"Preparing Production Profit Centers"

Celebrating the 66th Annual

Florida Beef Cattle Short Course

Proceedings

May 3 - 5, 2017

Department of Animal Sciences

Alto and Patricia Straughn IFAS Extension Development Center
Gainesville, Florida

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Department of Animal Sciences

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Welcome to the 2017 Florida Beef Cattle Short Course:

The 2017 Florida Beef Cattle Short Course Program Committee and the Department of Animal Sciences would like to welcome you to this year's Short Course. We look forward to this week every year in anticipation of delivering the premier educational event for serious beef cattle producers in the Southeast. We hope that you enjoy the program and take away some new knowledge about the beef cattle industry's future direction, additional management decision making skills, and new information about specific production and management practices that impact your beef cattle enterprise.

Planning for the Florida Beef Cattle Short Course is a year-round event. Shortly after every Short Course we review the survey comments from those participants that return them to us. The surveys are one of our key mechanisms to get your feedback about the quality and content of the Florida Beef Cattle Short Course. We appreciate the feedback that we get and would welcome all of our participants to return the surveys and voice their opinion. Late in the summer we begin evaluating subject areas and specific topics for the next year's Florida Beef Cattle Short Course. Our program committee works hard to identify important, timely topics that impact our beef cattle producers. We then work through the fall to identify the best speaker for that topic area and invite them to speak at the Florida Beef Cattle Short Course. We are privileged to get nationally recognized individuals to speak at the Florida Beef Cattle Short Course and appreciate the limited time they have in their schedules. Our excellent speakers come from both out of the state and within UF/IFAS. Our UF/IFAS speakers are a valuable resource, with Florida specific experience and an investment in the Florida beef industry. Likewise partnering with our valuable Allied Industry partners we work to bring you a viable and diverse Tradeshow to share industry and product specific information.

Gainesville has been the home of the Florida Beef Cattle Short Course for the past 65 years. Survey responses consistently indicate that our participants prefer the Florida Beef Cattle Short Course to stay in Gainesville. Remaining in Gainesville offers certain advantages for us to deliver the excellent program that you have come to expect. We hope the Alto and Patricia Straughn Extension Professional Development Center location provides a comfortable and professional location, allowing us to provide a cost-effective, valuable learning experience for you.

The Program Committee has worked hard over the years to deliver a premier program at a reasonable cost to our participants. The Florida Beef Cattle Short Course is a self-sustaining program and receives no direct financial support from the UF/IFAS Department of Animal Sciences or UF/IFAS Extension. In as much, the Florida Beef Cattle Short Course has to meet costs associated with speakers' expense, meeting space, refreshment breaks, and material costs. Unfortunately, we have to pass those increased costs on to our participants. Just like the beef cattle industry, our costs of operation continue to increase in all facets.

Thank you for choosing to attend the 2017 Florida Beef Cattle Short Course. We hope that the program meets your expectations and provides you with valuable information to impact your beef cattle enterprise.

Best Regards,

Matt Hersom

Matt Hersom

Chair, 2017 Florida Beef Cattle Short Course

Florida Beef Cattle Short Course
UF

66th Annual
Florida Beef Cattle
Short Course

May 3 – 5, 2017

Presented by

Department of Animal Sciences

Institute of Food and Agricultural Sciences

University of Florida, Gainesville, Florida

2017 Florida Beef Short Course Committee

Matt Hersom, Chair
Joel McQuagge
Todd Thrift

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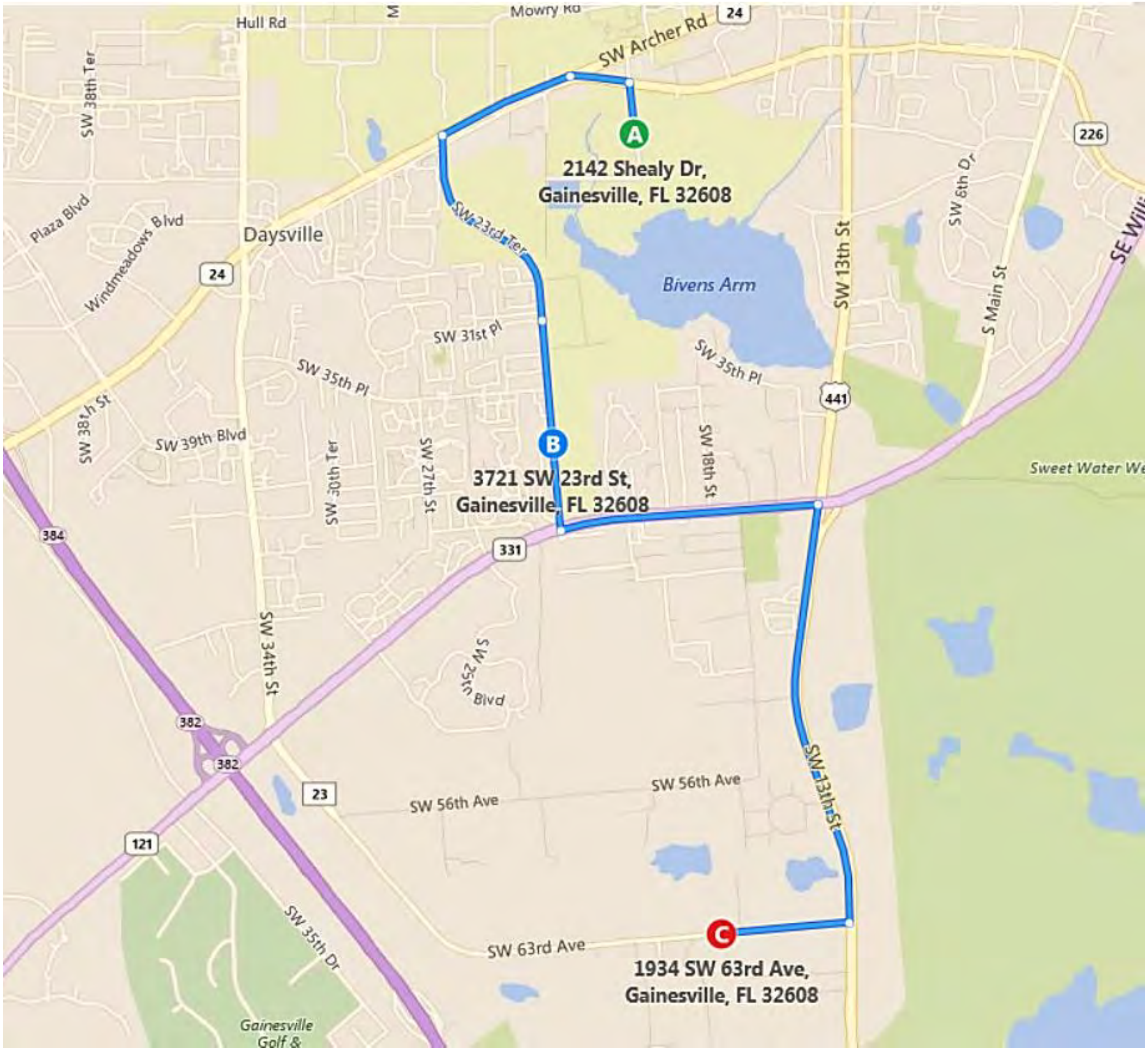

A

- Depart the Straughn Center, turn left on **Shealy Dr.** (.02 mi)
- Go to stop light and turn left on **SW 16th Ave/SR-226 W.** (0.2 mi)
- Bear left onto **SW Archer Rd/SR-24 W.** (0.5 mi)
- Turn left onto **SW 23rd Ter** (0.8mi)
- **Road name changes to SW 23rd St.**
- **Go through the round-about.**
- Your destination is on the left Beef Teaching Unit-**3721 SW 23rd St.**

B

- **3721 SW 23rd St.**
- Depart the Beef Teaching Unit and turn left onto **SW 23rd St.** (0.3)
- Turn left on **SW Williston Rd/SR 331 N.** (0.9 mi)
- Turn right onto **SW 13th St./US-441 S./SR-25 S.** (1.4 mi)
- Turn right onto **SW 63rd Ave./CR 23** (0.4)
- Your destination is on the right (if you reach SW 21st Terr., you've gone too far)

C

- **1934 SW 63rd Ave.**

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Thank you for your continued support!

2017 Florida Beef Cattle Short Course

"Preparing Production Profit Centers"

Wednesday, May 3, 2017

1:00 Welcome
1:15 Florida Cattlemen's Association Comments – Ned Waters, FCA, Bartow, FL
1:30 Beef Cattle Market Outlook – Chris Prevatt, Univ. of Florida – RCREC, Ona, FL
2:15 Efficiency of Protein Use by Beef Cattle – Tryon Wickersham, Texas A&M Univ., College Station, TX
3:00 Break
3:30 Economic Sustainability in the Florida Cow Herd – Flint Johns, Lykes Bros. Ranch, Okeechobee, FL
4:15 Florida Ranchers Beef Program – Don Quincey, Quincey Cattle Co., Chiefland, FL
4:45 Everything I Need to Know I Learned From the Internet – Matt Hersom and Todd Thrift, Univ. of Florida – ANISCI, Gainesville, FL
5:30 Reception

Thursday, May 4, 2017

8:30 Reproductive Tract Score: Tool or something else – Todd Thrift, Univ. of Florida – ANISCI, Gainesville, FL
9:15 Using Genomics to Affect Cow Herd Reproduction – Matt Spangler, Univ. of Nebraska, Lincoln, NE
10:00 Break
10:30 Managing Cow Nutrition - Jason Smith, Univ. of Tennessee, Knoxville, TN
11:15 Pasture Management for Optimal Productivity – Jennifer Tucker, Univ. of Georgia, Tifton, GA
12:00 Lunch at Beef Teaching Unit
1:30 Experiential Learning Demonstrations
Calf Processing, Carcass Ultrasound, Oocyte Pickup Technology, EPD's Simplified, Feed ID and Application, Reading Mineral Tags, Facility Design
6:00 Steak-Out at Horse Teaching Unit

Friday, May, 5, 2017

8:00 2016 Feeder-Finish Calf Demo Recap – Todd Thrift, Univ. of Florida – ANISCI, Gainesville, FL
8:30 Nutrient Profiling – Mineral Supplementation – Matt Hersom, Univ. of Florida – ANISCI, Gainesville, FL
9:15 Nutrient Profiling – Metabolic Imprinting – Philipe Moriel, Univ. of Florida – RCREC, Ona, FL
10:00 Break
10:30 Muscle Profiling – Tracy Scheffler, Univ. of Florida – ANISCI, Gainesville, FL
11:15 Integrated Nutritional Systems, Nicolas DiLorenzo, Univ. of Florida – NFREC, Marianna, FL

Agenda subject to change without notice.

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Speakers Biographies

66th Annual Florida Beef Cattle Short Course

Nicolas DiLorenzo
UF/IFAS North Florida Research and Education Center (NFREC), Marianna, FL
Dr. Nicolas DiLorenzo received his degree in Agricultural Engineering from the Universidad Nacional de La Plata, Argentina, in 2002. He moved to the U.S. in 2002 to pursue graduate studies at the University of Minnesota, where he obtained his Master degree in 2004 and his PhD in 2008, both in Animal Science with emphasis in beef cattle nutrition. From 2008 to 2010 Dr. DiLorenzo worked as a postdoctoral Research Associate at Texas Tech University in Lubbock, TX, conducting research in the area of feedlot nutrition and management. In 2010 he joined the University of Florida as an Assistant Professor in Animal Sciences at the North Florida Research and Education Center in Marianna. His primary research and extension interests are in the area of beef cattle nutrition, with the objective of improving the efficiency of use of forages minimizing the environmental impact. His research focuses on ruminal metabolism and fermentation, emissions of greenhouse gases, and nutrient excretion in cattle systems.

Matt Hersom
UF/IFAS Department of Animal Sciences, Gainesville, FL
Dr. Matt Hersom is an Associate Professor and Extension Beef Cattle Specialist at the University of Florida. His specific area of emphasis includes development of strategic nutritional and supplementation programs to optimize beef cattle performance utilizing forage and roughage based diets and evaluation of calf production and growing practices to improve animal performance in integrated beef production systems. Extension areas address expanding education experiences in beef cattle nutrition, implementation of optimal supplementation strategies for Florida cow-calf production, and development of increased pasture and forage utilization and management.

Flint Johns
Lykes Bros, Inc., Okcheechobee, FL
Flint Johns has been the Ranch Manager at Lykes Bros. Inc. since 2011. His primary responsibilities include management and oversight of cattle, farming, and equipment operations. Prior to his position as Ranch Manager he worked as a Special Projects Coordinator for Lykes Bros. Inc. from 2007 to 2011 as an analyst supporting the cattle, farming, forestry and biofuel crop divisions of Lykes Bros. Inc.

Flint received a Bachelor of Science in Food and Resource Economics in 2004 from the University of Florida and a Master of Agribusiness in 2006 from the University of Florida. Flint had the privilege of receiving the UF/IFAS College of Agriculture and Life Sciences Horizion Award in 2014 and the UF Alumni Association's Outstanding Young Alumnus Award in 2015. He currently serves as Chairman of the Florida Beef Council.

Originally from Ocala, FL, Flint now lives in Okeechobee, FL with his wife, Stephanie, and two children Hannah Kate (7) and Judson (4).

Philipe Moriel
UF/IFAS Range Cattle Research & Education Center (RCREC), Ona, FL
Dr. Moriel was located at the Mountain Research Station in Waynesville, NC where he worked as an Assistant Professor and Livestock Specialist with North Carolina State University. Starting in June 2016, Dr. Moriel's research program at UF will focus on: (1) nutrition of cows and heifers during gestation (Fetal-programming) and calf nutrition during early stages of pre-weaning phase (Metabolic Imprinting) to modify offspring metabolism and induce long-term consequences to offspring health, growth, and immunity; (2) strategic supplementation during pre- and post-breeding periods to optimize pregnancy rates and calving distribution of beef females; and (3) identify cost-effective, post-weaning nutrition and management strategies to develop replacement beef heifers and alleviate calf stress, increase calf immunity, response to vaccination, and value at sale.

Chris Prevatt
UF/IFAS Range Cattle Research & Education Center, Ona, FL
Chris Prevatt joined the University of Florida at the Range Cattle Research and Education Center in February 2014. He graduated from Auburn University (WAR EAGLE) in 2011 with a Bachelor of Science in Accounting. He then continued his studies at Auburn University and received his Master of Science in Agricultural Economics in August of 2013. During his undergraduate and graduate studies at Auburn University he worked on numerous livestock and forage economic research and extension projects. He continues to be actively involved with his family's cattle ranching endeavors in Alabama and Florida. At the University of Florida he works extensively developing economic information that cattle and forage producers can use to make more profitable management and marketing decisions. GO GATORS

Tracy Scheffler
UF/IFAS Department of Animal Sciences, Gainesville, FL
Tracy Scheffler received her B.S. from Michigan State University, M.S. from Purdue University, and PhD degree from Virginia Tech. She joined the Department of Animal Sciences at the University of Florida as an Assistant Professor in 2014. Her research program focuses on muscle biology and meat science. Specifically, she is interested in the effect of muscle metabolic properties on growth, composition, and efficiency of livestock, and the adaptations that occur in muscle in response to environmental and nutritional factors. Another focus is determining how these properties impact changes that occur in muscle early postmortem and during meat aging, in order to improve tenderness, color, and other traits that dictate economic value of fresh meat.

Jason Smith
Department of Animal Science, University of Tennessee, Knoxville, TN
Jason was raised in northern Virginia on a commercial cow/calf and hay operation. After receiving his B.S. in Animal Science and M.S. in Ruminant Nutrition from West Virginia University, he spent 2 years as a Ruminant Nutritionist and Biologist for the U.S. Food and Drug Administration's Medicated Feeds Team. Jason then furthered his formal education in beef cattle production at Virginia Tech, where his Ph.D. research was focused toward better understanding the long-term implications of early nutritional management strategies on feed efficiency and growth physiology of beef cattle. Jason is currently an Assistant Professor and Extension Beef Cattle Specialist for the University of Tennessee Institute of Agriculture, located in Knoxville, TN. There, his program is focused toward increasing producer knowledge of nutritional management and its impact to beef cattle productivity, production efficiency, and profitability. Through focusing in these areas, he hopes to facilitate the connection between both fundamental and applied research discoveries and producer application.

Matt Spangler
Animal Science Department, University of Nebraska-Lincoln, Lincoln, NE
Matt Spangler grew up on a diversified crop and livestock farm in Kansas. He received degrees from Kansas State University (BS; 2001), Iowa State University (MS; 2003), and the University of Georgia (PhD; 2006) and is currently an Associate Professor and Extension Beef Genetics Specialist at the University of Nebraska. He works as part of a team with colleagues at UNL and US MARC to improve genetic/genomic selection tools and methods.

Todd Thrift
UF/IFAS Department of Animal Sciences, Gainesville, FL
Dr. Todd Thrift received his B.S at the University of Kentucky in Animal Science, an M.S. at Oklahoma State University in Ruminant Nutrition, and a Ph.D. at Texas A&M University in Physiology of Reproduction. Dr. Thrift has a 70% teaching, 30% extension position in Beef Cattle Management. His teaching appointment has him teaching Cow/Calf Management, Beef Cattle Nutrition, and Stocker/Feedlot Management. His extension appointment has him focusing as a Beef Quality Assurance Coordinator and with the National Animal I.D. Prior to coming to the University of Florida; Dr. Thrift worked for Texas A&M University, as a beef cattle specialist for five years.

Jennifer Tucker
Department of Animal and Dairy Sciences, University of Georgia, Tifton, GA

Dr. Jennifer (Johnson) Tucker is an Assistant Professor in the Department of Animal and Dairy Sciences at the University of Georgia, located on the Tifton Campus. Raised on a beef cattle operation in South Central Kentucky, she grew up learning how to utilize grazing management and help to improve the pastures on her family's farm. She began at the University of Georgia in January 2016, after being the Alabama Extension Forage Specialist (Auburn University) for three years. Previously Dr. Tucker had worked at UGA in a post-doctoral position in the biomass for bioenergy program at Tifton Campus. In 2010 she obtained her Ph.D at the University of Kentucky, where she studied the effect of new novel endophyte tall fescue varieties on the physiology and growth of beef cattle.

Dr. Tucker currently sits on a number of nationally recognized boards including the Forage and Grassland Foundation (Board Member), serving her second term on the National Forage Testing Association Board, and as a public director on the American Forage and Grassland Council Board of Directors. At UGA, Dr. Tucker serves a split appointment and works to streamline her research/extension efforts to focus on improving beef nutrition and forage management and utilization in Georgia and across the Southeast. In addition to working with the widely recognized UGA Beef and Forage Teams, Dr. Tucker studies the influence of alfalfa interseeded into bermudagrass on beef nutrition, conducts grazing evaluations on warm season forage systems, as well as studies on the many other aspects of improved beef nutrition and forage management and utilization in Georgia. The main objective of Dr. Tucker's program is focused on improving beef nutrition and forage quality and utilization while extending the grazing season in the Southeast.

Tryon Wickersham
Department of Animal Science-Nutrition, Texas A & M

Dr. Tryon Wickersham is an associate professor in the animal nutrition section of the Department of Animal Science. He is also a member of the graduate faculty. He received his bachelor's degree in animal science from Texas A&M University and his master's degree and doctorate in ruminant nutrition from Kansas State University.

Dr. Wickersham teaches graduate level courses and laboratories in animal nutrition. He also directs research in ruminant nutrition with an interest in forage utilization and nitrogen metabolism. His previous research has focused on protein supplementation to cattle consuming low-quality forage and nitrogen metabolism in cattle consuming diets that are deficient in nitrogen. Future research goals include determining optimum supplementation strategies for ruminants consuming forages of divergent nutritive values and furthering our understanding of nitrogen metabolism in ruminants.

2017 Beef Cattle Market Outlook

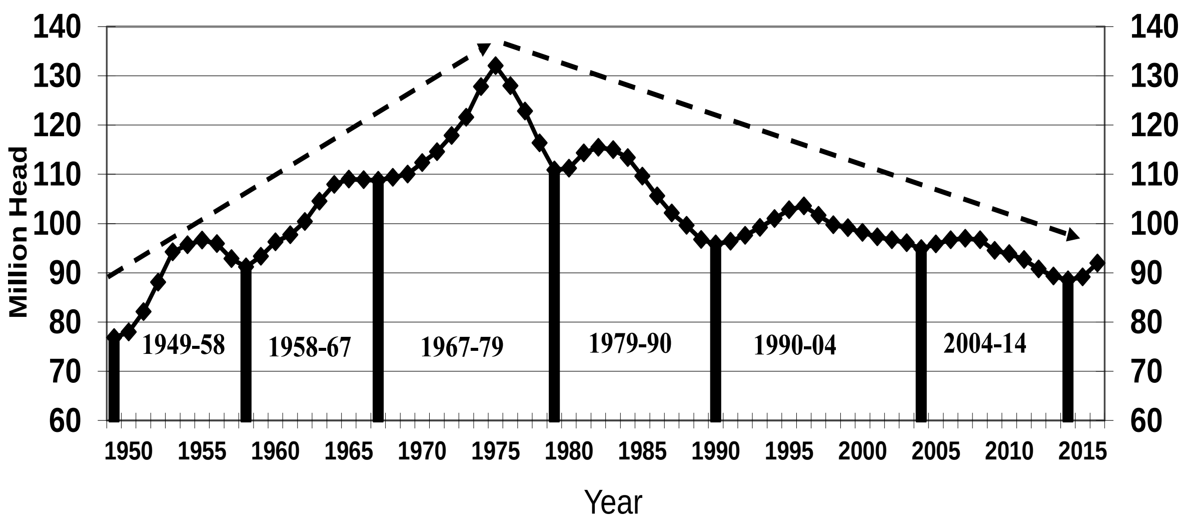
Chris Prevatt[1]

[1]UF/IFAS Range Cattle Research & Education Center, Ona, FL

The U.S. beef cattle industry has historically been a large contributor to U.S. cash receipts of agricultural commodities. During 2015, the U.S. beef cattle industry accounted for approximately $79 billion (21 percent) of the $377 billion of total U.S. cash receipts of agricultural commodities (Economic Research Service, USDA). Supporting this large dollar contribution of the U.S. beef cattle industry to the U.S. agricultural economy is a beef industry that is widely dispersed throughout 50 states and composed of numerous specialized production enterprises (seed-stock, extensive and intensive cow-calf, stocker, backgrounder, and feedlot enterprises). These enterprises expand and decrease over time as a result of an infinite number of variables that affect the levels of cattle inventory numbers and pounds of beef production.

The U.S. cattle inventory numbers have shown significant increases and decreases over the last six decades. Figure 1 describes the expansion and contraction of the U.S. cattle inventory between 1949 and 2016. Two distinct observations are notable in Figure 1 regarding cattle and calves inventory.

