DCHA

DAIRY CALF & HEIFER ASSOCIATION

ANNUAL CONFERENCE

-2023-

RESOURCE GUIDE

COMMITMENT TO EXCELLENCE

PRIOR LAKE, MN | APRIL 11–13, 2023

TABLE OF CONTENTS

COMMITMENT TO EXCELLENCE

DCHA
DAIRY CALF & HEIFER ASSOCIATION

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WELCOME!

Welcome to the 2023 Dairy Calf & Heifer Association Annual Conference and Trade Show. Themed "Commitment to Excellence," this year's conference continues to feature three specialty tracks – wet calf/weaning, post-weaned/ reproduction, and beef x dairy. Pick the track that's most pertinent to your business or explore a track that may fit a future business model.

REGISTRATION

TUESDAY, APRIL 11
6:30 a.m.–6:00 p.m.

WEDNESDAY, APRIL 12
7:00 a.m.–5:00 p.m.

THURSDAY, APRIL 13
7:00 a.m.–1:00 p.m.

TRADE SHOW

The conference trade show will kick off with a reception Tuesday evening and remain open throughout the entire conference. Listed below are the specific trade show activities and breaks.

TUESDAY, APRIL 11
4:30–6:00 p.m. Trade Show Reception

WEDNESDAY, APRIL 12
1:00–1:30 p.m. Trade Show Open
4:45–6:15 p.m. Trade Show Reception

THURSDAY, APRIL 13
9:00–9:55 a.m. Trade Show Open

CONFERENCE AGENDA

All times listed are Central time.

TUESDAY, APRIL 11

Registration opens
6:30 a.m.

OPTIONAL TOURS

NexGen Dairy
7:00 a.m. | Meet by registration
Eden Valley, MN
Sponsored by: Compeer Financial

University of Minnesota Huntington Bank Stadium and Andrew Boss Laboratory of Meat Science
8:00 a.m. | Meet by registration
Minneapolis, MN
1:30 p.m. | Tour buses return to hotel

Break
1:30 p.m.
Sponsored by: Dairy Tech, Inc.

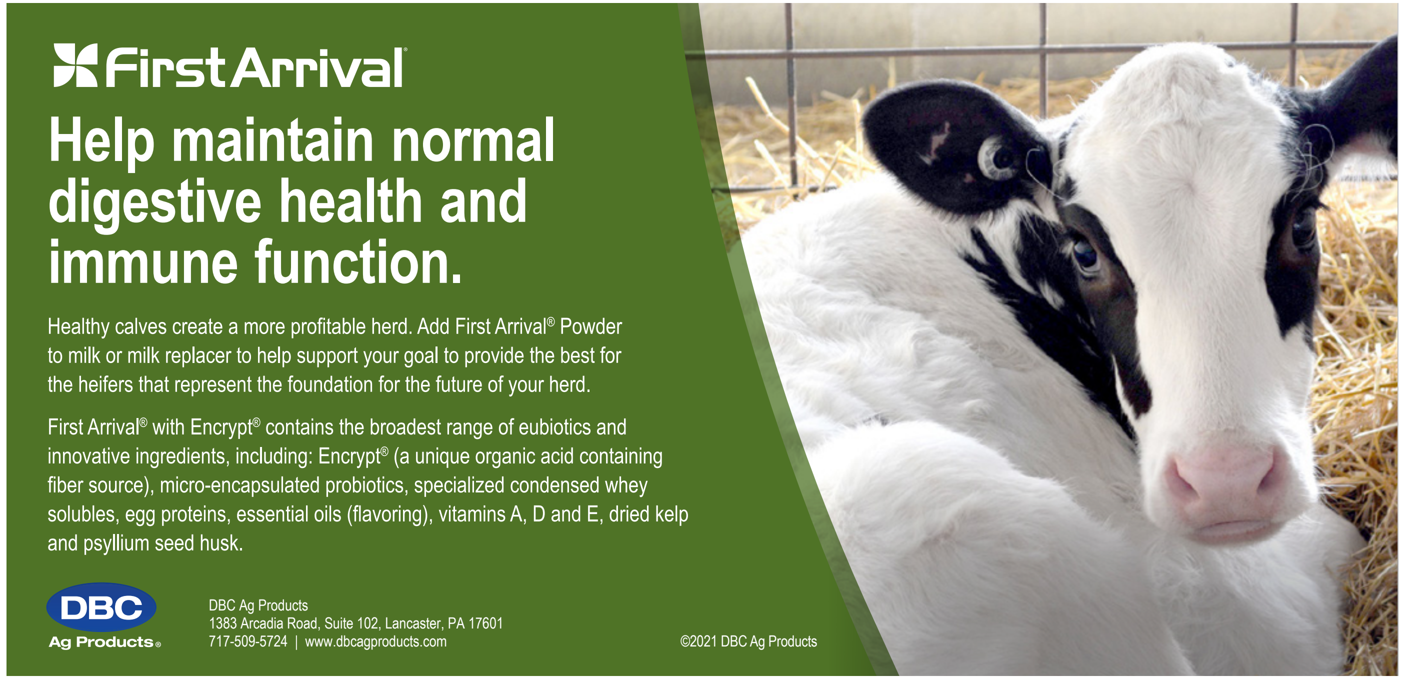
PRE-CONFERENCE SESSIONS

The genetic fingerprint of efficient feed conversion in beef on dairy cattle
2:00 p.m. | Isanti 3
Ben Voelz, STgenetics
Sponsored by: STgenetics

How do we raise better beef crosses starting at the calf?
3:15 p.m. | Isanti 3
Tom Earleywine, Land O'Lakes
Sponsored by: Purina and Land O'Lakes

Reception in the Trade Show
4:30–6:00 p.m.

Reunion dinner *(must have ticket to attend)*
6:15–8:00 p.m. | Isanti 1 & 2



WEDNESDAY, APRIL 12

Breakfast-plated
7:00–7:45 a.m.
Sponsored by: Arkion Life Sciences

GENERAL SESSION

The Champion's Code: Building relationships through life lessons of integrity and accountability from the sports world to the business world
8:00–9:30 a.m. | Minnetonka
Ross Bernstein
Sponsored by: Zinpro

Book signing with Ross Bernstein
9:30–9:45 a.m. | Prefunction 3
Ross Bernstein

TRACK OPTIONS – SELECT ONE

9:45–10:45 a.m.

