvest technique and timing and if these issues impact performance. More data will be available soon addressing these issues as well as evaluating brown midrib silage for beef cattle.

Table 7. Effects of increasing RUP in silage based growing diets on steer performance

	Treatments[1]					*P* - value	
Variable	0%	2.5%	5.0%	7.5%	10%	Lin.	Quad.
Initial BW, lb	595	597	597	596	600	0.98	0.60
Ending BW, lb	791	824	855	842	868	< 0.01	0.88
ADG, lb	2.51	2.91	3.31	3.15	3.43	< 0.01	0.82
Feed:Gain	6.74	6.26	5.71	5.52	5.35	< 0.01	0.57

[1] Adapted from Hilscher et al. (2016). All cattle were fed 88% corn silage with a combination of RDP and RUP supplements to achieve either 0, 2.5, 5.0, 7.5, or 10% supplemental RUP (% of diet DM). The RUP source was a blend of Soypass + Empyreal in the final diet.

Table 8. Effects of increasing RUP in silage based growing diets on steer performance

	Treatments[1]					*P* - value	
Variable	0%	3.25%	6.5%	9.75%	13%	Lin.	Quad.
Initial BW, lb	605	606	604	608	604	0.99	0.86
d 1-37							
Interim BW, lb	692	707	713	730	729	0.03	0.26
ADG, lb	2.34	2.74	2.96	3.29	3.38	< 0.01	0.06
Feed:Gain	6.45	5.62	5.24	4.83	4.48	< 0.01	0.10
d 38-83							
Ending BW, lb	808	833	829	864	857	0.01	0.17
ADG, lb	2.52	2.74	2.51	2.92	2.78	0.10	0.28
Feed:Gain	6.58	6.76	7.30	6.33	6.54	0.64	0.86

[1] Adapted from Oney et al. (2017). All cattle were fed 85% corn silage with a combination of RDP and RUP supplements to achieve either 0, 3.25, 6.5, 9.75, or 13% supplemental RUP (% of diet DM). The RUP source was a blend of Soypass + Empyreal in the final diet.

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ENSURING END PRODUCT QUALITY: MANAGEMENT CONSIDERATIONS

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PRICE RISK MANAGEMENT AS PART OF A MARKETING PLAN

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Introduction

A written risk management plan that takes into account cost of production, meeting customer wants, market seasonality and price risk can help producers recognize and take advantage of marketing opportunities. Cattle price movement and volatility, (both up and down) in the last several years have been breathtaking. Many cow-calf and stocker/yearling producers are aware of price risk tools available to them such as futures and options that can be used to try to mitigate price risk. Utilization of these tools by many cow-calf and stocker/yearling producers seems to be limited. The size of Feeder Cattle futures contracts and options along with the specification of weight at 50,000 pounds of cattle per contract keeps many producers from considering the use of these tools. For some producers the idea of getting a broker and the potential for margin calls related to a market position deters many from using these tools to potentially reduce price risk.

Livestock Risk Protection Insurance

An alternative for producers to futures and options for price risk management is Livestock Risk Protection Insurance (LRP). This insurance is available to feeder and fed cattle producers. It is single-peril insurance that covers price risk only. It doesn't cover production or death loss risk. LRP is similar to a put option in that it allows a producer to set a floor price while leaving market moves to the upside open. LRP is available in many forms, terms of length and coverage levels. The insurance is offered by the USDA Risk Management Agency (RMA) and is available from licensed crop insurance agents. Dr. Kathleen Brooks and Dr. Jay Parsons have authored two Nebraska Extension NebGuides "Livestock Risk Protection Insurance for Feeder Cattle" and "Livestock Risk Protection Insurance for Fed Cattle" that provide details on the rules and regulations of LRP and give examples of how it works. These NebGuides are available at http://beef.unl.edu/nebguides.

An Analysis of LRP Insurance Performance for Feeder Cattle Producers

When evaluating a risk management tool like LRP insurance, it is beneficial to review historic performance for how the tool would have performed given parameters that reflect a future projected use. An analysis of 5 LRP cattle products available in Nebraska from 2005-2014 was conducted by Jay Parsons and Kathleen Brooks (2015). They analyzed a 13-week coverage endorsement which was taken out on August 6, or the subsequent Monday if August 6 was on a weekend) of each year at the highest coverage price available for the insurance. This resulted in an ending date of November 5-7 of each year. This time represents when many producers are marketing calves or feeder cattle off of grass in the fall.

The premiums reported in the tables are what producers would have paid after the 13% subsidy paid by the USDA.