Figure 1. U.S. Cattle and Calves Inventory, January 1, 1949-2016



First, there was an increasing trend between 1949 and 1975 followed by a decreasing trend between 1975 and 2016 in U.S. cattle and calves inventory (denoted by the dashed lines with arrows). Between 1949 and 1975 U.S. cattle and calves increased from 77 to 132 million head, an increase of 55 million head or 77 percent. Then inventories declined between 1975 and 2016 from 132 to 92 million head, a decrease of 40 million head or -30 percent. The decline in U.S. cattle and calves inventory since 1975 has been caused by higher levels of efficiency in all sectors of the U.S. beef industry (more pounds of beef per brood cow), larger levels of competing meats, and a wider array of other goods and services demanded by U.S. consumers. This chart documents in the most recent cattle cycles (1990-04 and 2004-14) that the increases and decreases of cattle inventory numbers have been more moderate compared with historic cattle cycles which suggests that we may see only modest declines in cattle inventory numbers during the current cattle cycle. Arguably, U.S. policy and regulatory decisions, consumer beef demand, weather, and competition for land, labor, capital, and management, will influence the future size of the U.S. cattle industry.

Secondly, the mound shapes between the vertical bars in Figure 1 are cattle cycles. A cattle cycle is measured as the period of time from the lowest cattle and calves inventory to the next lowest level of inventory over time. Many cattle producers describe the cattle cycle as being from trough to trough. Since 1949 cattle cycles have ranged between 10 and 15 years in length. During the cattle cycles between 1949 and 1979 cattle and calves inventory increased by 18 to 23 million head during each cycle followed by a smaller decline in inventory numbers. Since 1979 the cattle and calves inventory increased by only 2 to 8 million head during each cycle followed by much larger declines of -8 to -20 million head. As should be expected, higher market prices (profits) lead to increases in cattle and calves inventory and lower market prices (losses from oversupply) lead to decreases in cattle and calves inventory. The current 2016 cattle and calves inventory level is similar to those of the mid-1950s.

2016 Cattle and Beef Supply Situation
U.S. cattle inventory numbers are currently surveyed once per year by the USDA as of January 1 of each year. U.S. cattle producers told the USDA their January 1st, 2016 cattle inventory numbers and this information was reported in the publication entitled "Cattle." The total cattle and calves inventory estimate was 92 million head. Figure 2 details the 2016 inventory levels for specific categories of cattle.

Figure 2. U. S. Cattle Inventory By Category, January 1, 2016

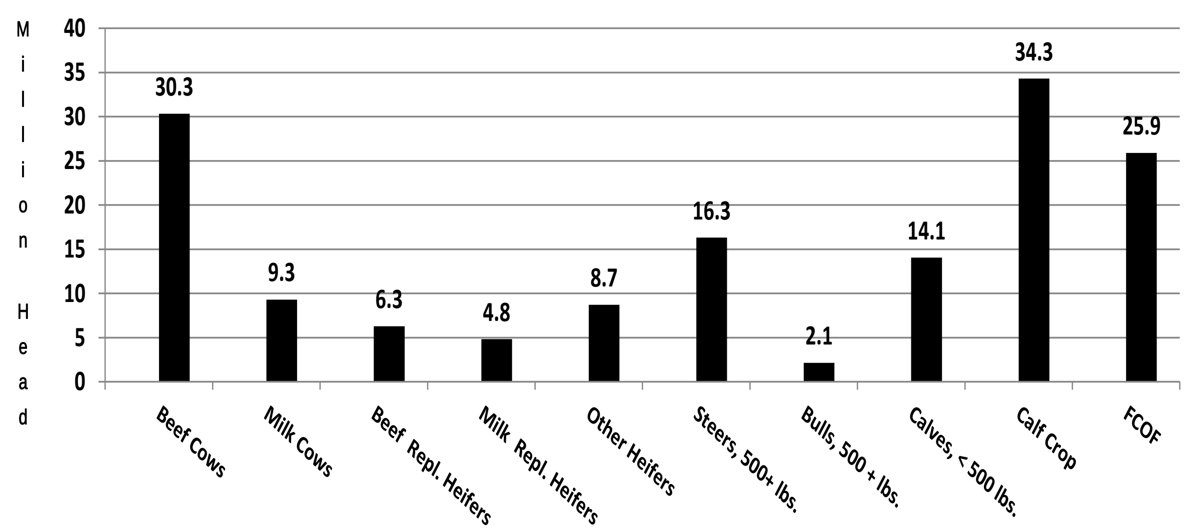
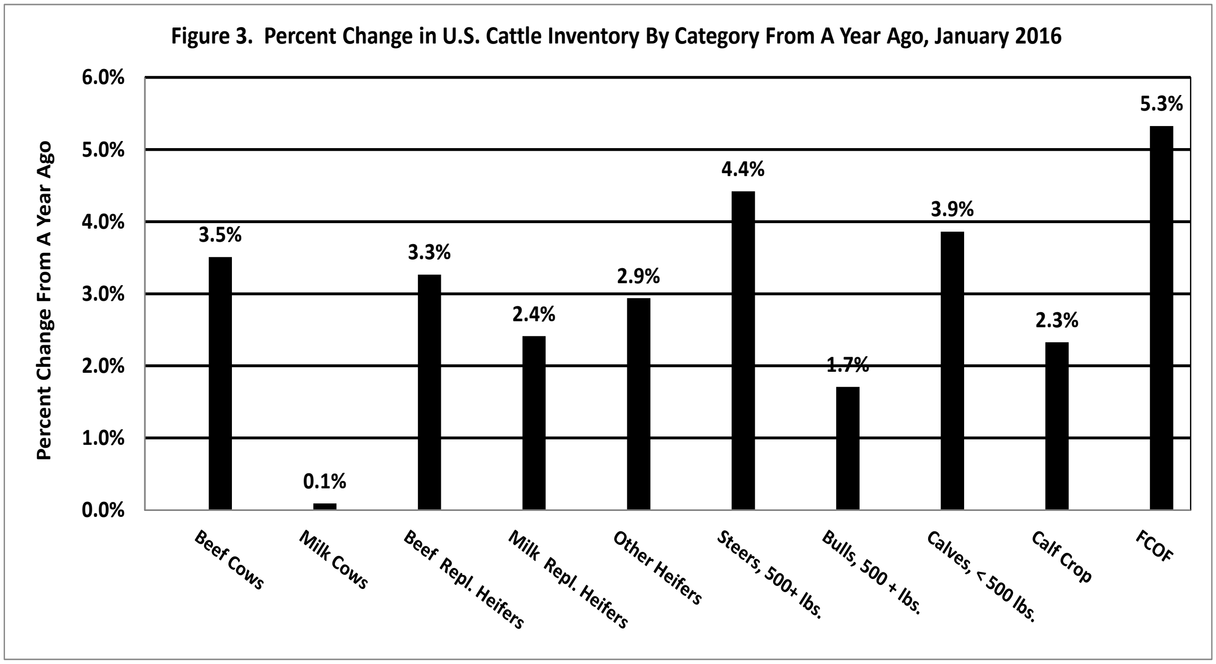


Figure 3 reports the percent change in the U.S. Cattle Inventory by category from a year ago (January 1, 2015 vs January 1, 2016). Increases were realized in all categories of the U.S. cattle inventories. Higher than average cattle prices, improved grazing conditions, lower production costs (feed, fertilizer, fuel, etc.), and profits are cited as the major factors supporting the increases in all categories of the U.S. cattle inventory.



The January 1, 2016 USDA survey reported that cattle producers had about 1.04 million head (2.7 percent) more cows that had calved than a year ago. Beef cows that had calved were 30.3 million head, up 1.03 million head (3.5 percent) from a year ago. Dairy cows that had calved increased about 8,000 head from a year ago to 9.32 million head (0.1 percent). Beef cow replacements increased about 199,000 head from a year ago to 6.3 million head (3.3 percent). Dairy cow replacements at 4.8 million head were up 114,000 head (2.4 percent) from a year ago. In summation, an increase in total cows (1.04 million head of beef and dairy cows) and total replacements (313,000 head of beef and dairy replacements) between January 1st, 2015 and January 1st, 2016 documents that robust herd expansion is underway in the U.S. cattle industry.

Additionally shown in Figure 3 were increases in inventory estimates compared with one year ago for other heifers (2.9%), steers, 500+ pounds (4.4%), bulls, 500+ pounds (1.7%), calves less than 500 pounds (3.9%). These increases provide support for a larger estimate of the inventory of cattle and calves when the January 1, 2017 Cattle Report is released.

A larger inventory of cattle and calves and larger calf crop during 2016 is expected to result in higher levels of beef production during 2017. USDA projects U.S. beef production during 2016 to be about 24.9 billion pounds which would be up 5.3 percent from the 2015 estimate of 23.7 billion pounds. This level of beef production will be influenced by any adjustments in average carcass weights and the level of feeder and live cattle imports (from Canada and Mexico). Due to significantly cheaper feedstuffs, slaughter weights should be heavier during 2016 and 2017.

Expected Outlook

- 2016 U.S. beef production is expected to increase to a total of 24.9 billion pounds, up about 1.2 billion pounds (5.3 percent) from 2015. The 2017 U.S. beef production is expected to increase to a total of 25.8 billion pounds, up about 0.9 billion pounds (3.4 percent) from 2016.

- 2016 U.S. beef exports are expected to increase to 2.5 billion pounds, up 0.2 billion pounds (8.6 percent) from 2015. 2017 U.S. beef exports are expected to increase to 2.6 billion pounds, up 0.1 billion pounds (4.9 percent) from 2016 due to improving trade agreements, lower beef prices, and world population growth. As should be expected with approximately

10 percent of U.S. beef currently being exported, any increase or decrease in the levels of U.S. exports of beef and/or competing meats (pork and poultry) will have a significant impact on U.S. domestic beef prices.

- 2016 U.S. beef imports are expected to decrease to 3.0 billion pounds, down 0.4 billion pounds (-12.3 percent) from 2015. 2017 U.S. beef imports are expected to decrease to 2.6 billion pounds, down about 0.4 billion pounds (-12.0 percent) from 2016 due to larger domestic beef production and other domestic competing meats.

- 2016 net beef supply (domestic beef production plus beef imports minus beef exports) is expected to increase to 25.4 billion pounds, up 0.6 billion pounds (2.6 percent) from last year. The 2016 increase is the result of an increase in domestic beef production (1.2 billion pounds or 5.3 percent), a decrease in beef imports (-0.4 billion pounds or -12.3 percent), and an increase in beef exports (0.2 billion pounds or 8.6 percent). Beef and veal imports are expected to be about 3.0 billion pounds during 2016, while exports are expected to be about 2.5 billion pounds. The resulting beef trade deficit (exports minus imports) of about -0.5 billion pounds is expected to be realized during 2016.

- 2017 net beef supply is expected to increase to a total of 25.8 billion pounds, up 0.4 billion pounds (1.5 percent) from 2016. The increase in 2017 is the result of an increase in domestic production (0.9 billion pounds or 3.4 percent), a decrease in beef imports (-0.4 billion pounds or -12.0 percent), and an increase in beef exports (0.1 billion pounds or 4.9 percent). Beef and veal imports are expected to be about 2.6 billion pounds, while exports are also expected to be similar at about 2.6 billion pounds during 2016. The resulting 2016 beef trade surplus/deficit (exports minus imports) is expected to be about even.

- 2016 competing U.S. meat production (pork and poultry) is expected to show a modest increase compared to a year ago. Pork production during 2016 is expected to show an increase of 0.4 billion pounds (1.6 percent) and broiler production is expected to increase by about 0.9 billion pounds (2.1 percent). Pork and broiler production are expected to total 24.9 and 40.9 billion pounds during 2016, respectively.

- 2017 competing U.S. meat production (pork and poultry) is also projected to increase compared with 2016. 2017 pork production is expected to increase 0.6 billion pounds (2.5 percent) and broiler production is expected to increase by about 1.1 billion pounds (2.7 percent). Pork and broiler production are expected to total 25.5 and 42.0 billion pounds, respectively.

Competing Meats

All three major meats, beef, broilers, and pork, are expected to increase during 2016 and 2017. During 2016 the three major meats are expected to increase to 90.7 billion pounds (up 2.5 billion pounds or 2.8 percent from 2015). Likewise, 2017 U.S. meat production of beef, broilers, and pork is expected to increase to 93.3 billion pounds (up 2.6 billion pounds or 2.8 percent). Figure 4 shows the U.S. beef, broiler, and pork production levels for 2013-2017. 2016 and 2017 are projected estimates by USDA as of 9/16/16. Notice the upward trends for each commodity.

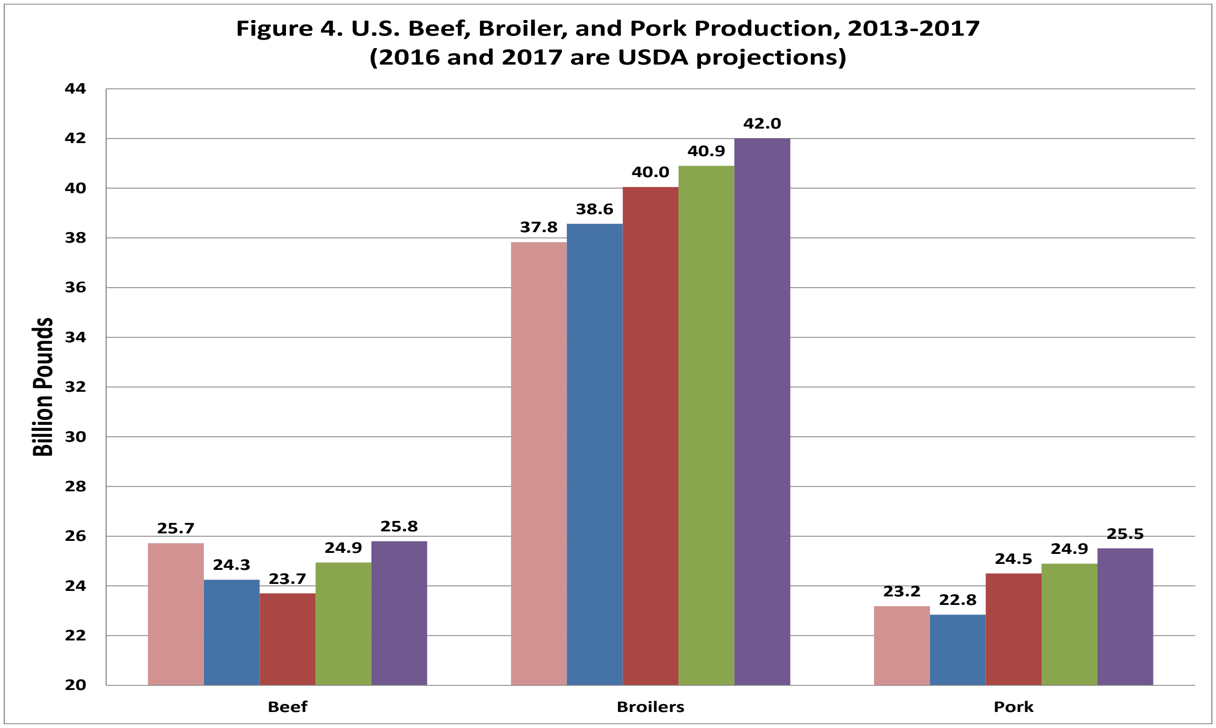
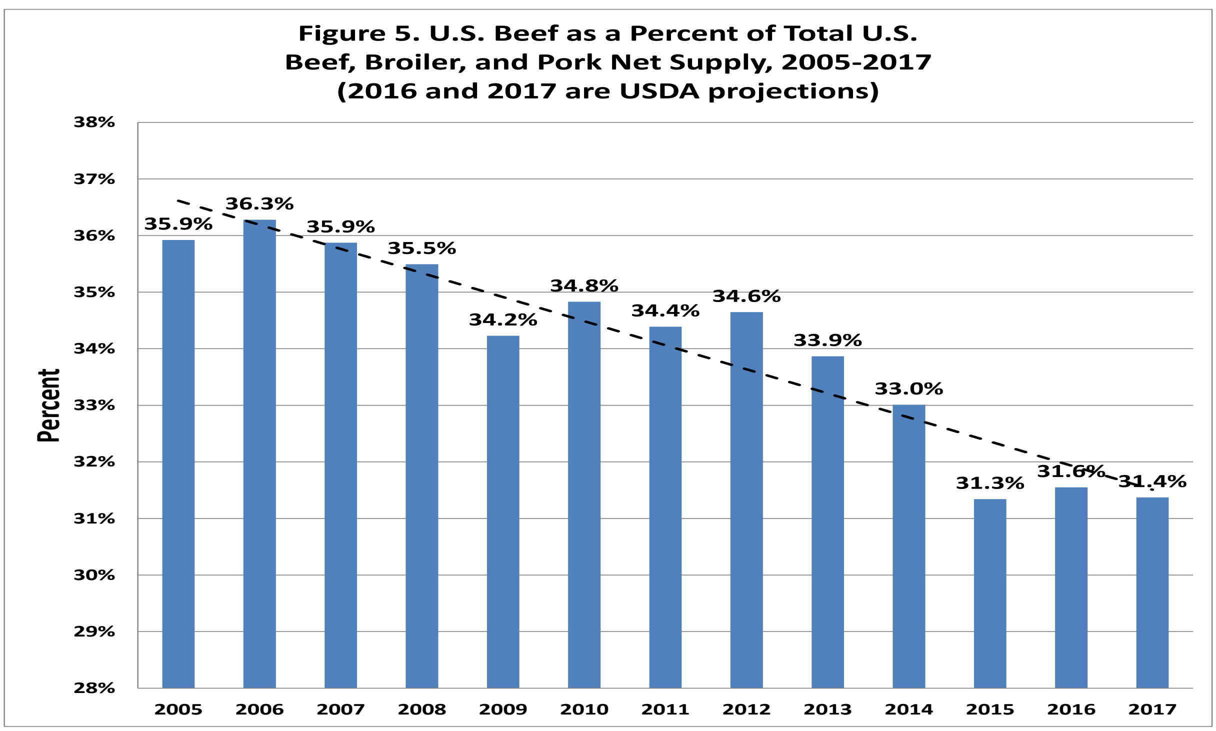


Figure 5 describes U.S. beef as a percent of total U.S. beef, broiler, and pork net supply between 2005 and 2017. U.S. beef as a percent of total U.S. beef, broiler, and pork net supply has ranged between 31.3 and 36.3 percent during the 13 years evaluated. The trend line shows that U.S. beef as a percent of U.S. beef, broiler, and pork net supply is decreasing over time. In order to reverse this trend a combination of actions will be necessary such as increased cattle and forage performance, lower production costs, favorable weather for forage production, improved consumer beef demand, and reasonable profits are needed to encourage future increased beef production.



Any changes in these production, import, and/or export levels of beef, pork, and broilers could have a significant effect on U.S. beef prices. Additionally, any increases or decreases in production input prices will likely alter these 2017 production projections. A watchful eye on the production and export levels of competing meats and input prices will help identify potential changes in beef production and prices.

Feed and Forage Conditions

The 2016 growing season of the major corn and soybean growing regions started with a normal planting schedule, but with more acres planted. Above average weather and growing conditions have caused yield levels to return to or exceed trend levels in most major grain growing areas (Crop Production, 09/12/16).

The 2016 corn production is forecast to be the highest level of production on record for the United States at 15.1 billion bushels. The area harvested for grain is forecast at 86.6 million acres, 7 percent above last year. The 2016 soybean production is forecast to be 4.2 billion bushels. The area for harvest in the United States is forecast at a record 83.0 million acres, up 1 percent from 2015.

Additionally, harvest weather is currently adequate in most areas for a timely harvest. If these production levels are realized, corn production will be about 1.66 billion bushels larger than a year ago (11 percent) and soybean production will be about 0.29 billion bushels larger than a year ago (7 percent).

2016 corn and soybean futures prices have decreased corresponding to the forecasted larger crops that were projected this season. Since the beginning of their respective futures contracts, the December 2016 corn futures prices ranged from a high of about $4.49 per bushel on 06/17/2016 to a low of $3.14 per bushel on 08/31/2016, while November 2016 soybeans ranged from a high of $11.86 per bushel on 06/13/2016 to a low of $8.59 per bushel on 11/10/2015. December 2016 corn is currently trading at $3.39 per bushel (CME Group, 10/07/16), while November 2016 soybeans is at $9.56 per bushel. The current futures prices represent a decrease in futures prices for corn and soybeans of about -25 percent and -19 percent from the highs during 2016, respectively. Corn and soybean prices are expected to move slightly lower as the 2016 harvest season continues. Therefore, livestock producers with storage facilities should take advantage of these lower prices and buy their feedstuffs during the 2016 crop harvest. If these lower grain prices continue, many sectors of animal agriculture will continue to see expansion.

Another factor that affects feed prices, feeder calf prices, and feeder cattle prices is the level of export demand for corn and soybeans. Any major changes in world grain supplies and/or export demand for these commodities could significantly move cattle market prices. Economic growth in several Asian countries has begun to slow down which may affect export grain demand. Additionally, the strength of the U.S. dollar is certain to influence the world grain export demand (a strong U.S. dollar negatively impacts U.S. grain export demand and vice-versa).

Total 2016 U.S. hay production is expected to be larger than a year ago. USDA's September Crop Production Report (9/12/16) estimated total hay production at about 140 million tons. That is up about 6.1 million tons (4.5 percent) from last year. Average yield is expected to increase marginally and acreage harvested is expected to increase slightly for hay production. Average yield is expected to increase from 2.47 to 2.50 tons per acre (1.2 percent). Harvested acreage is estimated to be up 0.68 million acres (3.1 percent) from 2015.

Pasture and range conditions have been better over many of the cow-calf states this year. The pasture and range conditions as of September 27, 2015 rated as poor or very poor was 18 percent of the total U.S. acreage compared to 22 percent last year (Crop Progress, 10/03/16). The current U.S. pasture and range conditions rated as good to excellent was 50 percent of the total U.S. acreage compared to 44 percent this time last year. These improved pasture and forage conditions coupled with increased hay supplies should continue to encourage some herd expansion even with moderately cattle prices being realized during 2016.

Beef Demand and Trade

U.S. beef demand has enjoyed moderate growth during the last several years despite a slow U.S. economic recovery. 2017 domestic beef demand is expected to be tested as significant increases in beef and competing meats are realized and consumers are expected to experience rising interest rates and prices for most goods and services. If consumer disposable income does not rise proportionally, shopping habits and choices will shift forcing consumers to substitute and/or reduce the bundle of goods and services they have consumed in the past.