WET CALF/WEANING TRACK

It takes a team: Finding the value in source farm communications
Isanti 1
Dave Renaud, University of Guelph

POST-WEANED/REPRODUCTION TRACK

Heifer nutrition: Balancing value and cost
Isanti 2
Paul Dyk, GPS Dairy Consulting

BEEF X DAIRY TRACK

Neonatal calf nutrition impact
Isanti 3
Jon Robison, JDR Livestock Consulting Management Services
Sponsored by: ABS

Morning break in the trade show
10:45–11:00 a.m.

TRACK OPTIONS – SELECT ONE

11:00 a.m.–12:00 p.m.

WET CALF/WEANING TRACK

It takes a team: Finding the value in source farm communications
Isanti 1
Dave Renaud, University of Guelph

POST-WEANED/REPRODUCTION TRACK

Heifer nutrition: Balancing value and cost
Isanti 2
Paul Dyk, GPS Dairy Consulting

BEEF X DAIRY TRACK

Neonatal calf nutrition impact
Isanti 3
Jon Robison, JDR Livestock Consulting Management Services
Sponsored by: ABS

Lunch-plated
12:00 p.m. | Minnetonka
Sponsored by: Agri-Plastics

DCHA Annual Business Meeting
12:15 p.m.

Trade Show open
1:00–1:30 p.m.

TRACK OPTIONS – SELECT ONE

1:30–2:30 p.m.

WET CALF/WEANING TRACK

Producer panel: Finding and keeping great employees
Isanti 1
Sarah Daugherty, Zachary Downs
Moderated by Ann Hoskins, Vita Plus
Sponsored by: Vita Plus

POST-WEANED/REPRODUCTION TRACK

Heifer management: Balancing value and cost
Isanti 2
Mike Overton, Zoetis

BEEF X DAIRY TRACK

What traits matter when beef genetics are used on dairies?
Isanti 3
Luke Fuerniss, Texas Tech University
Sponsored by: ABS

TRACK OPTIONS – SELECT ONE

2:30–3:30 p.m.

WET CALF/WEANING TRACK

Producer panel: Finding and keeping great employees
Isanti 1
Sarah Daugherty, Zachary Downs
Moderated by Ann Hoskins, Vita Plus
Sponsored by: Vita Plus

POST-WEANED/REPRODUCTION TRACK

Heifer management: Balancing value and cost
Isanti 2
Mike Overton, Zoetis

BEEF X DAIRY TRACK

What traits matter when beef genetics are used on dairies?
Isanti 3
Luke Fuerniss, Texas Tech University
Sponsored by: ABS

Afternoon Break in the Trade Show
3:30–3:45 p.m.

GENERAL SESSION

Where have we been and where are we going? Proactive conversations around changes in calf care
3:45–4:45 p.m. | Minnetonka
Dave Kuehnel, Rule of Three Solutions

Reception in the Trade Show
4:45–6:15 p.m.
Sponsored by: Milk Specialties Global

THURSDAY, APRIL 13

Breakfast-plated
6:45–7:30 a.m. Minnetonka

TRACK OPTIONS – SELECT ONE

7:30–8:55 a.m.

WET CALF/WEANING TRACK

Producer panel: Producer perspectives on group housing
Isanti 1
Aaron Jones Titterington, Joe Loehr
Moderated by Ben Ekern, Calf-Tel by Hampel

POST-WEANED/REPRODUCTION TRACK

Producer panel: Turning data into dollars: How these producers make their data work for them
Isanti 2
Justin Graham, Kristin Quist
Moderated by Matt Boyle, Zoetis

BEEF X DAIRY TRACK

Beef x Dairy systems panel: What are your differentiating factors?
Isanti 3
Dan Dorn, Jason Goff, Scott McNeley, Lee Leachman
Moderated by Jeff Langemeier, SCCL
Sponsored by: ABS

Morning break in the Trade Show
9:00–9:55 a.m.
Sponsored by: Axiota

TRACK OPTIONS – SELECT ONE

10:00–11:25 a.m.

WET CALF/WEANING TRACK

Producer panel: Producer perspectives on group housing
Isanti 1
Aaron Jones Titterington, Joe Loehr
Moderated by Ben Ekern, Calf-Tel by Hampel

POST-WEANED/REPRODUCTION TRACK

Producer panel: Turning data into dollars: How these producers make their data work for them
Isanti 2
Justin Graham, Kristin Quist
Moderated by Matt Boyle, Zoetis

BEEF X DAIRY TRACK

Beef x Dairy systems panel: What are your differentiating factors?
Isanti 3
Dan Dorn, Jason Goff, Scott McNeley, Lee Leachman
Moderated by Jeff Langemeier, SCCL
Sponsored by: ABS

Break
11:25–11:40 a.m. | Prefunction 3

GENERAL SESSION

11:40 a.m.–1:10 p.m. | Minnetonka
Producer panel: Overcoming challenges in dynamic dairy climates
Scott Blevins, Katie Grinstead, Kevin Miller
Moderated by Peggy Coffeen, UpLevel Dairy
Sponsored by: Afimilk

Schedule subject to change

2023 TRADE SHOW EXHIBITORS

4-D AG FASHION
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AGRI-PLASTICS

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2023 TRADE SHOW EXHIBITORS

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AURORA PHARMACEUTICAL
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CAMBRIDGE TECHNOLOGIES
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CASPER'S CALF RANCH, LLC
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ENDOVAC ANIMAL HEALTH
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FERA DIAGNOSTICS AND BIOLOGICALS
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BOOTH **306**

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JDJ SOLUTIONS (PEACH TEATS)
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BOOTH **104**