Two tables from the analysis have been added to with data from 2015 utilizing the same time frame to reflect what would have occurred last year.

Results of the analysis showed for 5 of the 11 years from 2004-2015 that an indemnity would have been paid for steers weighing less than 600 pounds (Table 1) and steers weighing 600-900 pounds (Table 2). Indemnities were paid from 2006-2009 and also in 2015. From 2010 to 2014, insurance premiums would have been paid by the producer but no indemnities would have been collected for the coverage selected. Over that 11 year period, purchasing insurance for steer calves less than 600 pounds would have resulted in the producer collecting an average of $1.55 per hundred weight of steer calf insured. For every $1.00 in premiums the producer paid, they would have gotten back $1.55. Another way to look at it is that it would have netted an additional $7.75 per head on a 500 pound steer.

For the time frame analyzed, the year when buying the insurance was really beneficial was in 2008. That year an indemnity of $18.42 would have been paid per hundred weight of steer calf insured or $92.10 per head on a 500 pound steer. The 2008 year is the example of when buying the insurance proved to be valuable.

For several years in a row, from 2010 – 2014, producers buying the insurance would not have collected an indemnity. Producers who started buying the insurance in 2010 may have wondered at the value of buying the insurance as prices tended to be steady or increasing over that 5 year period for the time frame insured. However, LRP insurance is probably best utilized when it is consistently part of a complete marketing and risk management plan. Trying to out guess what the market will do when using LRP insurance will likely result in disappointing results.

SUMMARY

The use of LRP in a risk management plan provides the opportunity to protect against an unexpected downturn in the market. LRP Insurance should be viewed as its title implies, as insurance. A person purchases insurance on a car or a home hoping that they will not need to collect an indemnity. LRP insurance is much the same. A producer purchases the insurance hoping that they won't need to collect, but knowing the insurance protects them from a major downward price move in the market.

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Table 1. LRP-Feeder Cattle Steers Weight 1, less than 600 lbs

	8/8/05	8/7/06	8/6/07	8/6/08	8/6/09	8/6/10	8/8/11	8/6/12	8/6/13	8/6/14	8/6/15	Average	Indemnity Ratio
Expected Ending Value (Nov 5-7)	115.87	126.80	129.07	129.91	111.75	124.74	149.22	155.48	176.23	240.99	228.80		
Coverage Price	108.17	119.16	127.61	129.14	109.68	120.89	144.82	135.13	175.49	238.62	209.96		
Actual Ending Value (Nov 5-7)	127.67	113.52	119.64	106.25	102.47	122.45	156.17	158.53	181.05	264.40	208.47		
Indemnity	0	5.64	7.97	22.89	7.21	0	0	0	0	0	1.49	4.11	**1.61**
Premium	0.77	0.99	3.04	4.47	2.69	2.10	3.33	0.43	3.53	5.52	1.24	2.56	
Net Effect	**($0.77)**	**$4.65**	**$4.93**	**$18.42**	**$4.52**	**($2.10)**	**($3.33)**	**($0.43)**	**($3.53)**	**($5.52)**	**$0.25**	**$1.55**	

Table 2. LRP-Feeder Cattle Steers Weight 2, 600 to 900 lbs

	8/8/05	8/7/06	8/6/07	8/6/08	8/6/09	8/6/10	8/8/11	8/6/12	8/6/13	8/6/14	8/6/15	Average	Indemnity Ratio
Expected Ending Value (Nov 5-7)	105.34	115.27	117.34	118.10	101.59	113.40	135.65	141.35	160.21	219.08	208.00		
Coverage Price	98.34	108.32	116.01	117.40	99.71	109.90	131.65	122.85	159.54	216.93	190.88		
Actual Ending Value (Nov 5-7)	116.06	103.20	108.76	96.59	93.15	111.32	141.97	144.12	164.59	240.36	189.52		
Indemnity	0	5.12	7.25	20.81	6.56	0	0	0	0	0	1.36	3.74	**1.61**
Premium	0.70	0.91	2.77	4.06	2.45	1.91	3.03	0.38	3.21	5.01	1.13	2.32	
Net Effect	**($0.70)**	**$4.21**	**$4.48**	**$16.75**	**$4.11**	**($1.91)**	**($3.03)**	**($0.38)**	**($3.21)**	**($5.01)**	**$0.23**	**$1.41**	

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BEEF INDUSTRY PANEL

Perspective from the Interface of Cattle Feeding and Processing

Marcine Moldenhauer
Meat Link Management

Feeder Perspective

John Schroeder
Darr Feedlot

Retailer Perspective

Dave Weaber
Delhaize Group

Moderator: Galen Erickson

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