Per capita consumption of beef is expected to increase during 2016. Domestic disappearance is expected to result in beef per capita consumption of 55.2 pounds per person in 2016. The combination of higher domestic beef production, a decrease in imports, and slightly higher exports are expected to show an increase in domestic net beef supply in 2016 (0.6 billion pounds or 2.5 percent) compared with a year ago. USDA has estimated per capita beef consumption for 2017 to be 55.6 pounds per person.

The 2015 average retail beef price was $6.29 per pound. Monthly average retail beef prices during the first eight months of 2016 averaged 28 cents per pound lower than a year ago ($6.07 vs. $6.35). The 2016 average retail beef price is expected to be about 3-4 percent lower than 2015. Average retail beef prices during 2017 are also expected to show a decrease of 3-4 percent due to expanding beef and competing meat supplies.

Additionally, it is very important that the U.S. beef industry continues to sustain and/or grow beef export markets. The U.S. currently exports about 10 percent of domestic beef production each year. The beef export market commonly adds between 12-18 percent of the value of a steer marketed (based on sales of beef, offal, and hides, etc.). For example, during August 2016 the added export value of beef slaughter contributed $257 per head to the value of each slaughter beef. Furthermore, the growth in beef export markets will also help to moderate the price impacts should any weaknesses occur in U.S. broiler and pork exports.

2017 Beef Price Outlook

The 2017 cattle market will likely experience lower average cattle prices compared with 2016 due to increased net beef supply, increases in domestic competing meat production, and weaknesses in the U.S. economy. The decrease in cattle market prices should be moderate and not as precipitous as the decreases experienced during 2016 and the second half of 2015. Volatile price movements in either direction are possible with abrupt changes in levels of meat production, beef demand, trade issues, and other economic variables.

The 2015-2017 U.S. net beef supply estimates are shown in Table 1. U.S. net beef supply is domestic beef production plus beef imports minus beef exports. The net beef supply is the amount of beef that is consumed in U.S. markets. The 2016 U.S. net beef supply is expected to show an increase of about 0.6 billion pounds (25.437B - 24.804B = 0.633B, 2.55 percent) compared with 2015. The 2017 U.S. net beef supply is expected to show an increase of 0.4 billion pounds (25.820B - 24.437B = 0.383B, 1.55 percent) compared with 2016.

Table 1. U.S. Net Beef Supply (Billion Pounds), 2015-2017.[1]

Item	2015	2016	2017
		(Billion Pounds)	
U.S. Domestic Beef Production	23.698	24.942	25.800
U.S. Beef & Veal Imports	3.371	2.955	2.600
U.S. Beef & Veal Exports	2.265	2.460	2.580
U.S. Net Beef Supply	24.804	25.437	25.820

[1]USDA data estimates reported as of September 16, 2016. Columns may not sum exactly due to rounding.

Minor changes in future U.S. beef import and/or export levels (due to beef demand, food safety, exchange rates, politics, regulations, etc.) can significantly change the U.S. net beef supply and consequently domestic beef prices. Additionally, the strength of the U.S. dollar will have a major influence on the levels of U.S. beef exports and imports. If the U.S. dollar trades stronger against currencies of our trading partners, expect less U.S. beef exports to these countries and more lean U.S. beef imports.

Total 2016 U.S. net supply of beef, broilers, and pork is expected to increase about 1.5 billion pounds (1.9 percent) compared with 2015. Likewise the 2017 U.S. net supply of beef, broilers, and pork is expected to increase about 1.7 billion pounds (2.1 percent) compared with 2016. Individually, 2016 U.S. net broiler supply is expected to increase 0.6 billion pounds (1.8 percent) and net pork supplies are expected to increase 0.2 billion pounds (1.1 percent), while U.S. net beef supply is expected to increase 0.6 billion pounds (2.6 percent). The increased supplies of beef and competing meats will likely limit beef prices during 2016.

Supplies of beef, broilers, and pork are expected to respond quickly to changes in demand. Any significant changes in domestic demand and/or foreign demand of these three competing meats could cause major movements in beef prices. Each industry is very capable of significantly altering production levels and is subject to wide changes in export and import levels.

Given the above projections regarding the 2017 U.S. net beef supply, beef cattle price projections were estimated for 2017. Beef cattle negotiated price projections were estimated by quarter for choice slaughter steers (basis USDA 5-area slaughter cattle), feeder steers, 750# (basis Florida), feeder steer calves, 550# (basis Florida), and breaking utility cows (basis Florida), as shown in Table 2. These auction market prices represent the range over which the particular class of cattle would average for the indicated quarter. For example, Choice slaughter steers during the first quarter of 2017 are expected to average between $97 and $107 per hundredweight. The highest average prices are expected during the second quarter for choice slaughter steers, the second quarters for 750# feeder steers, the second quarter for 550# feeder calves, and the second quarter for breaking utility cows of 2017.

Table 2. Estimated average cattle market prices by quarter, 5-area fed slaughter and Florida, 2017[1].

Item	2017 1st Qtr.	2017 2nd Otr.	2017 3rd Otr.	2017 4th Qtr.	2017 Avg.
Choice slaughter steers, 5-area, $/cwt.	$97-$107	$98-$108	$90-$100	$91-$101	$94-$104
Feeder steers, 750#, Florida, $/cwt.	$93-$103	$98-$108	$90-$100	$87-$97	$93-$103
Fdr. steer calves, 550#, Florida, $/cwt.	$107-$117	$113-$123	$106-$116	$101-$111	$107-$117
Breaking utility cows, Florida, $/cwt.	$44-$54	$48-$58	$43-$53	$38-$48	$43-$53

[1]The authors reserve the right to update these price projections as more economic information enters the marketplace.

For 2017, choice slaughter steers (basis USDA 5-area slaughter cattle) are forecast to post an annual average price between $94 and $104 per hundredweight. Florida feeder steers (750#) are expected to report an annual average price between $93 and $103 per hundredweight, Florida feeder steer calves (550#) between $107 and $117 per hundredweight, and Florida breaking utility cows between $43 and $53 per hundredweight. Breeding heifer, cow, and bull prices are expected to show decreases as the demand for herd replacements becomes weaker.

Factors to watch in 2017 that impact U.S. cattle markets include the growth of the U.S. economy, levels of unemployment, consumer confidence, domestic and international beef demand, input prices, exchange rates, interest rates, energy prices, levels of competing meats, adverse weather events, and outliers (food safety, war, terrorists incidents, etc.). Any significant movement of one or some combination of these factors is believed to have an overwhelming effect on U.S. business and consumer spending and cattle prices. As should be expected, the 2017 cattle market has the potential for some large price swings. Abrupt changes in the levels of the factors mentioned above could add much volatility to 2017 cattle market prices. Cattle producers will need to search for ways to lower their unit cost of production (what it costs to produce a pound of beef) and ways to enhance market prices in order to achieve higher levels of profitability during 2017.

Efficiency of Protein Use by Beef Cattle

Tryon Wickersham[1]

[1]Texas A & M, College Station, TX

Notes:

Economic Sustainability in the Florida Cow Herd

Flint Johns[1]

[1]Lykes Bros. Inc., Okeechobee, FL

Notes:

Florida Ranchers Beef Program

Don Quincey[1]

[1]Quincey Cattle Company, Chiefland, FL

Notes:

Everything I Need To Know I Learned From the Internet

Matt Hersom and Todd Thrift[1]

[1]UF/IFAS Department of Animal Sciences, Gainesville, FL

The internet is full of valuable information to assist beef cattle producers. Information is available to help producer make all manner of decisions regarding every aspect of cattle production. Producers can find information about all of the core topics of genetics, health, management, nutrition, and, reproduction. These topics show up on state and national association websites, industry trade magazine on-line edits, reputable industry websites, university on-line information, government on-line information, and industry associated non-government organizations. Below is a brief sampling some good resources.

Source	Website
National Cattlemen's Beef Association	http://www.beefusa.org/
Beef Quality Assurance	http://www.bqa.org/
Florida Cattlemen's Association	http://www.floridacattlemen.org/
CattleFax	https://www.cattlefax.com/
Beef Magazine	http://www.beefmagazine.com/
Drovers Journal	http://www.cattlenetwork.com/
University of Florida	http://animal.ifas.ufl.edu/beef_extension/index.shtml

However, for every good source of information there seems to be an equal number of sources that supply marginal information to out-right fabrications. More dangerous are the sites that provide information with just enough truth or validity underlying their claims or information to make them appear legitimate.

A number of sites allow and incorporate participants to share information. Now do not get me wrong experienced cattle producer have a wealth of knowledge that can be share with other cattle owners. However, exercise caution when the advice is based on anecdotal evidence. Likewise, examine offered advice and information with the intent to advance an agenda with a skeptical or critical eye. Some prime examples include the use of alternative products to cure or treat routine animal health care issues. These products are often promoted as alternatives, natural alternatives, or hidden cures that the "big pharma' or "big ag" don't want you to know about. If they worked well, don't you think they would be fully commercialized already?

When you run across questionable, alternative, mis-information, or out-right lies apply these evaluations.

- If it sounds too good to be true, it probably is.
- If it sounds too catastrophic, it probably isn't.
- Is the science behind the claim valid.
- What does the person stand to gain.
- Does everything I know about animal production tell me this is not likely.
- Call someone with the credentials to discern the validity if you can't.

Unfortunate, many of these sites are not even targeted for beef cattle producers, but rather for the perceived “socially conscious”. These sites portend to fully understand animal and plant agriculture in general. They provide the user with half-truths, logical fallacies, and one-time occurrences presented as routine. Many of these sites are linked to each other, linked to social media (Facebook, Reddit, Instagram, etc.), and have dedicated staff to advance an agenda. Often we may not even be aware of the existence of these sites. These alternative information sites and social media outlets often do not appear in our sphere of influence, or we do not become aware of them until a peripheral member of our social groups comments, links, or posts about it.

There are more information resources available to the beef cattle producer than ever before. The fact that you are attending the Beef Cattle Short Course already indicates that you are actively pursuing more knowledge to incorporate into your beef cattle enterprise. However, the challenge is sorting through the mountains of information. Use the expert resources you have available to you through UF-IFAS Extension at the county and state level, trusted allied industry, and other cattlemen.

Reproductive Tract Score: Tool or Something Else?

Todd Thrift[1]

[1]UF/IFAS Department of Animal Sciences, Gainesville, FL

Notes:

Using Genomics to Affect Cow Herd Reproduction

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[1]Animal Science, University of Nebraska-Lincoln, Lincoln, NE

Introduction
It should be common knowledge that fertility is the most economically relevant suite of traits in beef cattle production, followed in order by growth and carcass merit. The relative importance of fertility compared to other traits is roughly double for non-integrated firms, which the overwhelming majority of commercial cow-calf producers would be classified as.

To further illustrate the importance of fertility, a pragmatic view of efficiency in beef cattle as proposed by Dickerson (1970) is detailed below.

[Dam Weight*Lean Value of Dam + No. Progeny*Progeny Weight*Lean Value of Progeny]
- [Dam Feed*Value of Feed for Dam + No. Progeny*Progeny Feed*Value of Feed for Progeny].

The income component is comprised of output from harvesting the dam (or fraction of the dam accounting for death loss) and from harvesting progeny (again, accounting for death loss). The feed cost component accounts for the input of feed energy. The number of progeny per dam is in both components and, thus, increasing number of progeny will increase efficiency. *By simply increasing number of progeny per dam, through either selection, heterosis from crossing, or better management, we will increase efficiency of production* (Nielsen et al., 2013).

The challenge of improving fertility at the commercial level via genetics is two-fold:
1) How do producers select sires that will enhance their daughters' reproductive ability?
2) How do producers make educated decisions relative to the heifers that are retained as replacements?

These are the two decisions that need to be made at the commercial cow/calf level. Throughout the remainder of this paper, the current state of genomics and options and opportunities for commercial cattle producers to improve fertility through genetic tools will be detailed and discussed.

What do we know about the genetic control of female fertility?
Heritability (h^2) estimates of several reproductive traits are listed in Table 1 as reported in a review paper by Cammack et al. (2009). Many of these traits can be classified as lowly heritable. However, in some cases studies have reported much larger heritability estimates than the perceived bound of 0.10 generally associated with female fertility traits. Particularly for binary (yes/no) traits, the incidence rate (or success rate) can greatly influence the estimates of heritability. As the incidence rate approaches 50%, heritability estimates will likely become larger than cases where the incidence rate is more extreme.

Table 1. Summary of heritability estimates (h^2) for commonly used reproductive traits in beef cattle[1].

Trait	h^2	No. of references
Age at first calving	<0.10	2
	0.20-0.30	3
Age at puberty	<0.10	1
	0.10-0.20	3
	0.40-0.50	4
	>0.60	3
Calving date	<0.10	4
	0.20-0.30	3
	0.40-0.50	1
Calving rate	<0.10	1
	0.10-0.20	1
Calving success	<0.05	1
	0.05-0.10	1
Calving to first insemination	<0.10	2
Days to calving	<0.10	2
First-service conception rate	<0.10	1
	0.20-0.30	1
Heifer pregnancy	<0.20	1
	0.20-0.30	1
Number of calves	<0.10	2
	0.10-0.20	2
	0.30-0.40	1
Pregnancy rate	<0.10	4
	0.10-0.20	4
	0.20-0.30	4
Probability of pregnancy	<0.10	1
	0.10-0.20	1
	0.20-0.30	3
	0.50-0.60	1
Scrotal Circumference	0.20-0.40	3
	0.40-0.50	8
	0.50-0.80	3

[1]Adapted from Cammack et al., 2009.

Selecting sires to alter reproductive performance

For commercial herds, roughly 85% of gene flow or genetic changes made are due to the sires used over the past 4 years. Consequently, sire selection is a critical component of improving commercial level reproductive performance. Table 2 details a listing of reproductive traits that are included in beef cattle genetic evaluations in several countries.

Table 2. Example of countries with reproduction traits as part of beef genetic evaluation systems[1].

Trait	Country[2]
Scrotal circumference	AU, NZ, SA, NA, AR, UK, IR, BR, FR, US, CA, ME
Days to calving	AU, NZ, SA, NA
Heifer pregnancy	US, VE, BR
Heifer calving success	FR
Age at 1st calving	IR, UK, BR
Calving interval	IR, DE, UK
Stayability/productive life	US, CA, VE, UK, FR, BR

[1]Adapated from Johnston (2014).
[2]AU = Australia; NZ = New Zealand, BR = Brazil; VE = Venezuela; UK = United Kingdom; IR = Ireland; SA = South Africa; FR = France; US = United States; CA= Canada; DE = Denmark; AR = Argentina; NA = Nambia; ME = Mexico.

Unfortunately, most of these traits are lowly heritable, sex-limited (bulls will not have records themselves), or simply indicator traits (e.g., scrotal circumference) and thus yearling bulls will have EPD for these traits that are relatively low in accuracy. The inclusion of genomic information into EPD has aided in increasing accuracy for these traits. Since the American Angus Association's implementation of genomic-enhanced EPD in 2009, there has been considerable evolution in terms of adoption of this technology by the beef industry. In the past few years several beef breed associations have deployed this technology with several others quickly nearing this milestone.

The past seven years have illustrated the speed at which the technology, and our knowledge of it, has changed. Although perhaps "common knowledge" now, there have been considerable changes and advancements over a very short period of time that have greatly enhanced our ability to utilize this technology. We know that the inclusion of Molecular Breeding Values (MBV) into National Cattle Evaluation can add accuracy to EPD, particularly for young animals. Figure 1 illustrates this benefit when the MBV explains 40% of the genetic variation (GV; squared genetic correlation). The darker portion of the bars shows the EPD accuracy before the inclusion of genomic information and the lighter colored portion shows the increase in accuracy after the inclusion of the MBV into the EPD calculation. As the %GV increases, the increase in EPD accuracy becomes larger.

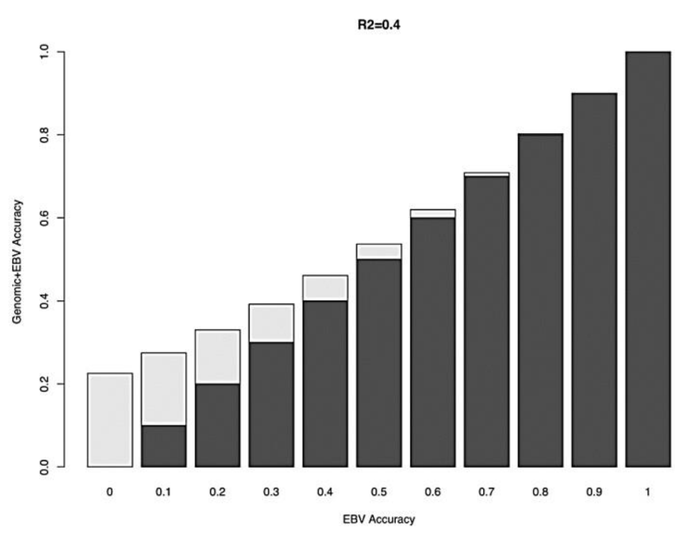

Figure 1.

Essentially this means that yearling bulls can have an accuracy associated with various EPD as if they had already sired several (10-30 depending on the trait) offspring. Buying bulls that have genomically-enhanced EPD offers a powerful tool for commercial producers to identify bulls that truly fit their breeding programs, particularly for lowly heritable traits such as fertility.

We also know the limitations of using MBV derived in one breed to predict the genetic merit of animals in a different breed, even closely related breeds (i.e. Angus trained and used in Red Angus; Kachman et al., 2013; Table 2). The fact is that the population of animals used to develop the DNA marker test must be representative of the population it will be used to predict in. As an example, a genomic test built using Angus cattle will not perform well if trying to predict the genetic merit of Hereford cattle.

Table 3. Estimated genetic correlations and standard errors for within-breed trained MBV for Angus, Hereford, and Limousin[1], evaluated in evaluation populations of each of four breeds[2]

	Weaning weight MBV		
Breed	Angus	Hereford	Limousin
Angus	**0.36±0.07**	0.14±0.08	-0.06±0.08
Red Angus	0.16±0.16	0.09±0.16	0.25±0.16
Hereford	0.04±0.21	**0.42±0.18**	0.27±0.21
Limousin	0.02±0.09	0.23±0.09	**0.40±0.08**

[1]Animals in the pedigree of the field data evaluation population were excluded from training; [2]genetic correlations and their standard errors are in bold characters when the MBV was evaluated in the breed in which it was trained. Adapted from Kachman et al., 2013.

Genomic applications for commercial cattle producers
Listed below is a description of several tests that are being marketed for use in commercial cattle that are not directly part of a breed association genetic evaluation programs (Van Eenennaam, 2016). Unfortunately, independent, peer-reviewed papers in the scientific literature documenting the field performance of any of these tests for commercial cattle do not exist.

GeneMax
There are two products exclusively distributed by Angus Genetics Inc. (AGI) and marketed by Zoetis® and designed for animals that are at least 75% Black Angus. These include GeneMax Advantage and GeneMax Focus. The first test involves tens of thousands of markers and is marketed as a heifer selection and mating tool that ranks heifers for net return using three economic indices (Cow Advantage: Predicts differences in profitability due to heifer development, pregnancy and calving, and sale of weaned progeny; Feeder Advantage: Predicts differences in net return of feeder calf progeny due to growth, feed efficiency and CAB carcass merit; Total Advantage: Predicts differences in profitability from genetic merit across all economically-relevant traits captured in Cow and Feeder Advantage index scores). It also identifies genetic outliers for cow cost, docility, marbling and tenderness, and also includes parentage information if the sires have been tested using either the 50K or i50K offered by Zoetis®. The second test utilizes fewer genetic markers and is marketed to provide genomic predictions for feedlot gain and marbling, in addition to paternity testing. These two tests are only intended for use on unregistered, commercial Angus animals.

Igenity Breed-Specific Tests

There are also two Angus-specific heifer selection tests available from Igenity; Angus Silver which includes calving ease maternal, heifer pregnancy, docility, milk, average daily gain, and marbling and Igenity Angus Gold, which additionally includes birth weight, mature weight, residual average daily gain, weaning weight, tenderness, ribeye area, back fat thickness and carcass weight. These two tests can be directly ordered through Igenity. Additionally, there are two breed-specific heifer replacement tests for Red Angus and Gelbvieh that can be ordered through the corresponding breed association. The Red Angus Herd Navigator test provides results on all traits for which the Red Angus Association of America (RAAA) calculates EPD, the RAAA HerdBuilder and GridMaster Indices, and parent verification if the potential sires have been tested with the RA50K test. Due to the breed-specific nature of this test, the Herd Navigator should only be used on females that are at least 75 percent Red Angus. The Gelbvieh Maternal Edge Female Profile is a low-density panel to be used by producers as a sorting tool for Gelbvieh-influenced commercial females. It includes calving ease, maternal calving ease, weaning weight, yield grade, marbling, and carcass weight.

PredicGEN

PredicGEN is a test marketed by Zoetis® as “a heifer selection tool for straight-bred or crossbred British/Continental animals that are less than 75% Black Angus”. The carcass traits predicted include marbling score, USDA yield grade, grid merit and tenderness. Results are reported back on a normally distributed 0 to 100 scale, with a mean of 50 based on Zoetis’® database of 20,000 genotyped animals.

Igenity Gold and Silver

The Igenity Gold and Silver tests, which include approximately 1,000 markers associated with 13 traits of interest and some randomly spaced markers, are being marketed by Neogen® as “DNA profiles for crossbred and purebred cattle.” A single prediction equation is used for each trait to give the score or molecular breeding value, irrespective of the breed makeup of the animal being tested. The silver test evaluates six traits (calving ease maternal, stayability, residual feed intake, average daily gain, tenderness, marbling), and the gold test includes an additional 7 traits (birth weight, calving ease direct, heifer pregnancy, docility, milk, ribeye area and back fat thickness). According to the Neogen brochure, the development of these tests involved large populations with phenotypic data and/or expected progeny differences (EPD) comprising tens of thousands of animals that represent various biological types. The six main datasets used to form the training data set for this test were from six breed associations: Angus, Hereford, Gelbvieh, Limousin, Red Angus, and Simmental. Data is reported back on a 1 to 10 scale.

An often overlooked test (that costs less than any of the above mentioned tests) is a simple parentage (or paternity) test. Simply knowing the true sire of commercial animals is beneficial and can inform keep/cull decisions.

Practical considerations

For commercial producers wishing to increase heifer pregnancy rates, or reduce the rate of culling of older females due to reproductive failure, a genomic test to aid in heifer selection is undoubtedly appealing. However, consider the scenario below.

Assume a genomic test explains 16% of the genetic variation for heifer pregnancy (meaning the test has a correlation (r) of 0.4 with the true breeding value). This is similar to what has been estimated in purebred, seedstock data (correlations range between 0.3 and 0.5 for fertility related traits). Further assume the heritability of heifer pregnancy is 0.1 (from Table 1 above). This means the hypothetical genomic test would explain 1.6% of the phenotypic differences between animals in their ability to conceive as heifers.