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EXHIBITION HALL MAP

EXHIBITORS

108, 110	4-D Ag Fashion 4-D Ag World
211	ABS Global
309, 311	Acepsis, LLC
100, 102	Agri-Plastics
217	Alltech, Inc.
219	American Dairymen
313	Anpario Plc
220	Aurora Pharmaceutical
113	Axiota
301, 303	Calf Star LLC
209	Cambridge Technologies
107	Casper's Calf Ranch, LLC
213	Colorado State University
119	Dairy Star
103	DBC Ag Products
308	Denkavit USA
117	DFA Animal Nutrition
205	ENDOVAC Animal Health
109, 111	FERA Diagnostics and Biologicals
106	Foerster-Technik N.A
317, 319	Genova Labs, LLC
313, 315	Hampel
320	Hoard's Dairyman
215	Hubbard Feeds
306	ImmuCell Corporation
212	JDJ Solutions (Peach Teats)
208	Key Ag Distributors
207	Kunafin 'The Insectary'
206	Land O'Lakes
214, 216	Lawleys Inc
210	M B Nutritional Sciences
112, 114	Microbasics LLC
316, 318	Midwest Dairy Solutions LLC
105	Midwest Milk Products
312	National Cattlemen's Beef Association
115	NEOGEN
218	Norbrook Inc
310	Select Sires, Inc.
120	Simplot Animal Sciences
204	STgenetics
304	Strauss Feeds
203	TechMix, LLC
116, 118	The Coburn Company Inc.
305, 307	Udder Tech Inc.
104	Vaxxinova

Where have we been and where are we going? Proactive conversations around changes in calf care

Dave Kuehnel, Rule of Three Solutions, LLC

My first experience with calves was in 1972 when our family moved to an 80-acre farm in southern Manitowoc County, Wisconsin. I was 13 years old. With a desire to become calf raisers, our family immediately went to work and stripped the inside of a 40 x 80 stanchion barn built about a century earlier and outfitted it with a milk replacer mixing kitchen, 132 individual stalls and the ventilation needed for a modern calf barn of 1972. We were helped and trained by mentors from Provimi Veal. Over the next few years, we added a barn for an additional 216 calves. I started working for two dairy producers up the road; they taught me how to milk cows, drive tractors and cut, chop and bale hay. I also worked in several "new" calf setups that turned out to be horrible environments for calf raising. Live and learn…. That statement alone is a good lesson.

Looking back on where we've come from as an industry the past 50 years, and where the next generation of people and technology may lead us in the years ahead, I had to organize my thinking into chunks to encapsulate what really are mind-bending changes. More than 25 years ago, I found myself telling people, especially young people, that it was really an incredible time to be a young life scientist. That statement holds true to this day and has picked up steam. Here are the core areas in which I've witnessed significant breakthroughs.

Nutrition and feeding

As an industry, we may have finally reached the end of the starvation diet as standard practice. It took us a while to learn as an industry. Good riddance, as well, to the use of soy flour in young calves. I've been witness to some really awful early autofeeder installations and watched the evolution through to acidified milk to well-managed autofeeders. Nationwide, the herd replacer milk replacer business has roughly doubled in volume over the past 10 to 12 years, in large part due to higher solids feeding. Pelleted starters still vie for pail space up against greatly improved texturized starters and homemade starters. In general, the whole starter world has much more thought and nutrition science applied today. There has been a significant recognition of greater protein needs in both liquid phase and early starters, in response to energy contribution being fed. Today's calves are incredible growing machines when fed well.

The industry has benefited from the development of modern milk ingredient substitutes – animal plasma, hydrolyzed wheat and carbohydrates, like dextrose and pre-gelatinized starch. The liquid phase of the calf's life cycle is viewed more as a diet, not just a liquid, balancing protein, fat and supplementing whole milk to adjust solids. We now know that fetal and early life nutrition will trigger stem cell programming. There is an epigenetic impact of early growth and nutrition, expressing itself in ways that we are barely understanding today. Research from around the world now supports the concept that early growth foreshadows adult performance and longevity. Inclusion of probiotics and other supplements and functional proteins are replacing broad-spectrum antibiotics worldwide. Many have successfully replaced animal fats in milk replacers with palm and coconut oils, opening up the confidence that dietary fats will be formulated as we do in other species, by fatty acid, not by ingredient per se. Some people and groups are still thinking in terms of volumes fed, not nutrients, for the milk phase and weaned calf.

Calf and heifer management

There will probably always be disagreement on open pails vs. nipple bottles, gang feeding, paired feeding or individual pens. But at least we're evaluating these while using standard operating procedures (SOP) developed with careful thought and consultation with calf-focused experts. We have witnessed the development and evolution of highly functional apps, which replaced bygone magnetic barn calendar breeding wheels. Producers of all sizes are administering measured amounts of pre-tested, pasteurized colostrum, rather than allowing "free-choice" access to a cow while tied between stanchions with a piece of baler twine. Targeted hay feeding and focus on rumen development (and now the entire gut microbiome) as a part of the animal's development has been driven by the recognition that there are biochemical and metabolic signals being sent based on diet management. More and more producers are viewing calf and heifer growth as an investment to be managed, rather than a pure expense to be squeezed. Radio frequency identification (RFID) tags, and all their related uses for feeding, sorting, pen locating, lifetime records management and interstate tracking, have swept through the dairy industry. Fractionation (of milk and whey products, even colostrum) and membrane technologies have and will continue to offer concentrated materials of higher and more specific use in human and animal nutrition.

Health and welfare

Animal welfare, sustainability and environmental impact considerations have now become integral in best practice development. If we are willing to look into reports of animal abuse, have we really figured out how to manage and monitor to prevent future animal welfare debacles?

The movement toward reduced- and then antibiotic-free production, driven by advances in essential oils, plant extracts, herbs, etc., will only accelerate and drive industry change.

Colostrum has moved into highly valued status, including the advent of A/B/C/D rating for immunoglobulin (Ig) G content, rather than pass/fail, and we now enjoy the ability to supplement mediocre colostrum with multiple product options. Research is looking into potential benefits of feeding transition milk for several days, aiding in developing the calf gut and immune system. There is an entire new industry developing around colostrum fractionation, component extraction and formulation of effective colostrum replacers, which will support Ig-deficient calves and supply a human benefit at the same time.

Labor, people and industry

Heifer growers organized to offer industry SOPs. Hats off to the Dairy Calf & Heifer Association and its founders! The interest and inertia surrounding the calf and heifer industry has supported the birth and growth of specialized and now certified growers for calves and heifers, along with an entire new category of nutritionists, veterinarians, consultants, salespeople and caregivers focused entirely on replacement animal husbandry, with a high percentage of women in every role. Dairy overall has seen tremendous growth in the use of consultants for every facet of the operation – from financial analysis to ventilation design to manure (nutrient) management. There is increased emphasis by universities and feed companies in calves and heifers, but some fear that interest and investment by industry in university research will be threatened in the future.