Van Eenennaam and Drake (2012) modeled the breakeven cost of testing all 45 potential replacement heifers born per 100 cows (weaning rate = 90%; 50% female) per year in a commercial herd with a replacement rate of 20%. To select replacement heifers a multiple-trait maternal selection index was developed that included maternal, pre-weaning performance, post-weaning performance, and carcass traits. It was further assumed that the producer was retaining ownership through the feedlot and marketing the cattle on a value based grid.

A hypothetical DNA test with an intermediate accuracy (0.3) with regard to the selection objective was then modelled. The breakeven cost of testing replacement heifers was approximately $24 per test. As the accuracy of the test increases, the breakeven cost will decrease. Interestingly, if the producer did not retain ownership they would have captured less than $10 of the total value, with the majority of the value being realized by post-weaning genetic improvement (i.e. feedlot/carcass traits).

These hypothetical examples, using realistic estimates of the accuracy of genomic tests for commercial cattle within breed, minimally cast some doubt on the economic return of testing commercial replacement heifers. Particularly given the overall importance of sire selection to the genetic improvement of commercial herds. Moreover, it has been shown multiple times that predicting the genetic merit of crossbred animals, particularly when they may contain breeds that were not represented in the training population used to build the DNA marker panel, is problematic and results in much lower accuracies.

A Path Forward

The use of “traditional” genetic selection tools and methods in the U.S. beef cattle industry to improve reproductive success is poor, at best. The development and use of proper crossbreeding systems is far from pervasive, the use of fertility EPDs in bull selection often takes a back seat to growth and carcass merit, and the utilization of economic selection indices seems to meet with skepticism due, in part, to confusion surrounding how they are developed. Although the above statements may be controversial to some, I cannot think of three action items that would lead to more progress in reproductive performance than the three listed below:

1) The commercial cow-calf industry needs to utilize composite or F_1 females. The majority of commercial producers should breed these to an unrelated terminal sire breed. Larger commercial producers may take advantage of scale and serve as a multiplier, focusing on the production of commercial replacement females. Data has shown that heterosis has a sizable impact on cumulative weaning weight over cow’s lifetime—and these estimates are nearly doubled for *indicus* F1 females.
2) Commercial bull buyers should utilize the currently available reproductive EPDs previously detailed in this paper. Buying bulls with genomically-enhanced EPD will add accuracy to bull buying decisions.
3) Commercial bull buyers should also utilize economic selection indices that correctly match their breeding objectives.

The three action points above are not “sexy”, but will have far greater impact per units of investment than using DNA marker panels to select replacement females given the current limitations of related to cost and accuracy of predicting non-pedigreed crossbred animals. This is not to say that genomics will not play an important role through marker-assisted management in the future as the technology matures but the utility of genomics will be marginalized relative to fertility until the lower handing fruit detailed above is fully exploited.

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Managing cow nutrition



66th Annual Florida Beef Cattle Short Course

Dr. Jason Smith
Assistant Professor and Extension Beef Cattle Specialist
Department of Animal Science
University of Tennessee Institute of Agriculture

Real. Life. Solutions.™


Photo courtesy of AgWeb


Photo courtesy of Scott Buchanan

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Over the next 40 minutes or so…

- My goal is to…
  - Discuss why we actually care about nutrition
  - Utilize results of previous research and extension efforts to focus on how nutrition can be utilized to improve cowherd productivity
  - Leave you with at least one factor to consider when evaluating your nutritional management program

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What production trait has the greatest impact on cow/calf productivity?

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Why nutrition matters…

- Genotype x environment = phenotype
- Nutrition is the major contributing factor to "environment"
- Interaction between nutrients/nutritional status and genes affect…
  - Growth and development
  - Health
  - Beef composition and product quality
  - **Reproductive outcomes**
    - Reproduction is a lowly heritable trait
    - This means that the environment tends to impact reproduction more than an animal's genetics

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Major factors that limit reproduction

- 1) She becomes pregnant, but loses the calf
  - Prior to calving
  - Between calving and weaning
- 2) She doesn't become pregnant in the first place
  - We're going to focus on nutrition's role

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Why doesn't she get bred?

- The bull, breeder, transfer tech., etc.
  - ~95 % or more of the time that a viable spermatocyte and oocyte meet, it results in the development of an embryo
- **The cow**
  - She wasn't cycling to begin with
  - Something else happened that prevented her from becoming pregnant

Photo courtesy of Landon Smith

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What causes her to cycle again?

- Her nutritional status
  - She has to receive certain hormonal cues
  - They tell her "you're ready to support another calf"
  - When that happens, she starts cycling again
- What drives those signals?
  - Body condition
  - Plane of nutrition

Photos courtesy of Progressive Cattleman Magazine and Matt Hersom, respectively

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Nutrient partitioning

Maintenance and lactation

↓

Growth

↓

Existing pregnancy

↓

Estrous cycle and establishment of a new pregnancy

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Protein vs. energy

- Protein often gets more credit than it deserves
  - "This feed is better 'cause it's higher in protein"
  - "Nutrition can't be the problem, I feed 16 %"
- Energy drives growth and performance, not protein
- Protein supports an energy-dependent level of growth and performance

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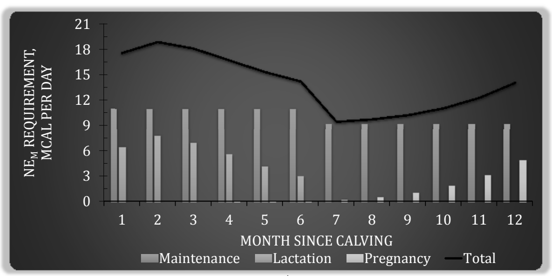
Focus on cow requirements: energy



Calculated for a 5-yr old cow with a mature body weight of 1300 lbs
Adapted from the NRC, 2000

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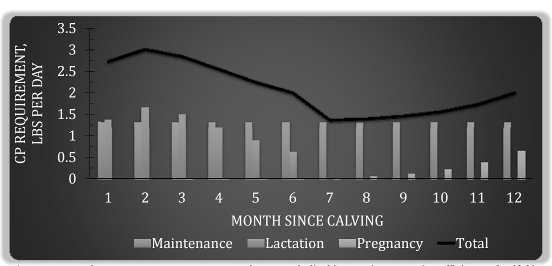
Focus on cow requirements: protein



Assumes enough energy present to support crude to metabolizable protein conversion efficiency of ~60 %
Calculated for a 5-yr old cow with a mature body weight of 1300 lbs
Adapted from the NRC, 2000

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The importance of body condition

- Insurance for reproduction
  - When we aren't meeting her energy and protein requirements
  - "Excess" body condition at calving will fill the void
    - Helps to ensure that:
      - She starts cycling within enough time to become pregnant during the breeding season
      - She doesn't sacrifice the pregnancy

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What is the ideal BCS at calving?

Effect of BCS at calving on the postpartum interval to return to estrus

BCS	Postpartum interval
3	89 d
4	70 d
5	59 d
6	52 d
7	31 d

Adapted from Houghton et al., 1990

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What is the ideal BCS at calving?

Effect of BCS at calving on overall pregnancy rate

BCS	Overall pregnancy rate
2	13 %
3	43 %
4	66 %
5	94 %
6	100 %

Adapted from Kunkle et al., 1994

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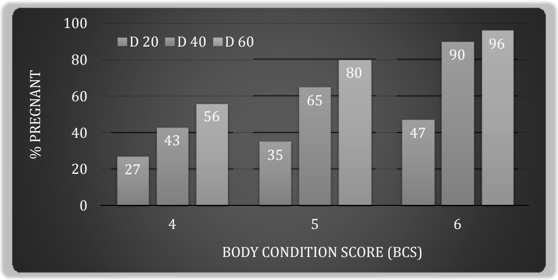
What is the ideal BCS at calving?



Adapted from Spitzer et al., 1995

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General rule of thumb for BCS

- "Ideal" BCS at calving and breeding for mature cows is ≥ 5
- This should be a target, but isn't always possible
- So when it isn't, what's the next best option?
  - Managing cattle on an increasing plane of nutrition
  - Moving them toward that "ideal" state of body condition

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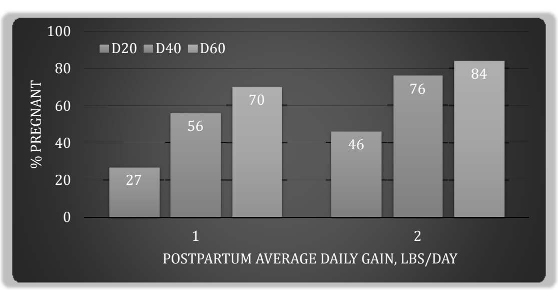
Plane of nutrition can be the saving grace



Adapted from Spitzer et al., 1995

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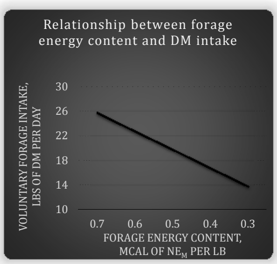
The first-calf heifer conundrum

- Why are those three-year olds so dang hard to get bred back?
  - Because they're different
  - They're still growing until they've weaned their second calf
- Their energy and protein requirements are ~10 to 15 % greater than mature cows
  - They need to be managed accordingly
    - Need ~10 to 15 % more of it
    - Needs to be ~10 to 15 % higher in energy and protein

Can they eat enough?

- Energy content is the primary indicator of voluntary forage intake
- If forage has a low energy content, they may not be able to eat enough to meet their requirements
  - Voluntary intake decreases as energy content decreases



Calculated for a 1300 lb cow
Adapted from the NRC, 2000

Meeting requirements in a forage-based setting

- Forages are generally the most economical means of meeting energy and protein requirements of the cowherd
  - The reality is that they won't always do it
- Need to utilize complementary supplemental feedstuffs that will fill the nutrient void that remains
  - Feed something that will provide enough supplemental nutrient(s)
  - Feed it at a level that will actually fill the void

The issue with supplemental feeds…

- Not all feeds are created equally
- Retail price doesn't always reflect those differences
- Moving forward, we need to consider basing supplementation decisions on nutrient needs and supplement value

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Retail price comparison

Option	CP content (% as-fed)	Unit of purchase (lbs)	Retail price ($/unit)	Retail price ($/lb)
A	28	200 lbs	$80.00	$0.40
B	16	2,000 lbs	$160.00	$0.08
C	28	2,000 lbs	$180.00	$0.09
D	16	2,000 lbs	$240.00	$0.12

CP = crude protein

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Value and total cost comparison

Option	Lb of CP per lb of feed	Lbs required per day[1]	Cost per lb of CP ($/lb)	Total cost[1] ($)
A	0.28 lbs	1.79 lbs	$1.43	$3,571
B	0.16 lbs	3.13 lbs	$0.50	$1,250
C	0.28 lbs	1.79 lbs	$0.32	$804
D	0.16 lbs	3.13 lbs	$0.75	$1,875

[1]To provide 0.5 lb of supplemental CP per cow to 50 cows for 100 days

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Sorting through the options

- Four major factors to consider:
  - What options are available to you?
  - Do any of those options act as a vehicle for something else that adds value?
  - Do they require additional expense or lead to savings in terms of time, labor, or storage?
  - Which option is the most economical means of filling the nutrient void?

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Nutrient cost

- Retail price does not paint the entire picture
  - Differences in nutrient content bias the comparison
- Evaluating nutrient cost "levels the playing field"
  - Accounts for differences in nutrient content
  - Allows for an un-biased comparison

$$\text{Nutrient cost} = \frac{final\ cost\ per\ lb\ of\ feed}{amount\ of\ nutrient\ per\ lb\ of\ feed}$$

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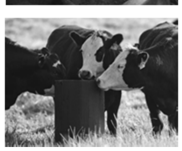
Mineral supplementation

- Mineral supplementation is crucial
  - Forages + trace mineralized salt will not meet mineral requirements most of the time
  - Provide constant year-round access to a good quality free-choice mineral supplement <u>that complements your forage base</u>
  - There is no "silver-bullet"



Photos courtesy of Drovers CattleNetwork

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Mineral supplementation

- Plays an important role in pretty much anything that impacts cow/calf productivity
- Find a formulation that your cattle will consume
- Choose the form that fits your management style
- Don't blend it with salt to reduce consumption
- Ask yourself, is saving a couple bucks per bag for a lower quality product a responsible decision?

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Is a couple bucks per bag worth sacrificing product quality?

Option	Price, $ per 50-lb bag	Annual cost[1], $ per cow	Annual savings, $ per cow
A	$23.00	$41.98	--
B	$20.00	$36.50	$5.48 @ $3.00/bag
C	$17.00	$31.03	$10.95 @ $6.00/bag

[1]Assumes a mineral supplement consumption of 4 oz. per head per day

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Take-home points

- Focus on managing body condition and meeting nutrient requirements to improve cow/herd productivity
- Do so in the most economical way possible
- If you're looking to cut costs, make sure the benefit outweighs the risk

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"If you feed them, they will come"

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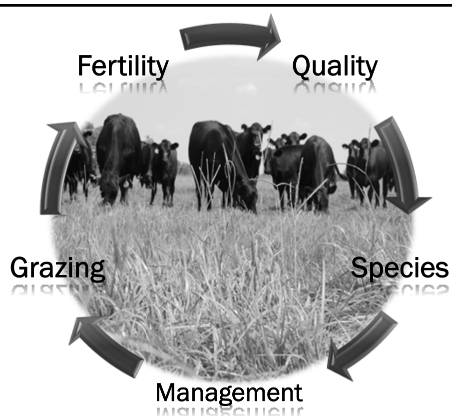
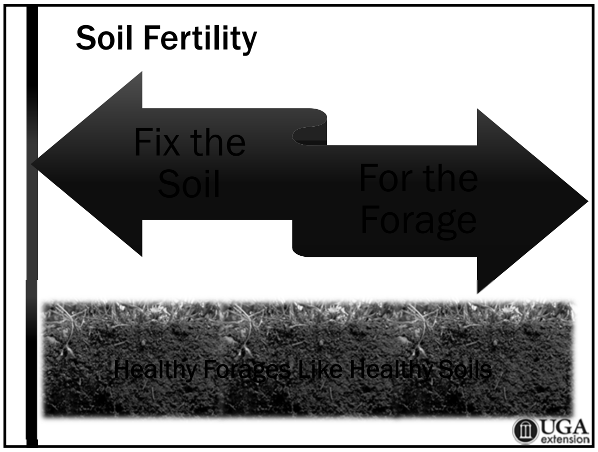
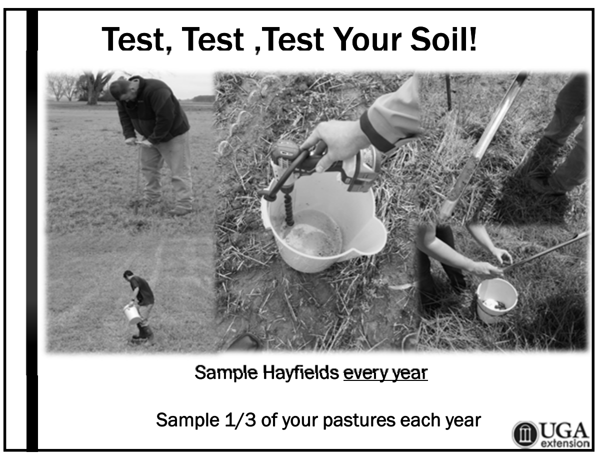
PASTURE MANAGEMENT FOR OPTIMAL PRODUCTIVITY

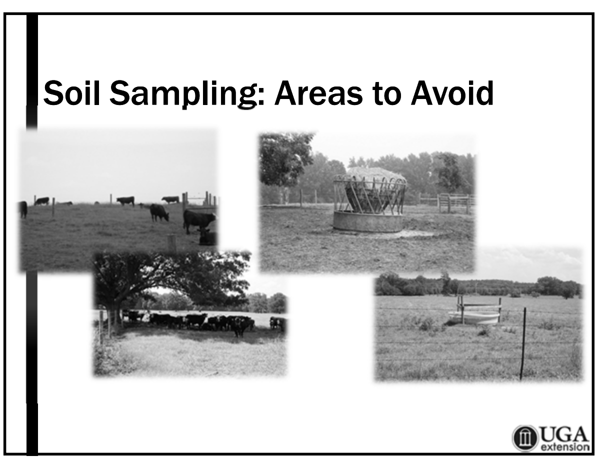
Jennifer J. Tucker, Ph.D
Assistant Professor/Extension Specialist
Department of Animal and Dairy Sciences
University of Georgia – Tifton



FOCUS ON FERTILITY


Soil Fertility
Fix the Soil
For the Forage
Healthy Forages Like Healthy Soils


Test, Test ,Test Your Soil!
Sample Hayfields every year
Sample 1/3 of your pastures each year

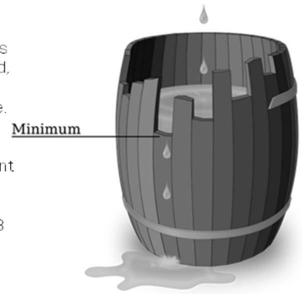

Soil Sampling: Areas to Avoid

Liebig's "Law of the Minimum"

"If one growth factor/nutrient is deficient, plant growth is limited, even if all other vital factors/nutrients are adequate.

Plant growth is improved by increasing the supply of deficient factor/nutrients first."

Justus von Liebig 1803 - 1873



UGA extension

Food for Thought:

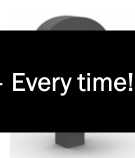
Soil test recommendations:

1. Apply 3 tons of Lime
2. Apply 100 lbs of N
3. Apply 40 lbs of P
4. Apply 60 lbs of K

UGA extension

Food for Thought:

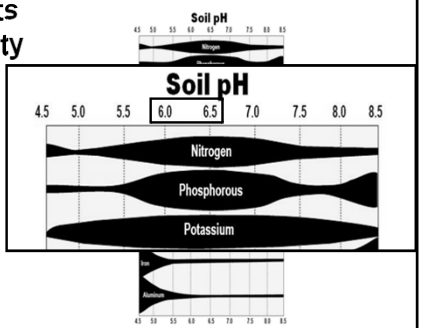
Soil test recommendations:



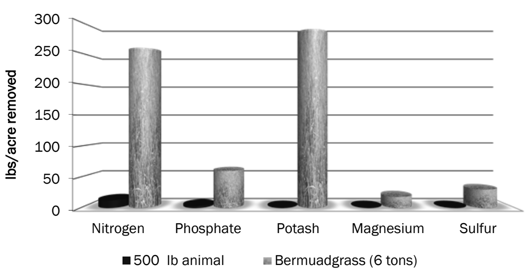
Choose Lime – Every time!

UGA extension

How Soil pH affects availability of plant nutrients



Approximate lbs of nutrients removed by Bermudagrass



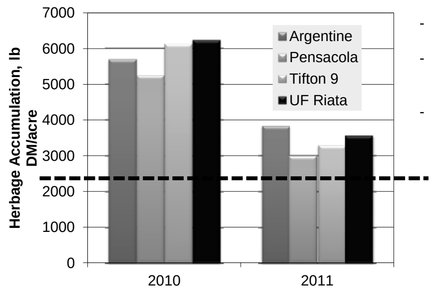
Southern Forages 4th Ed

Remember:

Fertility is the biggest economic input that can affect the output!

Forages Like Fertilizer!!

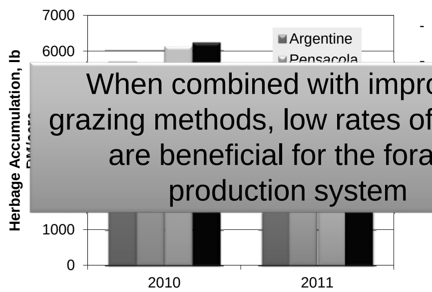
Fertility
How Does it Improve Efficiency?



- 55 lb N/acre
- Spring vs. fall growth
- Grazed every 4 wk – 50% greater herbage accumulation

Vendramini et al., 2013

Fertility
How Does it Improve Efficiency?

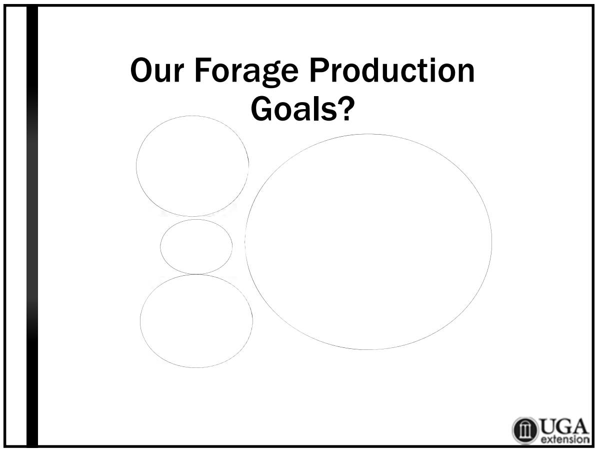


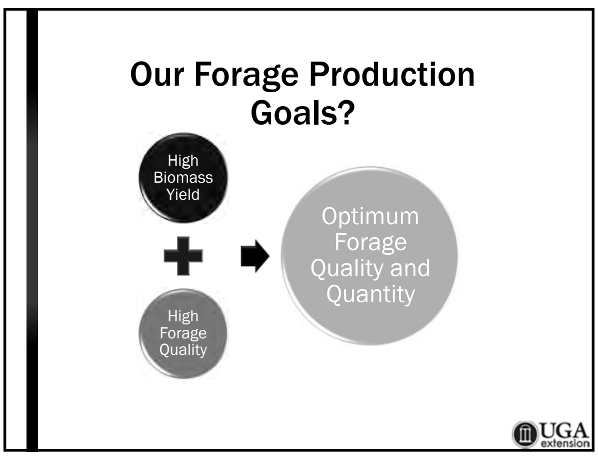
- 55 lb N/acre

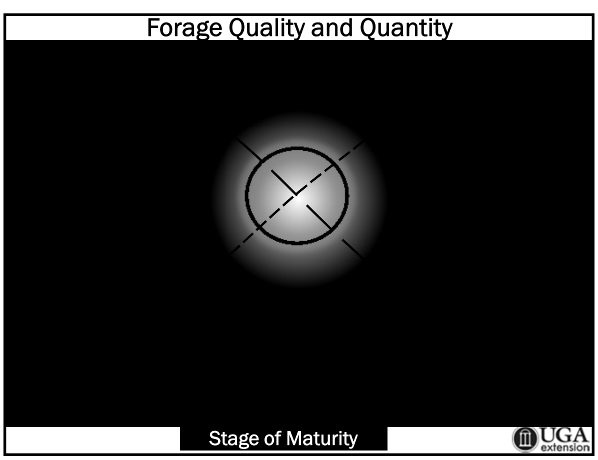
When combined with improved grazing methods, low rates of fertility are beneficial for the forage production system

Vendramini et al., 2013

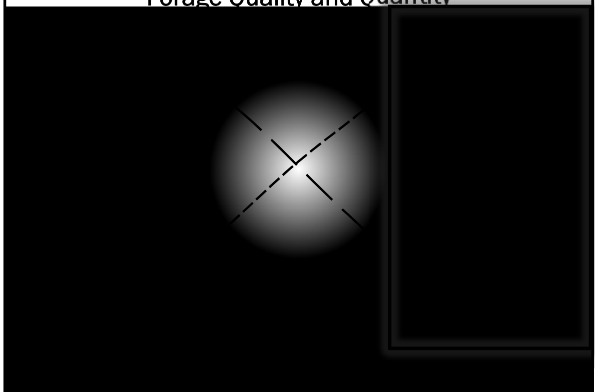
FOCUS ON FORAGE QUALITY


Our Forage Production Goals?
UGA extension


Our Forage Production Goals?
High Biomass Yield
High Forage Quality
Optimum Forage Quality and Quantity
UGA extension

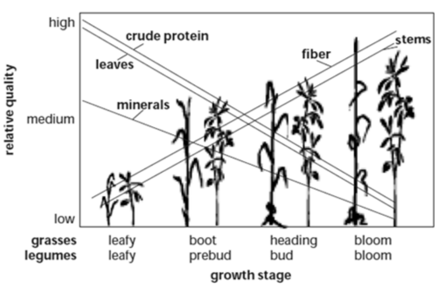

Forage Quality and Quantity
Stage of Maturity
UGA extension

Forage Quality and Quantity



Stage of Maturity

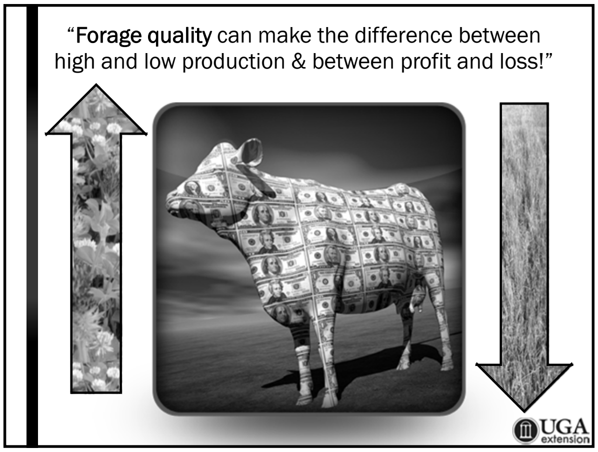
Figure 3. Effect of plant maturity on forage intake and digestibility.



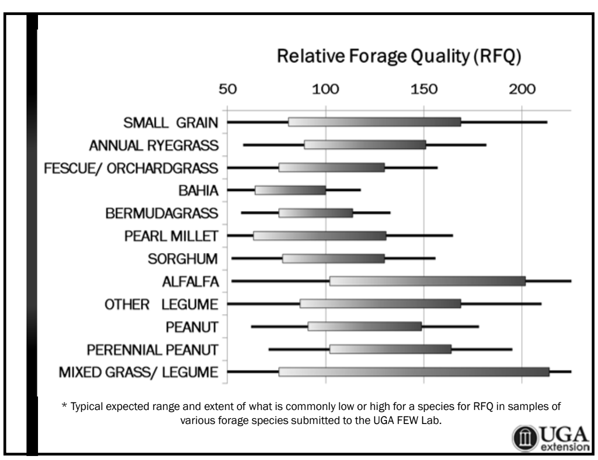
Source: *Adapted from Blaser, R., R.C. Hammes, Jr., J.P. Fontenot, H.T. Bryant, C.E. Polan, D.D. Wolf, F.S. McClaugherty, R.G. Klein, and J.S. Moore. 1986. Forage–animal management systems. Virginia Polytechnic Institute, Bulletin 86-7.*

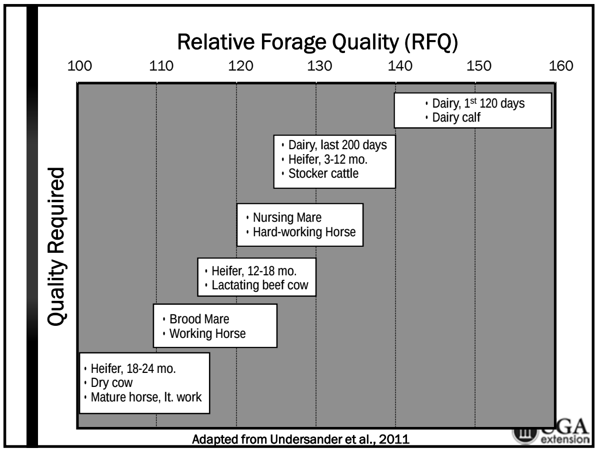
What is “High Quality Forage”?

- Results in high intake
  - *Consumed in large amounts*
  - *High DMI*
- Is digestible
  - *Large amounts of nutrients*
  - *High TDN*
- Contains proper balance of needed nutrients

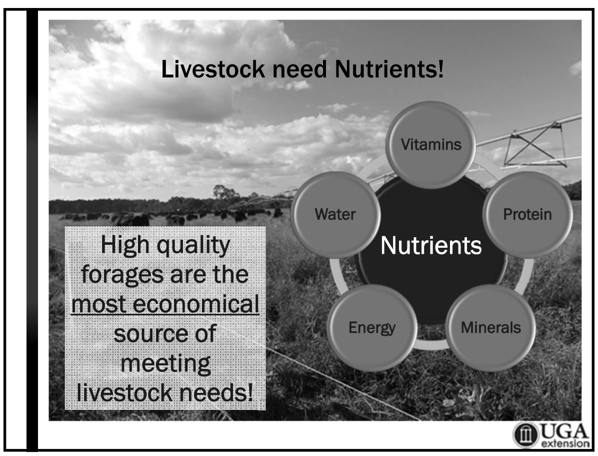

"Forage quality can make the difference between high and low production & between profit and loss!"
UGA extension


Unless you Test...
It's Just a Guess!
UGA extension

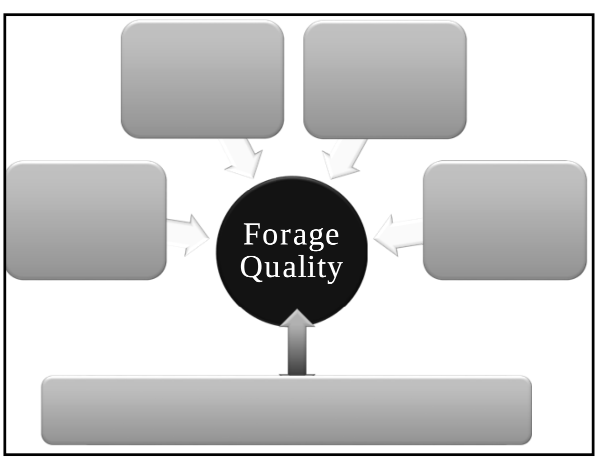

Relative Forage Quality (RFQ)
50
100
150
200
SMALL GRAIN
ANNUAL RYEGRASS
FESCUE/ ORCHARDGRASS
BAHIA
BERMUDAGRASS
PEARL MILLET
SORGHUM
ALFALFA
OTHER LEGUME
PEANUT
PERENNIAL PEANUT
MIXED GRASS/ LEGUME
* Typical expected range and extent of what is commonly low or high for a species for RFQ in samples of various forage species submitted to the UGA FEW Lab.
UGA extension



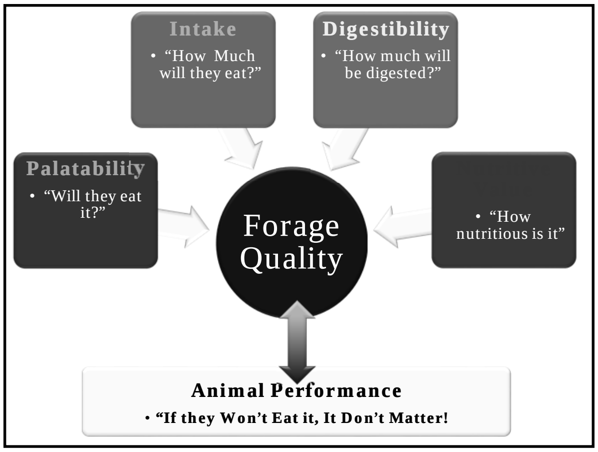
Relative Forage Quality (RFQ)
100
110
120
130
140
150
160
Quality Required
Dairy, 1st 120 days
Dairy calf
Dairy, last 200 days
Heifer, 3-12 mo.
Stocker cattle
Nursing Mare
Hard-working Horse
Heifer, 12-18 mo.
Lactating beef cow
Brood Mare
Working Horse
Heifer, 18-24 mo.
Dry cow
Mature horse, lt. work
Adapted from Undersander et al., 2011
UGA extension



Livestock need Nutrients!
Vitamins
Water
Protein
Nutrients
Energy
Minerals
High quality forages are the most economical source of meeting livestock needs!
UGA extension



Forage Quality



FOCUS ON FORAGE SPECIES

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True or False?

"One species of forage can maintain my herd all year round?"

FALSE

UGA extension

Species Selection

- There is NOT A MIRACLE FORAGE:
  - *That grows all year long*
  - *Is always high quality*
  - *Fixes it's own nitrogen*
  - *Can withstand continuous overgrazing*
  - *Can withstand extreme heat and cold*
- Choosing the right combination of forages is key!

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Forages for a Longer Grazing Season:

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There's no such thing a true Monoculture Pasture, to get the best utilization out of your pasture, mix things up!

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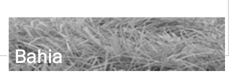
Bermudagrass   Bahiagrass

Remember:

Perennial Grasses are our most important "tool" and should provide the basis for almost all forage programs!

The Basics

- High-yielding, sod-forming, warm-season perennial grass
- Grows best on well-drained, fertile soils with ample moisture availability



- Deep rooted, sod-forming warm season perennial grass
- Adapted to <u>a wide range of soils and conditions</u>

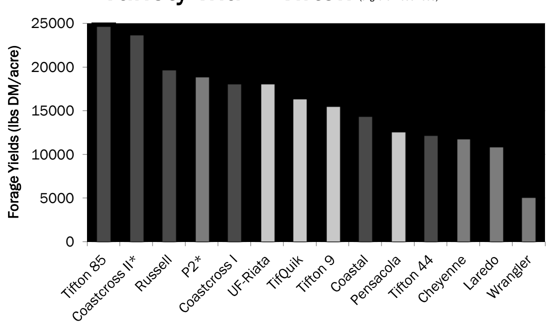
The Basics

Bermuda

- Several Bermudagrass varieties available – the better performing to date being Hybrid varieties which require vegetative propagation
- Hybrid bermudagrass varieties can potentially produce well over 4-6 tons of hay per acre, and can be cut four to five times per year when moisture is available

UGA extension

Warm Season Perennial Grass Variety Trial – Tifton (avg. over 2006-2008)



Source: D. Hancock UGA

UGA extension

Quality and Fertility

Bermuda

- Typical RFQ 90-100
- Range in RFQ 80-140

Fertility is Required!

- Check you pH
- Follow your soil test recommendations
- Replace you N, P, and K
- Pay Attention to Potassium – K is CRITICAL!

Bahia

- Typical RFQ 85-90
- Range in RFQ 75-110
- Less digestible than ‘Coastal’ bermudagrass of the same age (maturity level).

Fertility

- More forgiving when fertility is forgotten
- Responds well to proper fertility and management!

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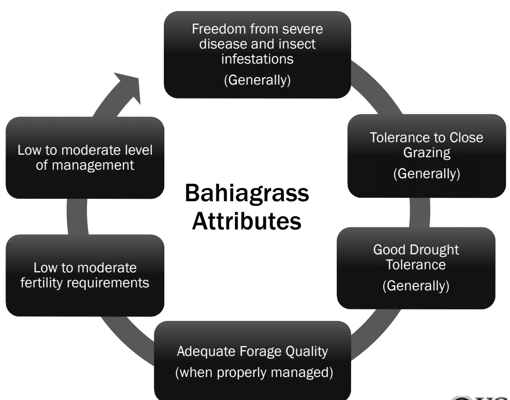
Bermuda

- Higher yielding than Bahia
- Generally Higher quality than Bahia
- If you have good soil conditions – plant BG

Bahia

- Will grow on soils too poorly drained for BG
- Is more shade tolerant that BG
- Can be successfully used in silvopasture and sod based rotation

UGA extension



UGA extension

UGA extension

USING ANNUAL SPECIES

Annual Grasses

Summer
- Pearl Millet
- Sorghum x Sudangrass
- Sudangrass
- Crabgrass!

Winter
- Oats
- Wheat
- Rye
- Annual Ryegrass

Complementary Plantings

Winter Annuals
- Most common
- Can be planted alone or mixed
- Can be managed for reseeding
- Drilled, Broadcast, or Prepared seedbed
- Grazed or Hayed
- Timing is Critical

Summer Annuals (excluding crabgrass)
- More expensive than WA's
- Difficult Management
- Potential for prussic acid poisoning and nitrate toxicity
- Graze/Hay (dependent on species)

Consider Sacrifice Areas

What is a Sacrifice Area?

- An area where livestock are held for a period of time
- Usually during inclement weather
  - *Extreme wet (winter)*
  - *Drought*
- Or while waiting for other pasture areas to re-establish or break dormancy and begin productivity for the season
- Commonly used for hay feeding during times of low quantity grazeable forage and harsh weather

What you need to know about Sacrifice Areas

- Renovation of some sort needs to occur on the area selected as the "Sacrifice Paddock"
- Ideal locations include
  - *Weak stands or area in pasture than can be excluded*
  - *Areas that need additional nutrients*
  - *Areas that are in need of re-seeding/re-establishing*
  - *Areas being transitioned from one forage crop to another*

Renovation option

- Seeding an annual forage to provide quick cover of bare soil created in sacrifice area
  - *Summer or Winter Annual (season dependent)*
  - *Provides a short-term grazing or hay crop and prepares the land for permanent pasture establishment in the fall*
  - *DO NOT use the same area as a sacrifice paddock the year following establishment*

Annual Rotation

- Identifying and "Annual Rotation" sacrifice area that <u>will not</u> be in permanent perennial pasture
  - *Rotate between winter annual and summer annual grass plantings*
  - *Use for grazing when grass in other pasture areas is limited*
  - *Common in my area –*

  Annual Ryegrass – Crabgrass

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FOCUS ON GRAZING

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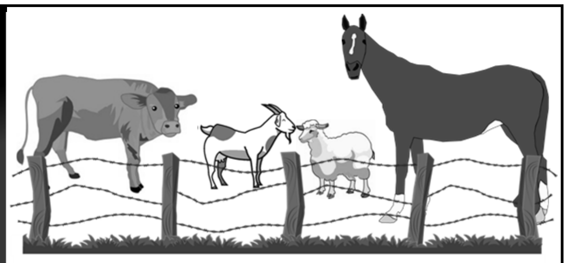

Fencing + Animals =/= Grazing System

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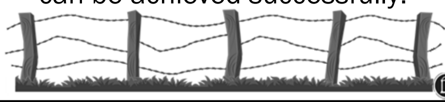
Grazing Management

When **grazing management** occurs through the implementation of **grazing methods** within a **grazing system**, a number of goals and objectives can be achieved successfully!



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Grazing Management

Requires an understanding of:

4/17/2017

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Matching Animal Requirements and Forage Quality

Stage of Production	TDN % Required	CP % Required
Dry Pregnant	48	7
Peak Lactation	60	12
Late Lactation	55	9

Kim Mullenix, Auburn University

Extension

Matching Animal Requirements and Forage Quality

Stage of Production	TDN % Required	CP % Required	Hay % TDN	Hay % CP	Supplement Needed
Dry Pregnant	48	7	48	7	No*
Peak Lactation	60	12	48	7	Yes
Late Lactation	55	9	48	7	Yes

Kim Mullenix, Auburn University

Nutrient requirements of different classes of cattle

Class of Animal	Stage of Production	TDN % Required	CP % Required
Mature Cows	Dry Pregnant	48	7
	Peak Lactation	60	12
	Late Lactation	55	9
1st calf Heifers	------------	62	12
Growing calves (500 lb)	-----------	61	11

Kim Mullenix, Auburn University
Adapted from NRC for Beef Cattle 7th ed. (2000)

Dry Matter (lbs/acre) of different bermudagrass and bahiagrass varieties after different growth periods in Louisiana

Weeks	Bermudagrass			Bahiagrass		
	Russell	Coastal	Jiggs	Tifton-9	Pensacola	Argentina
2	292[a]	511[b]	1080[c]	908[d]	1008[dc]	1528[c]
4	4523[a]	3788[a]	5988[b]	3791[a]	4200[a]	5301[b]
6	5981[a]	6082[a]	7688[b]	5621[a]	5589[a]	6014[a]
8	7284[a]	6733[a]	9525[b]	6369[a]	5043[c]	6608[a]
10	6831[ab]	5881[a]	8002[c]	6894[b]	6693[ab]	7857[bc]

[abcd]Rows with means with different superscripts are different (P<0.05)

Dore et. al. LSU 2006

CP (%) of different bermudagrass and bahiagrass varieties after different growth periods in Louisiana

Weeks	Bermudagrass			Bahiagrass		
	Russell	Coastal	Jiggs	Tifton-9	Pensacola	Argentina
2	20.3[a]	20.8[a]	20.8[a]	17.6[b]	17.0[b]	19.1[a]
4	11.1[a]	11.3[a]	11.4[a]	10.7[ab]	10.3[b]	10.1[b]
6	9.0[a]	8.7[ab]	8.0b[c]	8.2[bc]	9.1[a]	7.4[c]
8	6.9	6.9	5.8	6.8	6.5	6.1
10	6.8	6.6	5.8	6.8	6.2	6.5

[abcd]Rows with means with different superscripts are different (P<0.05)

Dore et. al. LSU 2006

NDF (%) of different bermudagrass and bahiagrass varieties after different growth periods in Louisiana

Weeks	Bermudagrass			Bahiagrass		
	Russell	Coastal	Jiggs	Tifton-9	Pensacola	Argentina
2	63.5[a]	57.8[b]	58.1[b]	63.0[a]	64.3[a]	60.7[ab]
4	67.9	62.0	63.8	64.3	67.8	63.4
6	69.6[a]	66.2[b]	68.9[a]	67.0[b]	65.6[b]	65.6[b]
8	69.6[a]	65.4[b]	67.9[bc]	67.1[bc]	66.9[bc]	67.7[ac]
10	68.9[a]	66.9[b]	70.6[a]	69.1[a]	70.5[a]	68.8[a]

[abcd]Rows with means with different superscripts are different (P<0.05)

Dore et. al. LSU 2006

Other Factors to Consider in Dore Study

- Harvest height = 2 inches
  - *Recommended LOWEST height for Bermuda/Bahia*
- Applied Fertility
  - Nitrogen @ 100 lbs/acre
  - Phosphorous @ 40 lbs/acre
  - Potassium @ 120 lbs/acre

Efficiencies of Grazing Systems

Grazing System	Efficiency
Continuous Stocking	30-40%
Slow Rotation (3-4 paddocks)	50-60%
Moderate Rotation (6-8 paddocks)	60-70%
Strip Grazing	70-80%

Adapted from D. Hancock UGA

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Rest Period for Forage Species

Forage Species	Cool weather	Hot weather
	Days rest	Days rest
Cool-season grasses Annual ryegrass, tall fescue	10-14	35-50
Warm-season grasses bermudagrass, dallisgrass	35-40	14-21
Legumes clovers, alfalfa	21-28	30-40

Adapted from Southern Forages 4th Edition

Adapted from Southern Forages 5th Edition

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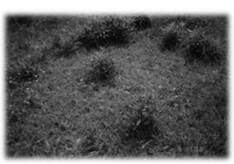
Proper Height and Rest = The Key to Grazing Success

- Most plants are grazed every 2-7 days
- Animals will chose new growth over older more mature, stemmy plants
- With recommended rest periods, roots will redevelop to approximately the same depth as uncut plants.



Continuously Grazed

Rotational Grazing

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Grazing Management Recommendations

- Graze no lower than 2 inches in Bermuda/Bahia dominant pastures
- Don't graze too soon or too often
- Keeping the bahiagrass between 2 and 6 inches – will keep the quality relatively high (in comparison).

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Questions?

GRASS www.georgiaforages.com

www.georgiaforages.com

www.ugabeef.com

1-800-ASK-UGA1

BEEF UGABEEF.COM

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2016 Feeder-Finish Calf Demo Recap

Todd Thrift[1]

[1]UF/IFAS Department of Animal Sciences, Gainesville, FL

Notes:

Nutrient Profiling – Mineral Supplementation

Deborah Price[1], Matt Hersom[1], Joel Yelich[1], Max Irsik[2], and Owen Rae[2]

[1]UF/IFAS Department of Animal Sciences, Gainesville, FL
[2]UF College of Veterinary Medicine, Gainesville, FL

Trace minerals (TM) are defined as a nutrient that is required in small amounts in the body and include cobalt, copper, iron, manganese, molybdenum, selenium and zinc; with each having roles in physiological, biochemical, and immune, processes throughout the animal's body. The TM are necessary for proper growth and development, and for immune and reproductive functions of both animals and humans.

An animal's requirements for TM begin while it is *in utero,* as TM are essential for proper embryonic development and survival (Ashworth and Antipatis, 2001; Hostetler et al., 2003). Moreover, TM deficiencies of the developing fetus carry over into the postnatal period with lesser TM storage in tissues of the neonates, further limiting neonatal growth, development, performance and immunity. During late gestation, the fetus undergoes a rapid phase of growth and increases its nutrient demands from the gestating dam to meet the needs of its developing organs. As gestation progresses, the fetal stores of TM in the body as a whole and particularly the liver increase (Hansard et al., 1968; Hidiroglou, 1980; Gooneratne and Christensen, 1989). Increased fetal and subsequent lactation TM demands increase the TM and nutrient requirements of late gestating and lactating animals. An animal's requirement for TM will ultimately vary depending upon its age, stage of production, and breed or genotype; necessitating the development of supplementation strategies that vary in response to the animals' level/stage of production (McDowell, 2003).