Labor changes have and are taking place in concert with consolidation. The proverbial "hired man" is now rarely a middle or high school student from a neighboring farm like I was. Now a whole crew of Latinos fill those positions, with the most bilingual individuals holding the best-paid positions. Most calves today are fed either by immigrants or Amish families. The exodus of "locals" from small/rural towns across America has brought many changes both on the farm and for communities. Labor availability is a huge and growing issue and will drive automation in many facets of our business. It also requires language and cultural skills that producers may need to develop.

The entire global animal milk replacer industry has converted from surplus (government-subsidized) skim milk to a whey- and whey fraction-based industry. The net improvement in ingredient quality has spurred competition for dairy powders from a growing high-value diet drink and nutraceutical industry. Exports are now about 20% of U.S. dairy production; picture that every fifth cow's production is not staying in the United States. What would we do if global conflict or supply chain disruption were so great as to tear that flow to pieces?

Genetics

The recent phenomenon of crossing beef bulls on dairy females has caused an increase in the value of bull calves that is nothing short of revolutionary. The practice has resulted in a quick income contribution of $200 to $300 more per cow per year, all from changing a semen straw from Holstein to Angus. Once a rarity, the use of sexed semen has dramatically increased the genetic improvement velocity of heifers. The dairy industry is enjoying huge advances in milk component yield due to genomic testing.

The changes I've witnessed in my 50 years of industry experience have been exciting, challenging and extremely encouraging. Our industry continues to develop enormous opportunities for individuals who are dedicated, inquisitive and open to new ways of improving the health and welfare of calves.

It takes a team: Finding the value in source dairy farm communication

David Renaud, University of Guelph

There are many challenges associated with raising surplus dairy calves. To overcome these challenges, management at the calf raiser is important; however, the quality of calves entering the facility is critical. Several studies have identified that calves entering a facility with low body weight, diarrhea, an infected umbilicus and other indicators of disease are at high risk for disease and mortality, but also poorer growth. The number of high-risk calves coming from different source dairy farms varies, suggesting that management on the dairy farm matters. Indeed, colostrum management, type of bedding provided and quality of calving supervision at source dairy farms, as well as the herd veterinarian's interest in calf health, have been associated with the rate of mortality of source dairy farm calves at the calf raiser.

To motivate change on source dairy farms, there are several considerations. First, the calf buyer is often considered by dairy farmers to be an important source of feedback on the calves and therefore could use their role as a source of motivation. The use of benchmarking has also been explored and found to motivate dairy producers, especially when a price premium is paid for high-quality calves. Working as a team, the calf raiser and dairy farmer can strive to improve economic gains on both sides while improving calf health, welfare and growth.

NOTES

Heifer management: Balancing value and cost

Michael W. Overton, Zoetis

Dairy replacement heifers represent one of the largest sources of cost related to dairy production, but this is not the full story. As the future of the dairy, well-grown, high-quality heifers also represent a huge source of value. Here, high quality refers to heifers that have high genetic potential, are grown such that just after first calving at 22-24 months of age, they are 82-85% of projected mature weight and do not have lingering health issues that may negatively impact future productivity. Unfortunately, excessive attention placed on cost reduction during the raising period and ignoring the future lost opportunity potential associated with low-quality, poorly grown heifers is far too common in our industry.

The production of high-quality heifers begins with reproductive management in the existing females. First, one needs to estimate how many heifers should be produced to meet ongoing replacement needs and this starts with projecting future replacement rates for the lactating herd over the next 2-3 years. Commonly, this is done by evaluation of recent years and adding in a little wiggle room. For example, if the historical replacement risk has been 36% for the past 2-3 years, a reasonable target would be to produce enough heifers to support 39-40% replacement *potential*. In the case of a 1,000-cow herd, this means that 360 animals leave every year, but one should produce enough replacements to allow up to 390-400 cows to be replaced. Producing excess animals above replacement needs is costly but not having enough animals to replace animals that need to be replaced is likely more costly. Another key piece is the heifer completion risk. If a herd needs 400 replacements and the completion risk is 82%, then 488 live-born heifers need to be produced. This extra cushion is important since past performance does not necessarily describe future performance and does not account for unexpected economic or management issues that may arise.

The next step is to carefully select the females to produce these replacements. Using sexed semen in all virgin heifers and some first-lactation animals seems reasonable but does not yield the best genetic progress. There are some older cows already in the herd with better genetics than some of the lower-end virgin heifers. The best approach to optimize genetic gain is to evaluate the animals and then use the best animals to produce the next generation.

Once the heifers are born, feeding and managing them to produce to their genetic potential is critical. The early life period (birth to 3-4 months of age) represents the best, most efficient time for lean tissue gain. The growth curve for height is curvilinear with the fastest gains occurring early in life and through breeding, at which time the growth in frame slows. On the other hand, weight gain is much more linear. With this in mind, it is critical to monitor the growth at different stages to maintain optimal performance. One approach would be to capture both height and weight at a variety of key stages, including birth, weaning, 4-5 months, 12 months (or just prior to breeding) and calving. For most farms, measuring these data at the time animals are moved is easiest. These data points provide important feedback at key phases of heifer management and development. Combining growth performance with genetic predictions for body size composite (gBDC), health and productivity should yield the best results and help protect against the creation of bigger lactating cows over time, which often results when focusing exclusively on growth rates and weight targets. Adding adult cow weights at the time of calving for lactations one through four can also provide good information to help evaluate milk production potential and trends over time.

A statement often repeated is: "you can grow them before they calve or you can grow them after they calve." Managers should strive to have heifers reach 95% of mature height and 82-85% of expected mature body weight (MBW) just after calving to reach their production potential in the first lactation. Heifers that are undersized at calving (less than 85% of targeted weight) will partition a greater percent of nutrient toward growth and away from production compared to well-grown heifers.