Bioavailability, refers to the proportion of mineral able to be utilized by the animal Various factors affect TM bioavailability and include the amount of TM in the diet, pH of the rumen and abomasum, antagonistic interactions with other TM, and breed and genetic variations in TM absorption and metabolism (Ashmead, 1993; McDowell, 2003). Available TM supplements can be delivered as a free choice mineral, a concentrated feed pellet, a soluble bolus, an injectable, or be added to animal's drinking water; where the form of TM delivery can also contribute to an animals' TM consumption (McDowell, 2003). The TM source, as either inorganic or organic is theorized to affect their bioavailability to the animal; with organic TM proposed to be more bioavailable than their inorganic counter parts (Spears, 1996). Moreover, the TM source may affect the ability of the TM to be utilized by the animal; with varying effects on post-absorption physiology. Trace minerals are involved in numerous enzymes related to cellular proliferation, carbohydrate and lipid metabolism, bone formation, and hormone production; all of which have the potential to impact animal growth, performance, and body composition.

Role of Trace Minerals in Male Reproduction

Proper spermatogenesis is necessary for successful reproduction and fertility. Poorer quality semen with decreased sperm motility, and increased sperm abnormalities and DNA damage can reduce fertility by inhibiting the ability of sperm to fertilize the oocyte or by generating poorer quality embryos (Saacke et al., 2000). Collectively, poor semen quality negatively affects reproductive potential of the male by reducing the number of offspring they are able to sire, and can reduce female production if they are not able to successfully fertilize a viable embryo. Spermatogenesis is known to be adversely affected by heat or cold stress, and poor nutrition, though, the effects of TM on male reproduction and fertility has received minimal attention in cattle. A majority of research on the effects of TM supplementation and source on male reproduction has been carried out in laboratory species, chickens, pigs, and humans. Furthermore, the effects of TM source on sexual development in bulls are even scarcer. One study conducted in peripubertal Hereford crossbred bulls demonstrated that supplementation with organic amino acid complexed compared to inorganic sulfate sources of Co, Cu, Mn, and Zn tended to reach puberty 15 d earlier during the experiment (Geary et al., 2016). This study implies potential effects of TM source on bull sexual development may exist; however, additional research is needed to clarify the effects on puberty and sexual maturity in beef bulls. The following section will now discuss the roles of individual TM in male reproduction.

Role of Trace Minerals in Female Reproduction

The level of nutrition (i.e. protein, energy, and/or nutrients), physiological, psychological, or environmental stress, and the endocrine milieu affect female reproduction, which is the essential to livestock production. While the effects of nutrition are accepted, the effects of TM and in particular, TM source need further clarification. Research has yielded conflicting results on the effects of TM supplementation and TM source on reproductive performance. No difference in AI pregnancy rate, AI first service conceptions rate, and number of inseminations per female was reported between beef cows that received two 20 g Cu oxide boluses and control cows that received no bolus (Arthington et al., 1995). A 2 yr experiment provided no supplemental Cu (control), inorganic Cu sulfate, or organic amino acid complexed Cu to 2 yr old crossbred beef cows from 45 d pre-calving through 60 d post-calving. In yr 1, the 30 d pregnancy rates were greater in control (86 %) and organic (75 %) compared to inorganic (57 %) cows and no difference in 60 d pregnancy rates occurred between any treatment, while in yr 2 organic (85 and 93 %) and inorganic (80 and 87 %) cow 30 d and 60 d pregnancy rates did not differ, respectively (Muehlenbein et al., 2001). Similarly, another 2 yr experiment that utilized 2 yr old crossbred beef cows that were fed no TM (control), inorganic (sulfates and Co carbonate), or organic (Co glucoheptonate, Cu lysine, and Mn and Zn methionine) sources of Co, Cu, Mn, and Zn from the time of calving to breeding did not observe differences in pregnancy rates between the control or TM sources in either yr, however, in yr 1 the ING cows tended to conceive earlier than the ORG cows (Olson et al., 1999). Supplementation of crossbred multiparous beef cows with no TM (control), inorganic sulfate or organic proteinate sources of Cu, Mn, and Zn during the 3rd trimester through 110-135 d post-calving did not result in differences in estrus response to PGF2α, or AI pregnancy rate in yr 2; however overall pregnancy rate tended to be greater in supplemented than control cows (Ahola et al., 2004). Additionally, no differences in AI, bull, and overall pregnancy rate were observed between crossbred beef cows not supplemented and supplemented with inorganic sulfate or organic amino acid complexes of Co, Cu, Mn, and Zn (Marques et al., 2016).

In contrast, several studies have reported positive results of TM supplementation or source on reproduction. Mature beef cows that received TM (Cu, Mn, Se, and Zn) injections 105 d pre-calving and 30 d prior to fixed-time AI had greater AI pregnancy rates (60.2 %) compared to controls (51.2 %) which received saline injection; however, final pregnancy rate did not differ between treatments (Mundell et al., 2012). First calf heifers supplemented with organic amino acid chelate sources of TM became pregnant earlier in the breeding season compared to first calf heifers supplemented with inorganic TM sources (Kropp, 1990). Likewise, dairy cows supplemented with organic amino acid complexes of Cu, Mn, and Zn and Co glucoheptonate had fewer days to first service, services to conception, and days to conception compared to dairy cows that received inorganic TM in their total mixed ration (Uchida et al., 2001). Beef cows supplemented with a low or high level of inorganic (Co carbonate, Cu and Zn sulfate, and Mn oxides) or high level of amino acid complex organic sources of Co, Cu, Mn, and Zn did not differ in overall pregnancy rates, however, the high level of organic treatment had a greater AI pregnancy rate (Stanton et al., 2000). Interestingly, young (3 and 4 year olds) but not mature Braford cows (> 4 years old) supplemented with organic TM had greater pregnancy rates and a reduced calving interval compared to young and old cows supplemented with inorganic TM sources (Arthington and Swenson, 2004). Similarly, in nulliparous and primiparous crossbred beef heifers supplemented with inorganic sulfate or 50 % organic proteinate sources of Cu, Mn, and Zn, estrous cyclicity in yr 2 tended to be greater in organic compared to inorganic heifers; however, overall pregnancy rate tended to be greater in inorganic compared to organic heifers (Ahola et al., 2005a). Collectively, these studies suggest that the results of

TM supplementation and/or source on reproduction may be occurring during early establishment of pregnancy or on early embryonic development evidenced by greater AI, early pregnancy, and fewer services to conception. Moreover, most studies have utilized synchronization protocols at the time of breeding, which can potentially mask any effect of TM source on pubertal development in heifers, and on length of postpartum interval in cows. Research to determine whether TM source affects heifer sexual development is warranted.

We undertook a number of studies using inorganic and organic source mineral two of the project objectives related to nutritional profiling on sexual development.

1. Study the effects of prenatal and postnatal TM source on sexual development in bulls in relation to puberty and sexual maturity.

2. Explore the effects of prenatal and postnatal TM source on sexual development in heifers with respect to puberty and pregnancy.

Effects of prenatal and postnatal trace mineral supplement source bull growth, performance, and sexual development

A study was conducted to evaluate breed (Angus, AN vs. Brangus, BN) and prenatal/postnatal TM source (inorganic, ING vs. organic, ORG) on bull growth, performance, and sexual development. Bulls (241 ± 2 d, 548 ± 9 lb, n = 32, 8 per TM × breed) born to dams that were supplemented with either Co, Cu, Mn, Se, and Zn as ING (Na selenite or salt sulfates) or ORG (Se-yeast and proteinates) TM sources were stratified by sire, age, and weaning BW. Bull diet included cracked corn, cottonseed hulls, a protein pellet, wet brewer's grains, and TM supplement pellet (1.0 lb/1,000 lbBW/day). Weekly BW, 28-d hip height, and bi-weekly semen collection, scrotal circumference (SC), and BCS (scale 1-9) were recorded. Serum and liver biopsies to determine TM status every 56 d. At puberty, there was no effect of TM source or breed except for sperm concentration which was greater in BN ($172.4 \pm 28.2 \times 10^6$ cells/mL) compared to AN ($96.9 \pm 23.3 \times 10^6$ cells/mL) bulls. At sexual maturity, except for ADG which tended to be greater in ING (2.76 ± 0.18 lb/d) compared to ORG (2.32 ± 0.18 lb/d) bulls and secondary abnormalities which were lesser in BN (9.6 ± 1.67 %) compared to AN (15.0 ± 1.18 %) bulls; no effect of TM source, breed or TM source × breed occurred for performance or seminal traits. Liver and serum TM concentrations were not affected by TM source. Mean liver Cu, Mn, and Se concentrations were greater in BN compared to AN bulls, while mean liver Co, Fe, Mo, and Zn did not differ by breed. Performance, body composition, serum and liver TM concentrations, and seminal traits were all affected by day of the experiment. Age at puberty did not differ by TM source, breed or TM source × breed. Although not significant, ORG bulls were numerically 41 d younger than ING bulls at sexual maturity. Bull TM source had minimal effects on pubertal parameters, but ORG TM supplementation may hasten the age bulls reach sexual maturity.

Table 1. Effect of inorganic (ING) or organic (ORG) prenatal and postnatal trace mineral (TM) supplement source on Angus (AN) and Brangus (BN) bull sexual parameters at puberty[1]

	TM source × Breed (B)					*P*-value		
Item	ING-AN	ING-BN	ORG-AN	ORG-BN	SEM	TM	B	TM×B
Puberty, *n*	8	6	8	5				
Age, d	338	342	346	313	15	0.52	0.34	0.23
BW, kg	730[x]	856[y]	842[xy]	730[xy]	53.0	0.89	0.88	0.04
ADG, kg/d[2]	2.43[ab]	2.71[a]	2.45[a]	1.83[b]	0.22	0.05	0.42	0.04
BCS	4.7	4.8	4.9	4.8	0.14	0.59	0.80	0.44
SC, cm[3]	29.9[a]	33.5[b]	31.2[a]	30.3[a]	0.82	0.26	0.11	0.01
Sperm conc., 10^6 cells/mL	102.2	218.3	91.6	126.5	36.4	0.17	0.05	0.28
Gross motility[4]	1.75	1.83	1.88	1.80	0.20	0.82	0.98	0.70
Normal sperm, %	34.0	51.5	51.0	61.0	8.93	0.15	0.14	0.68

[1]Puberty was defined as the date at which the bull's ejaculate with a sperm concentration $\geq 50 \times 10^6$ cells/mL and ≥ 10% motility.
[2]ADG was calculated based on difference from d 0 and when bull reached puberty.
[3]SC = scrotal circumference.
[4]Gross motility scale of 0 to 4, (0 = none, 1 = poor, 2 = fair, 3 = good, and 4 = very good).
[a, b] Row means with different superscripts differed, ($P \leq 0.05$).
[x, y] Row means with different superscripts differed, ($P \leq 0.10$).

Table 2. Effect of inorganic (ING) or organic (ORG) prenatal and postnatal trace mineral (TM) supplement source on Angus (AN) and Brangus (BN) bull sexual parameters at sexual maturity[1]

	Trace mineral (TM) source × breed (B)					*P*-value		
Item	ING-AN	ING-BN	ORG-AN	ORG-BN	SEM	TM	B	TM × B
Sexual maturity, *n*	6	2	4	3				
Age, d	412	370	371	332	24.3	0.14	0.13	0.94
BW, kg	972	955	911	789	87.1	0.23	0.45	0.57
ADG, kg/d[2]	2.89	2.65	2.40	2.21	0.22	0.07	0.38	0.93
BCS	5.3	5.3	5.1	5.0	0.21	0.41	0.78	0.78
SC[3], cm	34.1	35.0	33.5	32.0	1.44	0.25	0.85	0.43
Sperm conc., 10^6 cells/mL	172.2	222.5	116.9	134.2	55.3	0.23	0.56	0.77
Gross motility[4]	2.5	2.5	2.3	2.7	0.38	0.92	0.61	0.61
Normal sperm, %	75.5	76.0	77.0	77.7	2.4	0.53	0.82	0.97

[1]Sexual maturity was defined as the first date at which a passed to consecutive biweekly BSE.
[2]ADG was calculated based on difference from d 0 and when bull reached puberty.
[3]SC = scrotal circumference.
[4]Gross motility scale of 0 to 4, (0 = none, 1 = poor, 2 = fair, 3 = good, and 4 = very good).

Effects of prenatal and postnatal trace mineral supplement source on heifer growth, performance, and sexual development

A study was designed to examine the effects of prenatal and postnatal trace mineral (TM) source on heifer performance, body composition, and sexual development across 2 yrs in Angus (AN, yr 1 = 40, yr 2 = 30) and Brangus (BN, yr 1 = 40, yr 2 = 31) heifers supplemented with inorganic (ING, sulfate salts; yr 1 = 40, yr 2 = 31) or organic (ORG, Se-yeast and proteinates; yr 1 = 40, yr 2 = 30) trace mineral (TM) sources of Co, Cu, Mn, Se, and Zn. Heifers were stratified by maternal TM source, age, sire, and weaning BW, and randomly assigned to pens for a 168 d development period and combined into 4 breeding groups (1 per TM source × breed) for natural service breeding. The TM supplement was pen fed as a pellet 3 d/wk at 1.0 lb/1,000 lb BW/day. The TM source did not affect BW, BCS, or ADG at the end of development for both yrs. Mean liver Se concentrations were greater in ORG compared to ING both yrs. Liver Mn concentrations were greater in BN than AN both yrs, and liver Cu was greater in BN compared to AN at breeding in yr 1 and overall in yr 2. Pubertal status at the start of breeding in yr 1 did not differ by TM source, breed, and TM source × breed. In yr 2, more ORG (47% = 14/30) heifers were pubertal compared to ING (23% = 7/31). The interval to puberty in yr 1 was affected by TM source × breed, as ORG-BN heifers were pubertal 12 d earlier than ING-AN. In yr 2, ORG (405 ± 7 d) heifers were 29 d younger than ING (434 ± 8 d) heifers based on survival analysis of age to puberty. The interval to pregnancy in yr 1 was less in ORG and BN compared to ING and AN heifers, respectively. There was no effect of TM source, breed, and TM source × breed on age or interval to pregnancy in yr 2. Final breeding season pregnancy rates did not differ by TM source, breed, or TM source × breed for either yr. The results suggest that breed has a greater influence than TM source on performance and body composition traits. However, ORG prenatal and postnatal TM supplementation may hasten the time/age to puberty and pregnancy in heifers.

Table 3. Year 1 characteristics of Angus (AN) and Brangus (BN) heifers supplemented prenatally and postnatally with inorganic (ING) or organic (ORG) sources of trace minerals (TM)

	TM source × Breed (B)					*P*-value		
Item	ING-AN	ING-BN	ORG-AN	ORG-BN	SEM	TM	B	TM × B
Trial start, *n*	20	20	20	20				
Age, d	233	233	234	239	5	0.45	0.60	0.54
BW, lb	475	485	492	496	11	0.18	0.40	0.71
BCS	4.3[a]	4.6[b]	4.6[b]	4.7[b]	0.1	0.001	0.001	0.02
End Dev. (d 168)								
BW, lb	714	730	736	759	15	0.13	0.26	0.83
ADG, lb/d	1.43	1.43	1.41	1.52	0.07	0.49	0.31	0.48
BCS	5.4	5.4	5.4	5.5	0.1	0.38	0.56	0.77
RTS[1], (1-5)	2.8	3.2	3.0	3.6	0.2	0.09	<0.01	0.54
PA[2], cm^2	353	375	380	401	8.9	< 0.01	0.02	0.97
Cycling status start of breeding, *n* (%)[3]	4/20 (20)	4/20 (20)	2/20 (10)	3/20 (15)	--	0.36	0.71	0.71

[1]RTS = reproductive tract score, scale 1-5.
[2]PA = pelvic area, calculated from pelvic height and pelvic width measurements.
[3]Cycling status determined by progesterone concentrations, where concentrations ≥ 1.5 ng/mL was considered cycling.
[a-b]Means within a row with different superscripts differed, ($P < 0.05$).

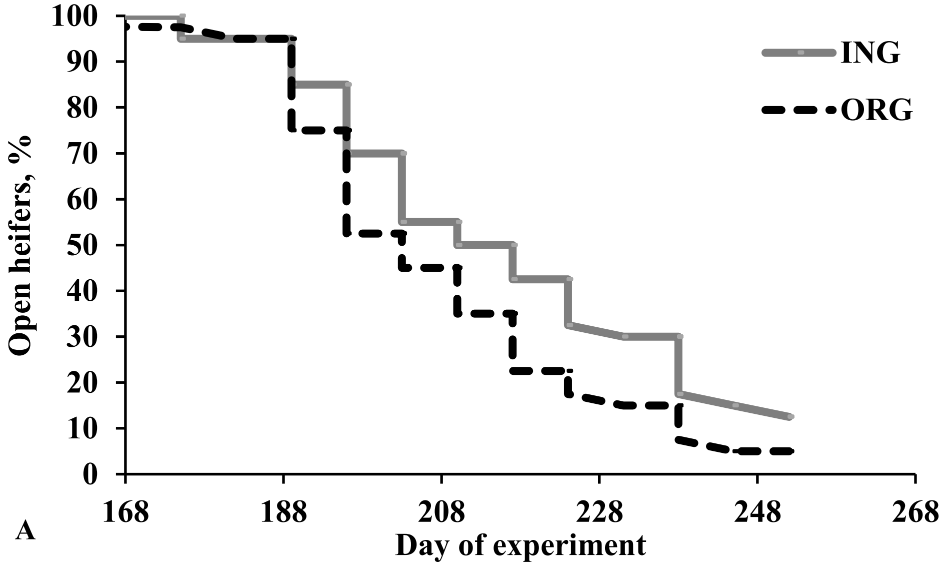

Figure 1. Effect of prenatal and postnatal inorganic (ING) or organic (ORG) trace mineral supplement source in year 1 in heifers on survival analysis interval to pregnancy. Mean (± SE) of interval to pregnancy: ING = 216 ± 4 d, ORG = 207 ± 3 d, ($P = 0.02$).

Table 4. Year 2 characteristics of Angus (AN) and Brangus (BN) heifers supplemented prenatally and postnatally with inorganic (ING) or organic (ORG) trace mineral (TM) sources

	TM × breed (B)					*P*-value		
Item	ING-AN	ING-BN	ORG-AN	ORG-BN	SEM	TM	B	TM × B
Trial start, *n*	16	15	14	16				
Age, d	245	243	238	231	4	0.03	0.28	0.52
BW, lb	476	525	474	523	14	0.91	0.001	1.00
BCS	4.4	4.7	4.3	4.6	0.08	0.40	<0.001	0.56
End Dev. (d 168)								
BW, lb	675	770	695	772	18	0.55	<0.001	0.66
ADG, lb/d	1.19	1.46	1.28	1.48	0.07	0.34	<0.001	0.48
BCS	5.0	5.6	5.2	5.6	0.1	0.51	<0.001	0.36
RTS[1]	2.9	3.4	3.6	3.6	0.3	0.16	0.40	0.38
PA[2], cm^2	444	481	440	481	11.3	0.86	0.001	0.87
Cycling status start of breeding[3], *n* (%)	2/16 (26)	5/15 (33)	7/14 (50)	7/16 (44)	--	0.05	0.40	0.21

[1]RTS = reproductive tract score, scale 1-5.
[2]PA = pelvic area, calculated from pelvic height and pelvic width measurements.
[3]Cycling status determined by progesterone concentrations, where concentrations ≥ 1.5 ng/mL was considered cycling.
[a-c]Means within a row with different superscripts differed, ($P < 0.05$).

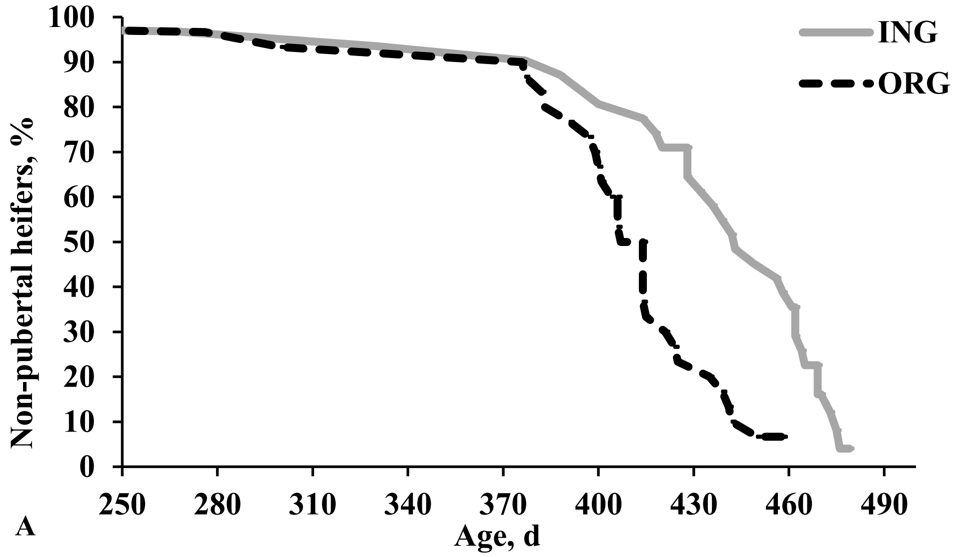

Figure 2. Effect of prenatal and postnatal inorganic (ING) or organic (ORG) trace mineral supplement source in year 2 in heifers on survival analysis of age to puberty. Mean (± SE) age to puberty: ING = 434 ± 8 d, ORG = 405 ± 7 d, ($P < 0.001$).

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Nutrient Profiling - Metabolic Imprinting of Beef Calves

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Introduction

Calf nutrition has detrimental effects on future health and performance of these animals. The process by which nutrition during early-stages of a calf life may permanently change calf development and performance was called "metabolic imprinting" (Lucas, 1991). The metabolic imprinting concept has substantial economic implications for agriculture, and should be explored if we want to improve the performance of animals destined for food production. In this article**,** we will summarize some of the research conducted in beef calf nutrition and its impact on growth and reproductive performance of beef calves.

Suckling beef calves weaned between 7 to 8 months of age

The major nutritional factors affecting preweaning calf growth are the milk production of the dam, and the quantity and quality of nutrients from pasture and supplements provided before and after birth (Greenwood and Cafe, 2007). However, limited information is available regarding the effects of nutrition at an early stage of life of suckling beef calves, and their subsequent growth performance.

In general, calf average daily gain, weaning weight, ribeye area, backfat thickness, and marbling scores at weaning increased as milk production of the dam increased. Also, days on feed in the feedlot linearly decreased as dam milk production increased, likely because of the greater body weight of calves at feedlot entry (Stuedemann et al., 1968). Further, grazing pressure (number of calves/acre) on rangeland by Brahman cow-calf pairs also affected calf body weight at weaning, with the increasing grazing pressure linearly decreasing weaning weights (Philips et al., 1991). However, milk production of cows and grazing pressure did not affect calf weight at slaughter, carcass weight, dressing percentage, and marbling scores in numerous studies (Stuedemann et al.,1968; Philips et al., 1991; Abdelsamei et al., 2005). Likewise, forage type provided during preweaning grazing period had little effect on finishing performance of calves. At calving, cow-calf pairs were assigned to either tall fescue or tall fescue-legume grazing (70% tall fescue, and 30 to 40% legume mixture of red clove, Korean and Kobe lespedeza and ladino clover) until the time of weaning (240 days of age). Calves grazing fescue-legume pastures were 48 lb heavier at weaning, 5 days younger at slaughter, and had 24 lb heavier carcass weight at slaughter compared to calves grazing tall fescue pastures. However, ribeye area, yield grade, marbling scores, and percentage of fat in kidney, pelvic and heart (KPH) were not affected by forage type provided during the preweaning grazing period (Holloway and Butts, 1983).