To illustrate the relationship between differences in actual vs. targeted weight at first calving and subsequent 305-day milk production, data from birth through three lactations were obtained for all animals born during 2015 to early 2019 on a single Holstein dairy. Animals calved at least once and had body weights recorded at the time of calving. Additionally, all animals had genomic outcomes and milk production data. From an initial population of 3,333 heifers that calved for the first time in 2017 through 2020, 1,751 entered their third lactation and had body weight recorded after calving. Since no true MBWs and no weights at the start of the fourth lactation were available, adjustments were made to the third lactation weights to estimate expected MBW. Cows were assumed to add an additional net gain of 2% in body weight from the start of the third lactation until maturity.

The estimated MBW were regressed against gBDC, resulting in the following equation: MBW (pounds) = 1,768 + 80.2*BDC. Using this derived equation, a predicted MBW (pMBW) was created for each animal that calved at least once. The product of 0.85 and pMBW was used as the targeted weight at first calving. Subtracting targeted weight from the actual weight resulted in the first lactation weight difference (L1 Wt Diff). From this L1 Wt Diff, three groups were created representing "Light" animals at calving (L1 Wt Diff = -400 to -75 pounds, n=2,549), "Targeted" animals (-74 to 75 pounds, n=631) or "Heavy" (76 to 300 pounds, n=163). Linear mixed models were used to evaluate 305-day milk within the group, using genomic milk, days in milk (DIM), DIM^2, age at first calving, and age at first calving^2 as fixed effects, and month and year of calving as random effects.

In the Light group, each additional pound closer to the targeted weight at first calving was associated with 7.4 pounds more 305-day milk in lactation one (p<-0.01) and 2.6 pounds more in lactation two (p<0.01). There were no significant effects of L1 Wt Diff in the Targeted or Heavy Groups for first lactation (p=0.38 and p=0.47), or second lactation (p=0.44 and p=0.82).

Next, the likelihood of achieving pregnancy (through 250 DIM) was evaluated using Cox Proportional Hazards models with Year and Month of First Calving, Age at First Calving, Age at First Calving squared, and genomic Cow Conception Rate (gCCR) as explanatory variables. There was no difference in the timing or likelihood of pregnancy across the three weight groups.

Similarly, a Cox model with Year and Month of First Calving, Age at First Calving, Age at First Calving squared, and Dairy Wellness Profit Index (DWP$) as explanatory variables were used to evaluate the risk of being removed (sold or died through 450 DIM). Animals in the Light group had a 1.7X and 1.9X higher risk of removal compared with Targeted and Heavy groups, respectively (p<0.01). However, when 305-day milk was considered as an explanatory variable in the model, there was a non-significant change in results. Now, the Heavy group was 1.3X more likely to be removed than either the Light (p=0.23) or Targeted group (p=0.26). Similarly, when Age at First Calving was removed, animals calving in the Heavy group were nearly twice as likely to be culled.

These changes in the model outcomes illustrate a couple of key take-home points:

- The primary driver for early culling was not weight group, per se, but rather the milk production differences that resulted from calving at a lighter weight than targeted.
- When adjustment for Age at First Calving was removed and 305-day milk remained, older heifers had a significantly higher risk of being culled.

Achieving the proper amount of growth prior to calving is one critical factor for first lactation animals to reach their genetic potential for milk production in first and second lactation. Animals that calve in at a lighter than desired weight produce less milk and this is likely due to the extra growth demands that divert nutrients away from production and toward growth. Older animals at calving often appear to produce more milk but much of this difference is likely due to lower growth demands in first lactation and the higher feed intake associated with a larger body mass. However, this extra milk comes at a cost, as feed costs are higher due to more days on feed as a heifer, and there's a higher risk of removal during the first lactation. Overall, this project demonstrates that failure to adequately grow heifers prior to calving limits their production potential in first and second lactations, and represents a large lost economic opportunity.

Neonatal calf development and nutrition

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The newborn calf's digestive tract is immature in the sense that it is not yet functional as defined by the physiological makeup of a mature bovine animal. It is, however, relatively mature in terms of its ability to use milk as a primary nutrient source. As a mammal, the newborn calf is highly reliant upon milk as its primary nutrient source. This dependence exists until such time as the digestive tract morphology and functionality sufficiently develops to allow for intake, digestion and fermentation, and absorption of nutrients derived from solid food sources to occur. The following progression puts into perspective the significant developmental changes that occur in a young calf's life to efficiently function as an adult bovine. At birth, it must adapt to a vastly new environment loaded with pathogens and initiate a functional digestive tract, including digestion and absorption of nutrients from a milk source, rather than receiving them via umbilical transfer. It must then undergo transitioning from a pre-ruminant digestive tract to a fully functional mature ruminant digestive tract. Under most normal circumstances, these changes will occur. However, it is the rate and magnitude to which these physiologically critical processes occur that significantly influence the calf's lifelong ability to realize its full genetic expression.

Calf growth and development often become melded together as if they are the same. In reality, growth is a function of development – positive or negative. Growth occurs as tissues develop, with positive growth associated with an increase in cell numbers and/or size. Typically, growth is measured in terms of weight or structural size changes and does not necessarily account for optimal tissue development. Growth of some tissues may impede the development of others. Typically, development occurs in phases from conception through maturity and is more highly regulated than growth. Development is the differentiation and maturation of cellular tissues capable of expressing the calf's genetic potential. It is often difficult to measure as it is occurring and may only be qualified and quantified during productive functions of the tissue measured.

Colostrogenesis begins approximately three to four weeks prior to parturition and is the process by which colostrum is formed in the mammary tissue. During this short period of time, mammary gland receptor sites are activated and transport portals are opened to allow for immunoglobulins, hormones, growth factors and other biologically active compounds found in blood to enter into the lumen of the mammary tissue unaltered. Within two days of parturition, there is a significant shift in hormonal balance and permeability of the mammary tissue, which blocks much of these transport mechanisms from continuing and allows for the synthesis of nutrients within mammary cells and their ultimate secretion into the lumen of the mammary gland. In a very general sense, colostrogenesis is an accumulation of non-nutrient compounds collected from maternal blood and nutrients synthesized and released from the mammary tissue.

Colostrum, as harvested immediately post-partum, is an excellent source of nutrients to the neonatal calf, containing quality proteins (essential amino acids), fats (essential fatty acids), minerals and vitamins. Non-nutrient components of colostrum include immunoglobulins (primarily IgG1), lactocytes, erythrocytes, leukocytes, growth hormone, prolactin, insulin, glucagon, IGF binding proteins, releasing factors, lactoferrin, transferrin and oligosaccharides. The nutrient and non-nutrient composition of colostrum changes with each succeeding removal from the mammary gland. Generally, the "colostrum to normal whole milk" transition harvested from the mammary gland is completed within the first six milkings post-partum. Thus, there is a volume of transitional milk produced and harvested, which contains a varied composition of milk nutrients and non-nutrient compounds that are beneficial to the newborn calf.

Colostrum has long been recognized as being essential in facilitating passive immunization in the newborn calf. The establishment of a pool of circulating, passively acquired immunoglobulin (Ig) provides the immune protection necessary to assist the calf through its early stages of growth and development. Serum Ig concentration, measured shortly after birth, was an important source of variation for mature equivalent milk and fat production in the first lactation. Colostrum is the first extrauterine source of nutrients and a temporary immunization delivery system to the newborn calf; therefore, it has a long-lasting impact throughout life. However, in more recent years, the entirety of colostral content has been determined to be of great significance in the performance of calves throughout their lives. These colostral effects have been widely recognized in animal science as reflected in the large amount of colostrum research conducted since the 1970s. Colostrum intake, with its nutrient and non-nutrient components, exerts marked effects on gastrointestinal development and function. Furthermore, there are important transient and long-lasting systemic effects on nutritional status, metabolism and various endocrine systems due to intake of nutrient and non-nutrient colostral components that contribute to survival in the stressful postnatal period. Small intestine villus circumferences and heights, and the rate of epithelial cell proliferation were higher in colostrum extract-fed calves versus controls. In addition to nutrients, the interactions between biologically active compounds in colostrum and the enterocyte lining of the calf's digestive tract are significant in promoting the establishment of intestinal digestion and absorption. Species differences in concentration and presence of some non-nutrient compounds have also been noted. This would suggest at least some level of species specificity with regard to colostrum impact on neonatal tissues.

Colostrum-derived non-nutrient compounds are significant effectors of gastrointestinal tract functions, including microbial populations, development of cellular proliferation, migration, differentiation and apoptosis, protein synthesis and degradation, digestion, absorption, motility and immune function within and outside of the gastrointestinal tract. They further influence metabolism and endocrine systems, as well as vascular tone and hemostasis. It is apparent that the effects of colostrum and, by extension, transitional milk are significant in newborn calf growth and development. The specific nature of colostral compounds and their effects on tissues and functionality are too important to ignore. It is significant to note that decades of attention have been given to the importance of the timely delivery of quality colostrum in sufficient quantities to yield positive results in newborn calves. However, the industry has failed to provide adequate support during the very important transitional phase of colostrum to whole milk or milk substitute diets. It would appear as though concern for cost has displaced the natural physiological requirement for transition. What cost is incurred from not allowing tissues to optimally develop and function? Do these early omissions lead to higher incidences of morbidity and mortality, and more long term to diminished genetic expression?

Natural whole bovine milk is the optimal nutrient package for rearing newborn calves. As such, it should be held as the standard in comparing alternative milk feeding programs. Whole bovine milk contains approximately 26.83% protein, 27.64% fat, 39.84% carbohydrate and 5.69% minerals on a 100% dry basis. Milk content varies relative to breed, diet, environment and stage of lactation. It is also important to note that milk harvested from stressed or infected cows can be altered significantly.

The protein fraction of whole milk is made up of two major types: casein (82%) and whey or serum (18%). Proteins in milk contain all 22 amino acids. The casein fraction contains phosphorus and forms structures known as micelles, which are held together with calcium phosphate bridges on the inside and casein on the outside, which help stabilize the micelle in solution. Caseins will generally coagulate at a pH of 4.6, whereas whey proteins remain in solution. Neither caseins nor whey proteins are degraded with normal, controlled pasteurization of high-temperature, short-time (HTST) methods. However, both can be sensitive to abnormally high temperatures over longer time.

There are more than 400 fatty acids found in milkfat. It is the most complex of edible fats. However, there are about 15 to 20 fatty acids comprising approximately 90% of the fat in milk. Approximately 65% of the fatty acids in milk are saturated, 30% monounsaturated and 5% polyunsaturated. Fat in milk is primarily in the form of triglycerides. Milk fats are typically unaltered with normal HTST pasteurization.

The primary carbohydrate in milk is the disaccharide, lactose (glucose + galactose). It exists in the form of two anomers, α and β, which convert back and forth with each other. Lactose is not affected by normal HTST treatment. However, lactose is involved in binding with proteins – creating a browning color, undesirable flavor and decreased availability of the essential amino acid lysine. This reaction, known as the Maillard reaction, is due to exposure to high heat.

Bovine milk contains many water-soluble vitamins: thiamin (B1), riboflavin (B2), niacin (B3), pantothenic acid (B5), pyridoxine (B6) and cobalamin (B12), as well as C and folacin. It also contains the fat-soluble vitamins A and D, and small amounts of vitamins E and K.

The normal minerals in bovine milk include calcium, magnesium, phosphorus, potassium, selenium and zinc, with small amounts of copper, iron, manganese and sodium. The portion of minerals in milk is somewhat small – at 5.69% – and is relatively consistent, except in milk from mastitis-affected cows.

The primary nutritional focus of a successful neonatal calf program should be on establishing a dietary regime capable of sustaining optimal growth and development. The nutritional inputs must reflect the quality of nutrients necessary to sustain maintenance and growth, and development requirements for energy, protein, vitamins, minerals and water. To attain optimal performance and productivity, this diet must be palatable and supply these nutrients at levels parallel to the calf's growth and development potential. Attention must be given to addressing the nutrient intake profile capable of supporting reduced inflammatory reactions, optimal digestion and absorption, enhancement of a vibrant digestive tract microbiome and stimulation of optimal gastrointestinal tract tissue development required for the transitioning pre-ruminant to ruminant. The calf-rearing industry has somewhat successfully invested heavily in strategies designed to keep calves alive and moderately protected against stressors and pathogenic organisms. However, the very foundation for maintaining optimal growth and development – nutrition – has been significantly reduced in its importance and attention. It is not uncommon to hear calf diet discussions centered on solids intake with minimal regard to actual nutrient content. Another primary focus seems to be what protein and fat percentages are fed versus what is the type of each nutrient fed and in what amounts. Water intake discussions are often minimalized and yet water is undeniably an essential nutrient. Economics of calf rearing are always of major concern and justifiably so. However, the determination of economic viability should be questioned. For example, what is the cost of growing and developing a calf with compromised ability for full genetic expression? The calf-rearing industry has a more complete understanding of the genetic, physiological and environmental aspects of successful calf raising than previously known. It is incumbent upon the industry to use this understanding to facilitate the optimal growth and development of newborn calves through to their intended purpose.