Creep-fed calves

It is well reported that weaning weights may be increased if limited or unlimited access to creep-feeding supplements is provided to beef calves (Faulkner et al., 1994; Sexten et al., 2004; Moriel and Arthington, 2013a,b). Also, creep-fed calves may experience enhanced dry matter intake (Moriel and Arthington, 2013a,b) and weight gain during the feedlot receiving period (Arthington et al., 2008), which represents the period with greatest frequency of health problems in newly received feedlot calves. Indeed, beef calves provided access to creep-feeding have decreased incidence of morbidity and mortality than calves receiving no creep-feeding supplementation (Fluharty and Loerch, 1996). However, most studies did not observe long-term effects of creep-feed supplementation on finishing growth performance and carcass traits of beef steers (Tarr et al., 1994; Myers et al., 1999; Shike et al., 2007).

In addition, creep-feed supplementation has been shown to affect future milk production of beef heifers (Hixon et al., 1982; Sexten et al., 2004). Beef heifers given free choice access to creep-feeding supplements for 90 days before weaning had greater weaning weights, similar milk production at 60 days of first lactation, but decreased milk production at 120 days of lactation compared to heifers that did not receive creep-feeding supplementation (Hixon et al., 1982; Table 1). Likewise, beef heifers provided free-choice access to soybean hull-based supplements (14% or 18% crude protein, CP) for 84 days before weaning were on average 55 lb heavier at weaning, but produced 12 to 21% less milk from day 52 to 164 of their first lactation compared with heifers receiving no creep-feeding (Sexten et al., 2004). However, both studies reported that weaning weights of calves was similar between calves born from heifers that received or did not receive creep-feeding supplementation. This response suggests that beef calves may compensate for the decreased dam milk production by increasing their forage intake. In addition, beef heifers provided creep-feeding supplements containing 18% CP had greater milk production than heifers fed supplements with 14% CP (Sexten et al., 2004). Thus, increasing the dietary concentrations of CP may alleviate the negative effects of enhanced weight gain on mammary gland development and subsequent milk production of beef heifers (Sexten et al., 2004).

Table 1. Growth performance and milk production of heifers that received (Creep) and did not receive (NoCreep) unlimited access to creep-feeding supplementation for 90 days before weaning (Hixon et al., 2005).

	Treatments		
	No Creep	Creep	SEM
Weaning weight, lb	445^{a}	482^{b}	30.8
Milk production, lb/day			
day 60 of lactation	11.0	9.0	0.15
day 120 of lactation	9.9^{b}	7.7^{a}	0.07

^{a,b} within a row, means without common superscripts differ ($P < 0.05$).

Early-weaned beef steers

Early-weaning is a management practice consisting of permanent calf removal at ages often less than 5 months. Conversely, normal weaning traditionally occurs when calves are between 7 to 8 months of age. Early-weaning is usually applied during periods of forage shortage. However, early-weaning may also improve weaning weights of calves (Thrift and Thrift, 2004; Moriel et al., 2014a,b), feed efficiency of cows and calves (Arthington and Minton, 2004), and reproductive performance of cows (Arthington and Kalmbacher, 2003).

Long-term effects of calf management following early-weaning on growth and carcass quality of beef steers have been reported by numerous studies. Although 12 of 18 studies reported that average daily gain of early-weaned calves was equal or less than normally weaned calves during the feedlot phase, 10 of 14 studies reported equal or greater feed efficiency for early-weaned calves (Thrift and Thrift, 2004). Calves provided a high-concentrate diet starting at 177 days of age had 11% greater overall feed efficiency during the feedlot phase compared to calves provided the same diet starting at 231 days of age (Myers et al., 1999). Further, calves weaned at 89 days of age and supplemented with concentrate at 1.0% of body weight on ryegrass pastures for 211 days had greater average daily gain (1.92 lb/day versus 0.88 lb/day) and feed efficiency (0.15 versus 0.08), during the receiving period in the feedlot compared to calves weaned and entering the feedlot at 300 days of age (Arthington et al., 2005).

Intramuscular fat deposition (marbling) can be enhanced if cattle are placed on high-energy diets starting at young ages. In a 2-year study, Myers et al. (1999) reported that providing high-concentrate diets to beef calves starting at 177 days versus 213 days of age enhanced the percentage of carcasses grading average Choice or better (87% versus 63% for early-weaned and normally weaned calves, respectively) and increased marbling scores (1,183 versus 1,128 for early-weaned and normally weaned calves, respectively). Thereafter, numerous studies proposed that feeding high-concentrate diets to calves starting at 3 to 6 months of age compared with starting at 7 months of age or older could be an alternative tool to enhance carcass quality and marbling scores. However, this approach did not result in consistent results. Of 13 studies comparing carcass characteristics of calves early-weaned or normally weaned (Thrift and Thrift, 2004), only 4 studies reported greater percentages of carcasses grading Choice or better, whereas only 6 studies reported greater marbling scores for early- vs. normally weaned calves. Reasons for the inconsistent results among those studies may be attributed to differences on common end point at slaughter (weight, age, or backfat thickness), calf age at the start of the study, diet composition (e.g. starch concentration), timing and number of steroid implants, and interaction among those factors.

Early-weaned beef heifers

Nutrition at early stage of life also has significant effects on reproductive performance of beef heifers. Growth rate between traditional weaning age (6-8 months of age) and puberty, and from early-weaning (3-4 months of age) to the time of normal weaning were negatively associated with age at puberty (Gasser et al., 2006a,b). Gasser et al. (2006a) demonstrated that enhancing the average daily gain of early-weaned heifers (2.80 versus 1.87 lb/day) decreased age at attainment of puberty by approximately 100 days (262 versus 368 days of age), and increased the percentage of heifers achieving precocious puberty at less than 300 days of age (100 versus 0%).

Body weight gain after weaning is a major variable that influences age and weight at puberty. Across multiple breeds, heifers that were fed to achieve the greater average daily gain (1.76 versus 0.88 lb/day) starting at 7 months of age tended to be younger (372 versus 387 days of age) and heavier at puberty (709 lb versus 663 lb) compared with heifers achieving lower growth rates (Ferrell, 1982). In contrast, early-weaned heifers with faster growth rates beginning at 70 days of age achieved puberty earlier, but at similar (Gasser et al., 2006b) or lighter body weight (Gasser et al., 2006a) compared to heifers on a lower plane of nutrition. This differences on body weight at puberty between heifers that were normally or early-weaned is likely an indication of metabolic imprinting effects of nutrition during early-stages of life.

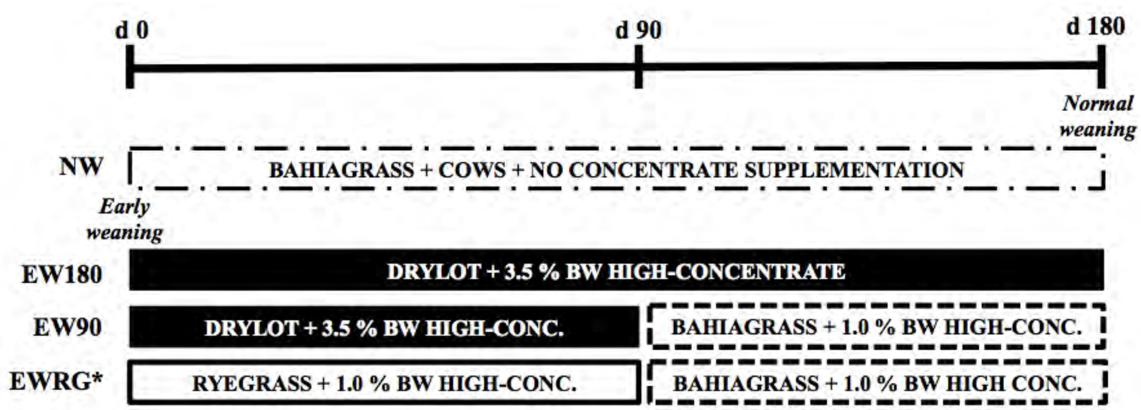
In summary, those results indicate the existence of a critical time in which nutritional management may induce early-activation of the reproductive axis, and have long-term consequences on age at puberty achievement.

Early weaning studies at the University of Florida

Despite the positive effects of early-weaning on growth and reproductive performance of beef calves that were described previously, few beef producers are willing to adopt early-weaning practice because of the limited amount of information on how to manage early-weaned calves, and increased labor associated with feeding calves daily. Therefore, 2 studies were conducted at the UF/IFAS Range Cattle Research and Education Center to evaluate different calf management systems for early-weaned beef calves and their long-term consequences on calf performance (Moriel et al., 2014a,b).

Experiment 1 evaluated the growth performance and carcass characteristics of Brangus crossbred steers, while experiment 2 evaluated the growth and reproductive performance of Brangus crossbred heifers. In both experiments, calves were either normally weaned at 250 days of age (day 180 of the study), or early-weaned at 70 days of age (day 0 of the study) and randomly assigned to 1 of 3 early-weaning calf management systems: 1) calves were early-weaned at 70 days of age and grazed on ryegrass and bahiagrass pastures for 180 days (EWPAST); 2) calves were early-weaned at 70 days of age and limit-fed a high-concentrate diet in drylot for 180 days (EW180); and 3) calves were early weaned at 70 days of age and limit-fed a high-concentrate diet in drylot for 90 days, then grazed on bahiagrass pastures for additional 90 days (EW90; Figure 1). When the early-weaned calves were in drylot, they were limit-fed the high-concentrate diet at 3.5% of body weight (as-fed). When the early-weaned calves were on pasture, they were supplemented with the same high-concentrate diet at 1.0% of body weight (as-fed). Calves that were kept with the mothers until weaning (250 days of age) did not receive supplementation from birth to 250 days of age.

Figure 1. Timeline diagram of each treatment from early-weaning (EW; day 0 of the study) to the time of normal weaning (NW; day 180 of the study). NW = steers remained with cows without concentrate supplementation until day 180 of the study; EW180 = steers early-weaned and limit-fed a high-concentrate diet at 3.5 % of body weight (as-fed) in drylot until day 180 of the study; EW90 = steers early-weaned and limit-fed a high-concentrate diet at 3.5 % of body weight (as-fed) in drylot until day 90 of the study, then grazed on bahiagrass pastures and fed the high-concentrate diet at 1.0 % of body weight (as-fed) until day 180 of the study; **EWRG** = steers early-weaned, grazed on ryegrass pastures and fed the high-concentrate diet at 1.0 % of body weight (as-fed) until day 90 of the study, then on bahiagrass pastures and fed the high-concentrate diet at 1.0 % of body weight (as-fed) until day 180 of the study.



Experiment 1 demonstrated that overall growth performance of early-weaned steers was similar or greater than steers normally weaned at 250 days of age (Table 2). Early-weaned calves provided a high-concentrate diet in drylot for at least 90 days (groups of EW90 and EW180 steers) were heavier at the time of normal weaning and at shipping (day 260 of the study) compared to normally weaned steers and early-weaned steers that grazed ryegrass and bahiagrass pastures. However, calf nutrition provided after birth in this experiment did not affect the overall carcass characteristics and marbling score at slaughter (Table 2). Only 6 of 13 studies reported greater marbling scores for early-weaned vs. normally weaned steers. Reasons for the inconsistent results among those studies and our experiment 1 may be attributed to the differences related to the criteria selected for slaughter (target body weight or backfat thickness), breed, calf age at the start of the study, diet composition (for instance, diets with high or low starch concentrations), and interaction among those factors.

Table 2. Growth performance and carcass characteristics of beef steers developed in different calf management systems from the time of early-weaning (EW; day 0 of the study) until shipping *(Experiment 1)*.

Item	Treatments[1]				SEM	*P*-value
	NW	EWPAST	EW180	EW90		
Body weight, lb						
day 0 (Early-weaning)	189	198	203	203	9.2	0.64
day 180 (Normal weaning)	475^{a}	432^{a}	652^{b}	535^{c}	19.7	<0.01
day 260 (Shipping)	504^{a}	507^{a}	793^{b}	610^{c}	25.6	<0.01
Slaughter	1042	1066	1132	1119	35.7	0.22
Days on finishing diet	202^{bc}	227^{c}	141^{a}	187^{b}	14.9	0.002
Hot carcass weight, lb	650	663	707	705	22.5	0.22
Yield grade	3.12	3.14	3.15	2.98	0.196	0.91
Marbling	404	418	401	456	41.4	0.75

[a,b] Within a row, means without common superscript differ ($P \leq 0.05$).

[1]NW = steers remained with cows from birth until the time of normal-weaning (day 180 of the study); EWPAST = steers early-weaned on day 0 of the study, grazed on ryegrass and bahiagrass pastures + concentrate supplementation at 1% of body weight until the time of shipping (day 260 of the study); EW180 = steers early-weaned on day 0 of the study and limit-fed a high-concentrate diet (3.5% of body weight) in drylot until day 260; and EW90 = steers early-weaned on day 0 of the study, limit-fed a high-concentrate diet (3.5% of body weight) in drylot for 90 days, then grazed on bahiagrass pastures with concentrate supplementation at 1% of body weight until day 260 of the study.

Experiment 2 demonstrated that early-weaned heifers limit-fed a high-concentrate diet for at least 90 days in drylot, and early-weaned heifers grazed on pastures and supplemented with concentrate at 1% of body weight for the entire study, had similar or greater growth performance than heifers that were normally weaned (Table 3). From day 180 of the study until the end of the breeding season (day 395 of the study), heifers were supplemented with concentrate at 1.5% of body weight (as-fed). During this period, no differences were detected for average daily gain among treatments (average daily gain = 1.50 lb per day). Interestingly, limit-feeding a high-concentrate diet in drylot, for at least 90 days, increased the percentage of heifers cycling at the start of the breeding season compared to normally weaned heifers (Table 3). Particularly, a greater percentage of early-weaned heifers fed high-concentrate diet in drylot for 90 days achieved puberty at the start of the breeding season, despite having similar body weight and average daily weight gain compared with heifers normally weaned at 250 days of age. This response indicates that we can anticipate puberty achievement if heifers are exposed to high-concentrate diets and high-growth rates at young ages (approximately 70 days of age).

Table 3. Growth and reproductive performance of beef heifers developed on different calf management systems from the time of early weaning (EW; day 0 of the study) until the time of normal weaning (day 180 of the study; Experiment 2).

	Treatments[1]					
Item	NW	EWPAST	EW180	EW90	SEM	*P*-value
Body weight[2], lb						
day 90 (Early-weaning)	306[a]	297[a]	361[b]	376[b]	8.1	<0.001
day 180 (Normal weaning)	467[a]	392[b]	577[c]	476[a]	14.1	<0.001
day 335 (Breeding season)	712[a]	643[b]	800[c]	720[a]	17.5	<0.001
Age at puberty, days	429[a]	418[a]	298[b]	358[c]	14.9	<0.001
Body weight at puberty, lb	753[a]	674[b]	629[b]	643[b]	26.2	0.09
Pubertal heifers at start of breeding season, % of total heifers	30[a]	40[a]	100[b]	80[b]	13.2	0.002
Pregnant heifers, % of total heifers	60	50	78	70	15.6	0.64

[a,b] Within a row, means without common superscript differ ($P \leq 0.05$).
[1]NW = heifers remained with cows from birth until the time of normal weaning (day 180 of the study); EWPAST = heifers early-weaned on day 0 of the study, grazed on ryegrass and bahiagrass pastures + concentrate supplementation at 1% of body weight until day 180 of the study; EW180 = heifers early-weaned and limit-fed a high-concentrate diet (3.5% of body weight) in drylot until day 180 of the study; and EW90 = heifers early-weaned and limit-fed a high-concentrate diet (3.5% of body weight) in drylot for 90 days, then grazed on bahiagrass pastures with concentrate supplementation at 1% of body weight until day 180 of the study.
[2]From the time of normal weaning (day 180 of the study) to the end of the breeding season (day 395 of the study), heifers were grouped by treatment and rotated among bahiagrass pastures every 10 days, and were provided concentrate supplementation at 1.5% of body weight.

In summary, metabolic imprinting is the process by which calf nutrition, during first few months of life, may permanently affect the metabolism and performance of beef steers and heifers. Early-exposure to high-concentrate diets may enhance growth performance of beef steers, as well as, enhance the growth performance and accelerate puberty achievement of beef heifers. Identifying strategies that can enhance calf performance during early postnatal life may provide unique opportunities to optimize feed resources and increase the profitability of beef cattle operations.

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Exploring Factors that Contribute to Beef Tenderness

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Introduction

Consumers consistently rank beef tenderness among the most important factors that determine eating satisfaction. Although industry efforts have improved the consistency and tenderness of beef, Brahman and other *Bos indicus* breeds have garnered a reputation for lower marbling, tougher beef, and greater variation in eating quality. This reputation puts *Bos indicus* cattle and their crosses at a distinct marketing disadvantage: value based marketing systems reward higher marbling, and many U.S. branded beef programs have restrictions on hump height. Yet, consumers are willing to pay $1-2 per pound premium for a product they know will be tender (Igo et al., 2013; Platter et al., 2013). Thus, there is considerable economic incentive to continue improving tenderness and consistency, particularly for *Bos indicus* influenced beef.

Beef tenderness is a function of connective tissue (Purslow, 2014), marbling or intramuscular fat (Platter et al., 2003), and postmortem protein degradation (Huff-Lonergan et al., 2010). Age of animal, as well as location of the meat cut, explain a large proportion of connective tissue-related differences in beef tenderness. In contrast, when considering the same cut from carcasses within an age (maturity) group, marbling and protein degradation are key contributors to variation in eating quality. While marbling remains a challenge in *Bos indicus* influenced beef, toughness is largely attributed to altered activity of protein degradation systems during meat aging.

The primary factor governing protein breakdown in postmortem muscle is the calpain-calpastatin system (Koohmaraie, 1992; Geesink et al., 2006). Calpain cuts proteins into fragments, which disrupts the structure and integrity of muscle cells, and contributes to tenderization of beef. Calpastatin specifically inhibits the degradative action of calpain. *Bos indicus* cattle are well-documented to possess elevated calpastatin content in muscle, which inhibits protein degradation and results in tougher beef (Wheeler et al., 1990; Whipple et al., 1990b; Pringle et al., 1997).

Why is calpastatin higher in muscle from *Bos indicus* cattle?

While elevated calpastatin in *Bos indicus* is a well-documented phenomena, the regulation of its content in muscle is poorly understood. Calpastatin is present in muscle throughout an animal's life, and calpastatin content is established in muscle before the animal is slaughtered. Thus, there is likely an important physiological basis for differences in calpastatin among breed types, and it is logical to link this with heat tolerance. Thermotolerance may result from reduced heat production, increased capacity for heat loss, or a combination. While slick hair and sweat gland properties improve heat dissipation in *Bos indicus* cattle, there is also evidence to support that metabolism is altered to reduce heat production. While limiting metabolism is beneficial for thermoregulation, this would also be expected to negatively impact production parameters, such as milk production or muscle growth.

Muscle growth is an energetically demanding process that contributes to metabolic heat production. In order to increase muscle mass, proteins must be generated as well as degraded, which is also referred to as protein turnover. The net balance of synthesis and degradation dictates the gain in muscle mass. In living muscle, the calpain-calpastatin system, along with several other systems, contribute to protein degradation. While calpain affects numerous proteins, calpastatin is the only known inhibitor for calpain (Goll et al., 2003). In this manner, calpastatin alone has broad capacity for inhibiting protein degradation. Thus, greater calpastatin content observed in Brahman and *Bos indicus* breeds may be a mechanism for restricting protein turnover in the live animal, in order to restrain metabolic rate and heat production.

Postmortem protein degradation and beef tenderness

In living muscle, calpain and calpastatin action are tightly regulated to have precise control over protein degradation. While the content of calpain and calpastatin is important in dictating the breakdown of muscle, the function or activity is also significant. These mechanisms are studied intensively in living muscle with regard to agricultural production and human health, but understanding regulation of activity in the changing environment of postmortem muscle is quite complex.

At slaughter, muscle does not immediately become meat; rather, a number of changes occur during the "conversion of muscle to meat." The physical, biochemical, and energetic changes that ensue in muscle after slaughter are critical for determining the development of meat quality attributes. For instance, the loss of oxygen supply leads to a shift in metabolism and a gradual depletion of available energy resources. In turn, the loss of energy results in rigor, or the stiffness of death. Meanwhile, the pH of muscle declines from approximately 7.4 to 5.6, and carcasses slowly cool from body temperature (101°F) to <40°F at 24 hours postmortem. The rate and extent by which these changes occur influence development of beef tenderness.

Although refrigerated storage of meat for several weeks after slaughter (aging) improves beef tenderness, the majority of tenderization caused by protein degradation occurs in the first 24-72 hours postmortem. During this time, changes in pH, temperature, and calcium, affect calpain activity. In particular, increases in calcium within muscle cells trigger activation of calpain. Once activated, calpain begins breaking down structural and contractile proteins within muscle cells. Calpain also clips calpastatin; these calpastatin fragments retain inhibitory activity, which declines during the subsequent aging period. Classically, the ratio of calpain: calpastatin activity is considered a predictor of tenderness, and this ratio is also generally less favorable in *Bos indicus* cattle.

Are other muscle attributes different in *Bos indicus* influenced cattle?

Considering muscle represents the largest proportion of the body on a weight basis, shifting muscle characteristics could be important to regulating overall body metabolism and heat tolerance. Thus, it raises the question: what else might be different in *Bos indicus* influenced muscle? Muscle is a heterogeneous tissue, and the properties of individual cells vary in order meet specific functional demands. Muscle fibers (cells) are classified according to their contractile and metabolic properties, which is dictated by functional demands. There is an association between fiber type characteristics and meat tenderness. Further, certain fiber types tend to have greater calpastatin content, which is linked to growth rate and function of specific muscles within the animal. However, when comparing the same muscle, the type of contractile proteins expressed in *Bos taurus* and *Bos indicus* is not significantly different (Seideman, 1985; Whipple et al., 1990a; Wright, 2016), and thus likely does not explain variation in either calpastatin content or tenderness.