References available upon request.

What traits matter when beef genetics are used on dairies?

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Beef × dairy production system

The obvious goal of breeding dairy cows with beef semen is to improve the value of the resulting terminal calves. Beef semen generally adds value to feeder calves born to dairy cows (Cabrera, 2022; McCabe et al., 2022). Nonetheless, much variation exists between the quality of beef sires used on dairies, and, consequently, the true system-wide value of the resulting calves. Beef × dairy calves are expected to grow more efficiently, show improved muscularity and increase carcass yield compared with straightbred dairy cattle. However, calf value can be quickly offset by poor reproductive and lactation performance of the dairy cow if caused by low-quality semen or dystocia. Dairy producers have many options to source beef genetics, but decisions can be simplified by balancing necessities of keeping dairy cows in production with endpoint value of beef calves.

Overview of breeds

Crossbreeding beef and dairy cattle enables matching complementary breed strengths. Beef × dairy calves are preferrable to contemporaries with all dairy genetics for converting feed to carcass weight, improving muscling and decreasing internal fat (Dolezal et al., 1993; Kauffman et al., 1976; Nour et al., 1983b, 1983a; Taylor and Murray, 1991). Breed type alone isn't precise enough to optimize selection of terminal sire genetics. Jersey genetics as compared to Holstein genetics are generally negative for beef production because of poor rate of gain, smaller mature size and decreased red meat yield (Lehmkuhler and Ramos, 2008).

Because of differing terminal merits among dairy breeds, different beef breeds are used as terminal sires. Angus semen is estimated to be used for greater than 60% of all beef × dairy matings (Halfman and Sterry, 2019; McWhorter et al., 2020). Angus sires generally offer the most progressive calving ease, growth and meat quality traits of any breed (Figure 1). Since premiums are paid for black-hided cattle that yield well-marbled carcasses, Angus bulls are generally a good choice for the beef × dairy system (McCabe et al., 2019; Williams et al., 2012). However, influence of Continental breeds – mainly Charolais, Limousin and Simmental – is more common for Jersey cow matings because of advantages in muscling and feed efficiency (Pereira et al., 2022). Selecting the right bull for beef × dairy matings improves the quality and consistency of the feeder calf supply originating from dairies.

Tools for selection

Leverage data collected from beef cattle to guide beef bull selection for the dairy herd. When available, expected progeny differences (EPD) are the most reliable measure of genetic value and should be prioritized for selection more than pedigrees, genotypes or performance data alone. Though not all beef breed associations use a common database and genetic evaluation, a table of adjustment factors is published annually by the U.S. Meat Animal Research Center (USMARC) to convert EPDs from one breed association's data to another (Kuehn and Thallman, 2022). The relevant traits for beef × dairy sire selection included in the adjustment factors are calving traits (birthweight), growth traits (weaning and yearling weights) and carcass traits (marbling score, ribeye area and carcass weight). Calving ease is another relevant trait for sire selection that is consistently reported by beef breed associations. Unfortunately, phenotypic and genetic data are inconsistent for fertility, gestation length, feed intake and measures of mature size.

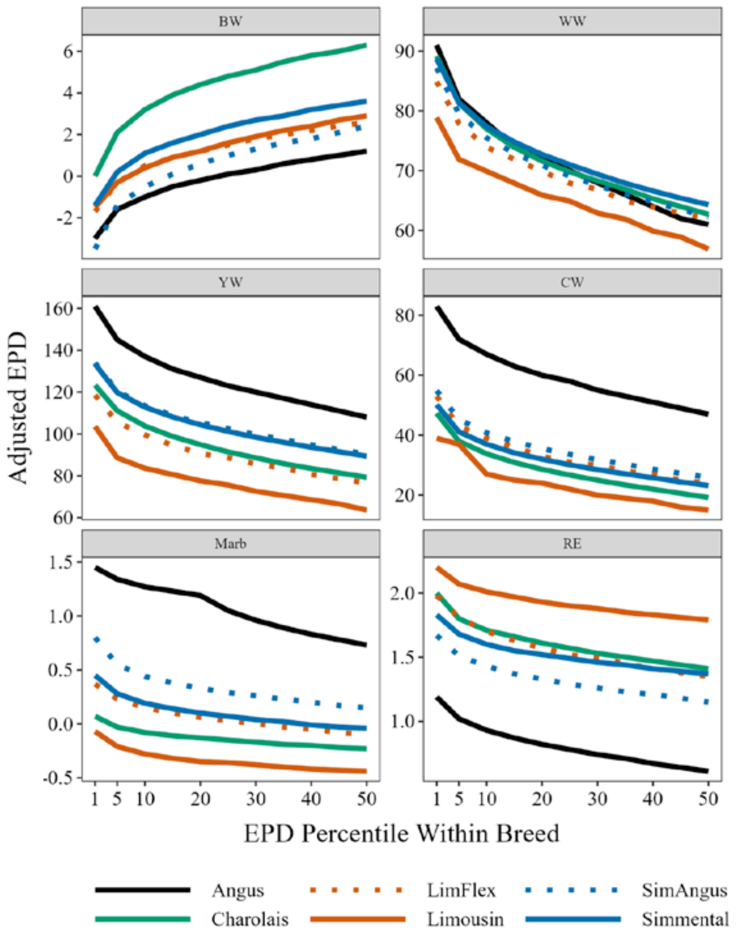
In addition to EPDs, beef breed associations publish indexes to simplify selection of beef terminal sires. Each breed publishes a unique terminal index ($B for Angus, TI for Simmental, MTI for Limousin, and TSI for Charolais). While the indexes are valuable for selecting beef cattle, more precise indexes are needed for selecting beef bulls for the dairy herd (Berry et al., 2019). The American Angus Association publishes two specialized indexes – one for selecting Angus bulls for Holstein cows ($A×H) and one for Jersey cows ($A×J) – to help prevent calves from Holstein dams from producing carcasses of excessive length and to help calves from Jersey dams yield heavier, more muscular carcasses. Additionally, the American Simmental Association publishes an index (HOLSim) for selecting SimAngus bulls for Holstein cows. As a general rule, Angus bulls should be in the top 10% of the breed for terminal indexes and Continental bulls should rank in the top 25% of their respective breeds. Recommendations made here and throughout are based on ongoing research conducted at Texas Tech University.

Fertility

Cabrera (2014) estimated the cost of an additional day open to be approximately $5 per cow, emphasizing the importance of fertility for economic viability. Expectations for beef semen fertility should be similar to expectations for dairy semen fertility. However, when sire conception rate is compared among bulls, consider season, number of previous lactations and number of previous services of the inseminated cows, because these factors are known to affect conception rate (McDowell et al., 1976; Mellado et al., 2011; Walsh et al., 2011). Foraker et al. (2022) identified no difference in conception rate between beef and dairy semen when dairy mating records were matched by cow breed, lactation and season.

While selection pressure for dairy bull fertility can be placed on sire conception rate from genetic evaluations, no analogous measure of fertility is available across beef bulls. Instead, beef bull fertility is evaluated phenotypically (Butler et al., 2020). Genetic suppliers have data capture systems to rank bulls within their respective programs, which is based on

Figure 1. Summary of expected progeny differences (EPD) across breeds using adjustment factors published by USMARC (Kuehn and Thallman, 2022)



semen quality, breeding records and fertility indexes. Beef bulls are best selected for fertility via data shared by genetic suppliers and performance relative to dairy semen in the herd after considering the cows inseminated.

Calving difficulty

While many factors affect calving difficulty, the most easily selected traits are gestation length, birthweight and calving ease. Longer gestation and heavier birthweight are associated with greater incidence of dystocia (Johanson and Berger, 2003; Linden et al., 2009). Calving difficulty resulting in metritis or endometritis negatively affects the dam's future fertility and milk production (LeBlanc, 2008; Sheldon et al., 2009). Since mature pelvic size of Jersey cows is smaller than that of Holstein cows, traits related to calving difficulty should be more strictly evaluated when semen is selected for Jersey-influenced females (Anderson et al., 2007; Heins et al., 2008; Rastani et al., 2001). While minimizing birthweight enhances calving ease, birthweight in the absence of dystocia is positively associated with growth performance and calf survivability (Bullock et al., 1993; Gregory et al., 1991; Portes et al., 2020).

Selection of beef bulls for smooth calving should focus on maximizing calving ease and optimizing birthweight. Bulls should rank in the top third of the breed for Calving Ease Direct (CED); this equates to an 8 or greater CED EPD on an Angus base. Since beef calves have more muscular hips and shoulders, calving ease should be prioritized more than it would be for dairy × dairy matings when resulting progeny are long and angular. Adjust birthweight (BW) to a level that enables proportion of assisted births to be equal between beef × dairy and dairy × dairy matings. If percentage of assisted births for beef × dairy calves exceeds the percentage for straightbred dairy calves by 1%, decrease the BW EPD of beef bulls by approximately 1 pound (Ritchie and Anderson, 1991).

While gestation length is not consistently measured for beef sires, clear sex and breed differences are observed. Bull calves are generally carried 1.5 days longer and weigh 5 to 10 pounds (2.27 to 4.54 kg) more than heifer calves (Andersen and Plum, 1965; King et al., 1985; Ritchie and Anderson, 1991). Consider management of increased calf size if male semen is an option. Additionally, longer gestation periods are observed when beef sires are used as opposed to dairy sires (Foraker et al., 2022; Scanavez and Mendonça, 2018). Holsteins have an expected gestation length of 279 days; Jersey and Angus breeds have an expected gestation length of 283 days; and Continental breeds have an expected gestation length of approximately 290 days (Irish Cattle Breeding Federation, 2020). Not all breed associations and genetic suppliers place emphasis on selecting bulls for gestation length, so CED and BW are more reliable selection criteria.

Feedlot and carcass performance

Growth performance is a trait of clear economic importance. The two EPDs to select for growth rate in beef cattle genetic evaluations are weaning weight (WW) and yearling weight (YW). On an Angus base, beef bulls should have a minimum WW EPD of 75 and a minimum YW EPD of 130.

The main carcass traits of importance are carcass weight (and dressing percentage), ribeye area and marbling score. The major beef breed associations include an EPD for carcass weight (CW). Angus bulls should have a minimum carcass weight EPD of 55. Ribeye area (RE or REA) is the single best genetic predictor of carcass muscularity. Expect beef bulls to have greater than 1.0 RE or REA on an Angus base. Carcass eating quality is best selected by marbling or intramuscular fat (Marb, MB or MRB). Expect Angus bulls to have a minimum marbling EPD of 1.0. When bulls of continental breeds are used to prioritize muscling, marbling EPDs should rank in the top 20% of the breed.

The guidelines listed above for growth and carcass traits are stringent to identify ideal beef bulls for crossbreeding with dairy cows. Sires that meet these specifications will provide value through all phases of the beef supply chain. In instances where bulls with these specifications cannot be found, calving ease and fertility should not be compromised. Instead, standards for terminal traits should be lowered, depending on marketing endpoint. For example, if calves are sold as feeder cattle, WW is a better indication of growth to the marketing endpoint than YW. If calves are sold live as fed cattle, carcass specifications can be relaxed.

Next steps

In cases where all the listed specifications for growth and carcass traits are met, emphasize other traits. Feed efficiency data are becoming more common and are imperative for future progress. Selecting Angus bulls in the top 25% of the breed for residual average daily gain promotes feed efficiency. Similarly, putting downward selection pressure on feed intake without decreasing growth should decrease intake relative to gain. Additionally, phenotype, such as muscularity of the forearm and hindquarter or boldness of rib shape, should improve lean muscle mass of resulting progeny and improve efficiency of gain. As genetic suppliers refine and increase the quality of beef bulls available for dairy producers, selection criteria should become more and more stringent to make the most of beef × dairy matings.

References available upon request.

NOTES

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