Curiously, metabolic characteristics and regulation of metabolism may be important for the adaptability of *Bos indicus* muscle. Recent evidence supports that mitochondria content may be greater in Brahman (Wright, 2016), and functional aspects of mitochondria may also differ. Considering mitochondria are the energy "powerhouses" of the cell, this has potential ramifications for metabolic heat production and thermotolerance, as well as postmortem tenderization. From a postmortem perspective, there is a couple possibilities for how mitochondria may influence tenderization. First, mitochondria can sequester calcium; in turn, this could prevent increases in calcium within the cell, thereby delaying the activation of calpain. Moreover, mitochondria participate in pathways that initiate cell death, which are expected to hasten postmortem metabolism and instigate protein breakdown. The expectation is that Brahman muscle may be more resistant to cell death. In general, these ideas reflect that *Bos indicus* muscle possesses additional mechanisms to maintain or protect the cell in the face of adverse physiological circumstances.

Conclusions

Beef tenderness is a complex trait influenced by inherent muscle properties, as well as the conditions that exist in muscle after slaughter and processing. It is well-established that calpastatin content is generally greater in *Bos indicus* influenced cattle. However, the physiological basis for elevated calpastatin and its significance to heat tolerance and muscle growth is poorly understood. While calpastatin clearly plays a role in tenderization, other differences in muscle metabolism exist in *Bos indicus* muscle, and these also are likely to contribute to impact protein degradation and tenderization. Ultimately, it is important to understand the relationships between muscle characteristics and heat tolerance, in order to develop strategies that optimize growth and tenderness without sacrificing thermoregulatory capacity in *Bos indicus* breeds.

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Integrated Nutritional Systems

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Introduction

After reaching a historical low of slightly over 29 million head of beef cows in 2014, the U.S. beef cattle inventory continues to recover, adding an additional 1.5 million heifers and cows in the last two years. While this is a very positive sign of the recovery of the U.S. beef industry, and a testament of the resilience of a mature and consolidated industry, in the short term this has caused a depression in prices that has forced producers to adapt to a new normal. Only a few years ago (taking 2014 as an example), when feeder prices were as high as $240/cwt, almost any supplementation strategy was sufficient to generate a profit by supplementing cattle a little extra time after weaning, preconditioning or even creep feeding. Grain prices at that time were already depressed (as they continue to be today despite some slight recoveries), which meant that byproducts to use in cattle supplementation were very reasonably priced. It was not uncommon to be able to supplement newly weaned 500 lb calves with a $180/ton supplement, with a feed cost ranging from $0.6 to $0.9/head/day, assuming 10 lb/d feeding. Those same supplemental programs, using conservative estimates, were generating an additional 1 lb of ADG over not supplemented calves, which on a 45 days preconditioning or backgrounding period could lead to $10/calf in gross income (around $9/head when feed costs were included). While feed prices have not changed much since 2014, cattle prices have dropped to about half of what they were, and many viable supplementation strategies have changed drastically. In the current scenario of prices, the best strategies are those that aim at maintaining the condition of cows during the winter with the minimal amount of supplementation, without hindering pregnancy rates, and selling calves at weaning. When a drought such as the one currently hitting the southeastern U.S. is added on top of the current market conditions, early weaning of calves becomes more critical than ever to avoid losing body condition in cows as the forage shortage deepens. Strategies that aim at maximizing the impact of supplementation on performance while minimizing the inputs, have been the focus of several research projects conducted at the North Florida Research and Education Center (NFREC) in the past years. *The objective of this work is to review a series of studies aimed at assessing the impact of supplementation on nutrient intake and cattle performance.*

The first great challenge: How much hay are cows eating?

The ability of Florida beef production systems to sustain the growth of cows and calves during the summer with minimal input (almost exclusively pasture and minerals) is contrasted every year with the challenge of the winter months. Depending on where in Florida beef production takes place, the forage shortage in the winter time could result in the need of supplementation for as long as 120 days. The use of stockpiled forages, mainly in central and south Florida reduces the reliance on hay and other forms of conserved forages, which are almost a must in north Florida unless the grazing of winter annual pastures is an option. However the quality of most stockpiled forages in Florida often lead to a shortage of nutrients that need to be provided in the form of supplement such as liquid byproducts, grain byproducts, etc. Any supplementation program relies on the ability of effectively determine how much forage is cattle consuming in order to be able to supply the remaining nutrients (if needed). However, measuring hay or haylage intake in field conditions can be almost as challenging as measuring intake of a grazing pasture. Not being able to accurately predict intake of the basal forage in the diet leads to inaccuracies in the amounts of supplement needed. Because winter feed costs are typically one of the largest expenses in a beef cattle operation, in times of lean markets such as this one, the importance of supplementing the correct amounts in order to prevent loses in body condition that may lead to open cows, is imperative.

Waste can turn hay or haylage into the most expensive feed in an operation. While little research has been conducted to accurately assess hay waste under various feeding systems, an excellent summary of results conducted in the Midwestern U.S. was presented a few years ago in the Florida Ruminant Nutrition Symposium (DiCostanzo and Jaderborg, 2015) and the reader is referred to that reference for further information on hay waste. A link to the actual proceedings paper by DiCostanzo and Jaderborg (2015) is provided in the Literature Cited section.

Waters et al. (2015) conducted a 2-year study at the NFREC to assess the impact of various feeding strategies on heifer development. Waters et al. (2015) fed Tifton-85 bermudagrass hay ad libitum in a pasture, and intake was recorded by weighing the amount of hay offered (weighing an entire bale) and the amount of refusals recovered. Over a period of 140 d each year, the heifers in the study by Waters et al. (2015) gained 0.40 and 1.06 lb/d when fed only bermudagrass hay or supplemented with 80:20 corn:soybean meal, respectively. Table 1 shows the exact amount of hay consumed in each treatment and the intake as % of BW. One of the interesting observations when comparing these data with most studies of hay intake conducted in the Midwestern U.S., is the decreased intake in terms of % of BW observed in Florida. It is quite possible that a lower digestibility of warm season forages fed in the Southeast, along with the more limiting concentrations of protein in these forages, limits rumen digestion, and thus decreases intake capacity. This initial observation in the study by Waters et al. (2015) was later confirmed in other studies conducted. A subsequent study was conducted at the NFREC Feed Efficiency Facility (FEF) in Marianna, to determine hay intake; however, this time using the GrowSafe feed intake system at the FEF. A total of 120 mature cows were enrolled in the study, 60 of them were in mid-to late lactation, with calves of approximately 5 months of age, and the other 60 cows were weaned two weeks prior to the initiation of the study. All cows and calves in the study were fitted with radio frequency identification to assess individual intake in pens of 5 cows ("weaned" treatment) or 5 pairs each ("lactating" treatment) at the FEF. During the 56 days of the study, feed intake of Tifton-85 bermudagrass hay offered ad libitum, was monitored continuously. Data from this study (DiLorenzo and Lamb, unpublished) are summarized in Table 1 and Figure 1. The results from this study showed that hay intake in weaned cows was 1.4% of their BW, while lactating cows consumed 1.7% of their BW (Figure 1). Again these values contrast with those reported in studies conducted feeding better quality hay, typically from cool season forages. A final study conducted at NFREC (Ciriaco et al., 2015) is also summarized in Table 1. In the study by Ciriaco et al. (2015), recently confirmed pregnant heifers were fed Tifton 85 bermudagrass hay and were offered or not 5 lb/d of a mixture of 50:50 molasses:crude glycerol. Results confirmed the observations in previous studies. When no liquid supplement was offered, heifers in Ciriaco et al. (2015) consumed 1.36% of their BW daily. *As an important conclusion from this segment of the review of literature, the voluntary intake of hay of warm season forages observed across various categories of beef cattle, seems much lesser than what has been reported in cool season forages.* The intake of Tifton-85 bermudagrass hay in cattle not supplemented, *ranged from 1.36 to 1.72% of their BW*, and was decreased by 15% when cows were weaned after 5 months of lactation (Figure 1).

Moving on with the integration: postweaning supplementation

As indicated during the introduction, cattle markets are the great driver of the postweaning management strategies. For example, in current market conditions, it is probably a much better option to sell calves at normal weaning, or even earlier if early weaning may be needed because of drought conditions and forage shortage. Regardless of marketing strategy, it is important to know the expected performance of weaned cattle under various scenarios to be able to re-assess the market conditions every year and decide on whether may be economical or not to feed calves for some time after weaning. While retaining weaned calves may not be typical in many Florida cattle operations, almost all of the cow/calf operations keep a portion of their females as replacement. This heifer development period has several unique characteristics in terms of ideal rates of gain, timing of that weight gain and nutrient profile of the diet. Because nutritional considerations for heifers can be an entire subject on its own, this review will not cover that aspect in detail, but rather summarize the most relevant principles of heifer development providing some local examples form studies conducted at the University of Florida. Waters et al. (2015) fed developing heifers the following three treatments: 1) ad libitum Tifton-85 bermudagrass hay (BGH); 2) ad libitum BGH plus 2.7 lb/d of an 80:20 corn:soybean meal mix; or 3) ad libitum BGH plus 6 lb/d of perennial peanut hay. After a development period of 140 days during which heifers were supplemented, they were managed as a single group until the beginning of the breeding season. Figure 2 shows the results in terms of the evolution of their BW during the entire study. When growing heifers were fed over two consecutive years either BGH only, or BGH plus *Brassica carinata* meal pellets (43.6% CP, 76% TDN) at 0.3% of their BW/d, growth rates were 0.32 and 0.92 lb/d, respectively (Figure 3; Schulmeister et al., 2017). A study was conducted in collaboration between NFREC and Louisiana State University (Demeterco et al., 2016) to determine the effects of feeding ryegrass conserved as hay or haylage on animal performance in growing Angus and Brangus steers. Steers had an initial BW of 540 lb and were fed ad libitum amounts of ryegrass hay or haylage for 14 days of adaptation and 64 days of experimental period. Steers fed ryegrass haylage had an ADG of 0.99 lb, while those fed ryegrass hay had an ADG of 0.60 (effect of forage conservation method on ADG, $P < 0.05$). In conclusion from this study, and extrapolating to a heifer development situations, if heifers of similar initial BW were to be developed using ryegrass haylage as the sole forage source, supplementation may still be needed to achieve a target ADG of 1.5 to 1.8 lb/d.

Taken together, the studies by Waters et al. (2015), Schulmeister et al. (2017), and Demeterco et al. (2016) suggest that when developing heifers in the southeastern U.S., even the best quality hay or haylage available may not be sufficient to produce the rates of weight gain necessary to achieve the target weight before the breeding season, and supplementation may be needed.

Finishing cattle in Florida?

Finishing cattle in Florida is perhaps the greatest challenge for a full integration of a beef/forage system. While the topic is complex and deserves a much more in depth analysis than the one intended in this review, it is noteworthy that the few operations that are finishing cattle in Florida are doing so in a very competitive manner. Considering the challenges related to weather, which may impact directly on performance, and availability of high-energy grains or byproducts, a few operations have been able to take advantage of some of the state competitive advantages to challenge the conventional wisdom in terms of beef production systems in Florida. Some of those advantages include 1) a very large consumer market and the possibility of creating branded products that add value to Florida calves; 2) availability of some high-energy byproducts (DDGS, gluten feed, molasses, etc.) that can help to partially replace corn and other high-starch grains without much effect on animal performance; 3) a readily available source of heat-adapted calves that for the most part need to be loaded in trucks to leave the state at weaning. While the number of cattle finished in Florida is still small compared to traditional cattle-finishing regions of the U.S., Several interesting initiatives in Florida are worth highlighting and certainly well suited to challenge the conventional wisdom in terms of cattle finishing operations. The marketing component of branded Florida beef that is associated with Florida cattle finishing operations is remarkable and is one of the greatest competitive advantages. However, on the grand scheme of things, still the vast majority of the nearly 900,000 calves produced in Florida every year, leave the state at weaning or shortly after.

Take home message

Florida beef production systems have several competitive advantages that may allow for the expansion of current systems, integration (to a certain degree) or diversification (backgrounding, heifer development, etc.). Despite the abundance of forages, the quality of Florida forage resources can be limiting. Intake of hay from warm season forages seems to be lesser than that reported in cool season forages. This may have implications in nutrient balancing of hay-based diets during the months of forage shortage. Additionally, the quality of warm season forages available, is in part the reason why the majority of the calves leave the state at weaning or shortly after, limiting the opportunities for backgrounding or stocking operations. However, heifer development is an important segment of the Florida beef industry and it can be a challenging enterprise, considering the very specific targets needed in terms of rate of weight gain. When attempting to develop heifers with any form of conserved forage, it may be difficult to obtain rates of weight gain greater than 1 lb/d, unless heifers are supplemented. Fortunately, the availability of byproducts from the citrus, cotton, sugar cane, and peanut industry provide ample opportunities for cost-effective strategic supplementations. Additionally, the abundance of winter annual pastures in central and north Florida can provide forage of excellent quality, albeit, with great dependence on weather (and this year should be a perfect reminder of that). A series of research-based strategies have been developed by the University of Florida in terms of cattle supplementation and heifer development, and a valuable compilation of those can be found in the University of Florida Beef Extension Research Reports, available at http://animal.ifas.ufl.edu/beef_extension/#beef.

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Table 1. Summary of experiments conducted at the University of Florida NFREC in Marianna, in which ad libitum intake of Tifton-85 bermudagrass hay was recorded.

	Waters et al. (2015)		Ciriaco et al. (2015)		DiLorenzo and Lamb (unpublished)	
Number of cattle	40	40	6	6	60	60
Cattle type	Developing heifers	Developing heifers	1-mo pregnant heifers	1-mo pregnant heifers	Lactating mature cows	Weaned mature cows
Hay DMI, lb/d	7.7	6.6	11.9	10.8	21.2	18.1
Hay DMI, % BW	1.42	1.11	1.36	1.23	1.72	1.43
Supplementation	no	2.7 lb/d of 80:20 corn:soybean meal mix	no	5 lb/d of 50:50 molasses:crude glycerol	no	no

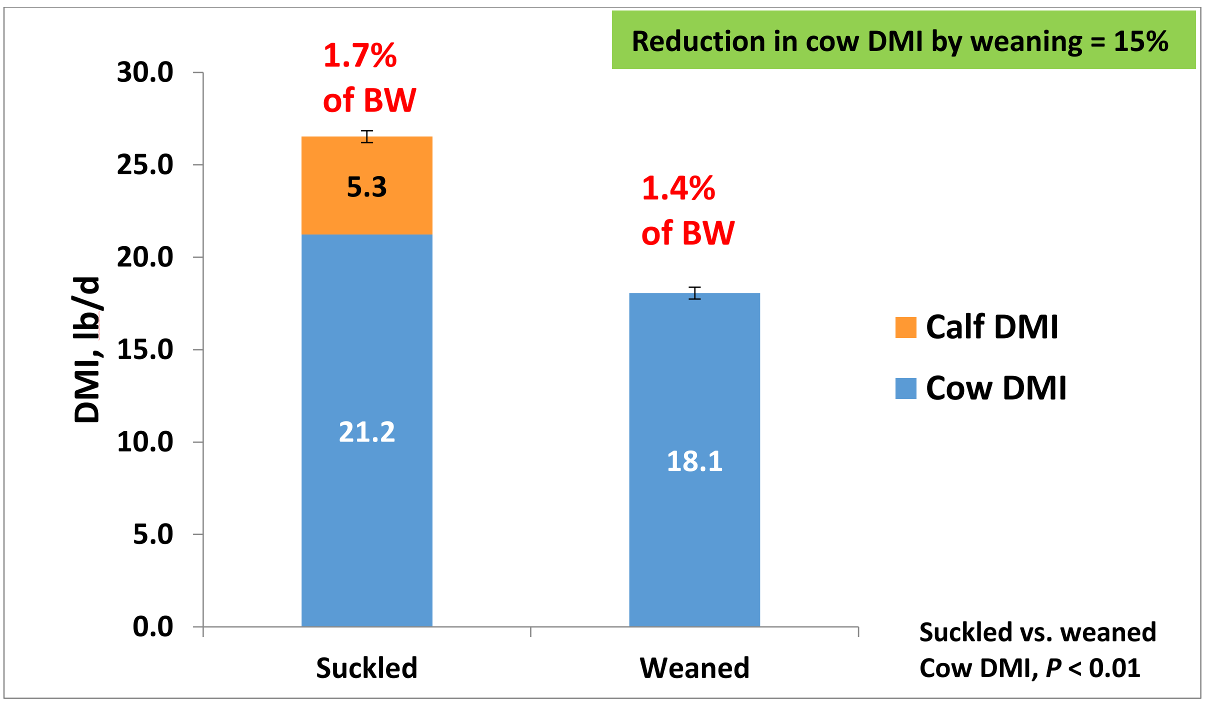

Figure 1. Ad libitum intake of Tifton-85 bermudagrass hay by mature cows at 5 months of lactation or after weaning. Hay intake was reorded for 56 days using the GrowSafe system of the NFREC Feed Efficiency Faciliy in Marianna, FL (DiLorenzo and Lamb, unpublished).

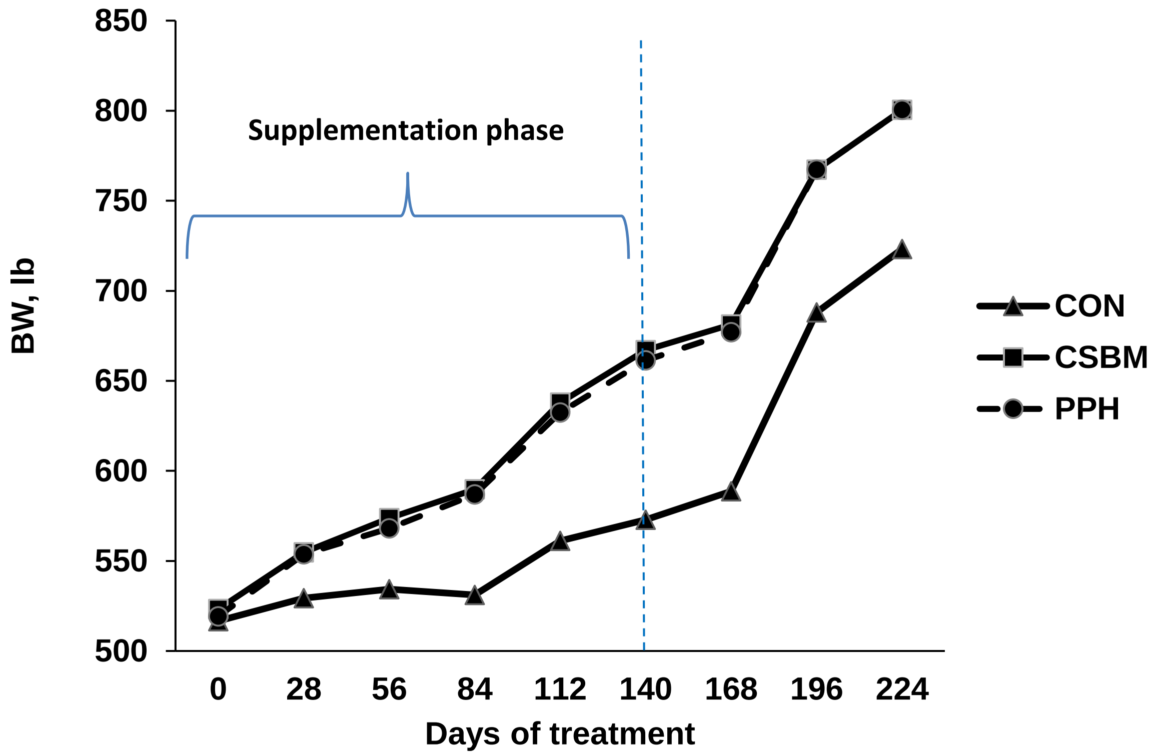

Figure 2. Evolution of BW in heifers fed bermudagrass hay and supplemented or not during the development phase. Treatments: CON) ad libitum Tifton 85 bermudagrass hay (BGH); CSBM) ad libitum BGH plus 2.7 lb/d of an 80:20 corn:soybean meal mix; or PPH) ad libitum BGH plus 6 lb/d of perennial peanut hay.

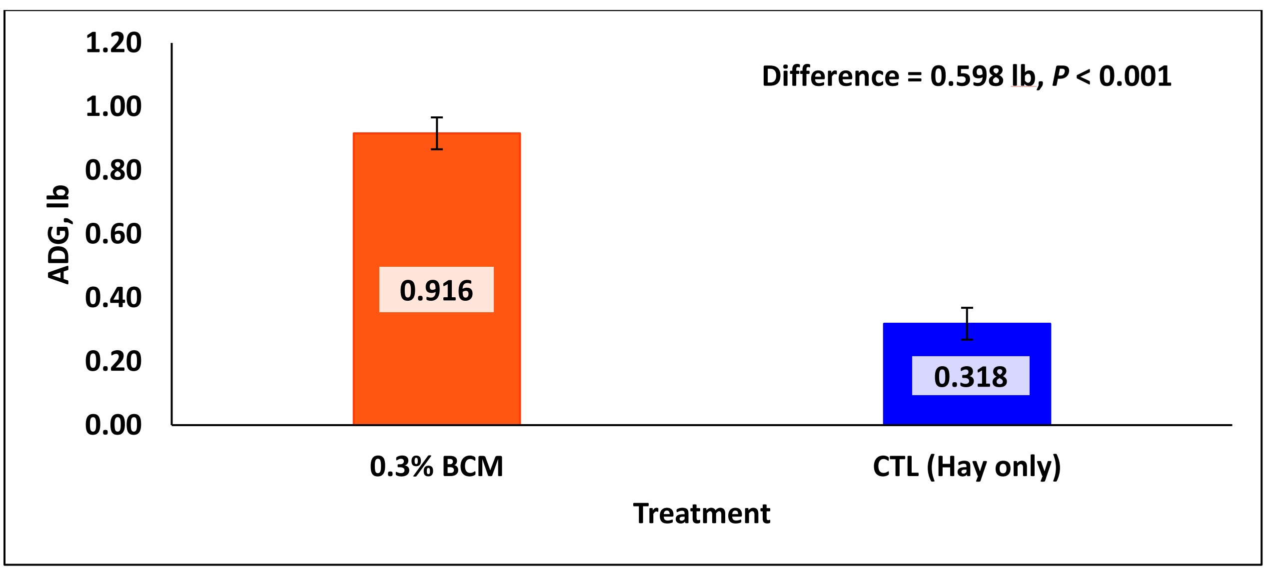

Figure 3. Effect of feeding *Brassica carinata* meal pellets (43.6%CP, 76% TDN) at 0.3% of BW/d on heifer performance (529 lb of initial BW) over 2 consecutive years. Total of 64 heifers used in the study for a total of 70 days each year. All heifers were fed ad libitum amounts of Tifton-85 bermudagrass hay (Schulmeister et al., 2017).

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