Cattle Breeding and Genetics I & II
Purebred Cattle Marketing

Coordinators: Dr. Joe Paschal
Dr. Andy Herring

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Wendt Ranches
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Predictable , profitable, red hided, heat tolerant genetics that perform both on the hoof & the rail.

CATTLE STATS

SOUTHERN LIVESTOCK STANDARD

R.A. BROWN RANCH
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AMERICAN BRAHMAN
ABBA
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Texas A&M
Beef Cattle Short Course
beefcattleshortcourse.com

Texas A&M
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CAPITAL FARM CREDIT

CapitalFarmCredit.com

Basics of Beef Cattle Record Keeping

HC Neel, IV
Executive Director
Santa Gertrudis Breeders International

Why Should You Keep and Report Records?

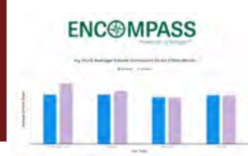
- First and foremost, records aid greatly in monitoring the costs associated with cattle production.
  - Am I making or losing money?
  - Annual cow costs or cost per cow
  - What did it cost to increase efficiency or improve a particular trait?
    - Is it cost effective to your operation?
- Seedstock breeders:
  - Maintaining and reporting accurate records/phenotypes is essential for accurate and useful EPD calculation.
- Commercial breeders:
  - Even if your cattle are not involved in a genetic evaluation, you have to know how your cattle are performing.
  - Genetic improvement can still be achieved without EPDs if accurate record keeping is maintained.

How Do I Even Keep Records?

How Do I Even Keep Records?

CattleMax

DIGITALBEEF®



ASA The PERFORMANCE RECORDS

What Records Should I Keep?

- What kind of operation do you run?
  - Seedstock?
  - Commercial?
  - Stocker?
- What are your goals?
- What are you retaining?
  - Keeping any replacement females?
- How are you marketing your calves?
  - At weaning through the sale barn?
  - Retained ownership?
  - Etc.

Which Records are Important?

- All of them!
- However, certain records can become more or less important depending on your specific operation.
- There are a few that every operation should strongly consider keeping track of.

Individual Animal ID

- Whether her name is "Lulu," "704," or "0037F," it is essential to have an individual animal ID on every animal.
- This will help you keep track of individual records.
  - Track individual animal performance
  - Culling/retention decisions
  - Cow longevity
- Needed for any form of genetic evaluation.
- May have traceability or biosecurity requirements depending on how you market calves.

Inventory

- Keeping track of your herd inventory is highly important as it serves as your benchmark for basic information.
  - Number of cows exposed
  - Number of cows at calving
    - Calving rate per cow exposed
  - Number of calves weaned
  - Culled/deceased animals
  - Number of head purchased
  - Number of cows/bulls

Pregnancy Data

- Conception Rates
  - Open cows should be culled
  - Sentimental value loses money if a cow isn't doing her job
  - Recommend having conception rates for each group of females
    - Heifers vs. Mature Cows, etc.

Calving Data

- Highly important for your culling/selection/mating decisions
  - Individual Animal ID for both dam and calf
  - Calving Ease Score
    - Assisted, unassisted, etc.
  - DOB of calf
  - Death loss and reason why
    - For registered cattle, will need to put in the proper management code with your association
    - Highly important in any kind of Whole Herd Reporting System

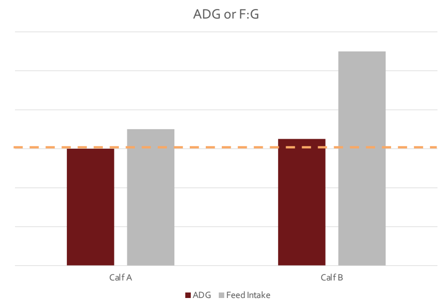
Supplement & Mineral Consumption

- Keep track of how much mineral/supplement you are using in your operation.
- Usage and cost per cow

ADG or F:G

- If you have the capability, measuring post weaning ADG or Feed:Gain is highly beneficial
- Helps to measure efficiency which can aid in genetic selection

ADG or F:G



Vaccination and Health Records

- Important for your own expenses
- Vital to keep track of when you vaccinate, deworm, etc. and what you are using
  - Is it working?
  - Some products may be more cost effective for you with the same results
- Individual health records could aid in culling decisions

Income and Expenses

- It's just a good business practice to keep great records on how much money you have coming in and going out.
  - Operating income
- Also, can use these figures to help calculate your cost per cow and adjust management practices as needed within means.
- Revenue vs. Profit
  - NOT the same thing!

Other Ranch Records to Think About

- Bull Fertility
  - Breeding Soundness Exam (BSE)
  - Don't want to turn out a bull that can't breed
- Rainfall by Month
- Herbicide and Fertilizer Usage

Tracking Certain Traits/Phenotypes

Accuracy

- No matter what traits you need to record for your herd, it is imperative that you record them accurately.
- Proper Equipment
  - Make sure your equipment is functioning properly
- Consistency
  - Take every measurement the same
  - Eliminates bias
- Ensure measurements are taken within the proper age parameters
- Contemporary Groups

Contemporary Groups

- A set of calves that experience similar management and have the same opportunity to perform
  - Same sex (bulls and heifers should automatically be placed in separate CGs)
  - Same environment
  - Same feed resources
- Calves in a contemporary group should be born within no more than a 90-day period of each other
- Contemporary group size can only get smaller, never larger
- Responsibility of proper contemporary groups falls on the breeder

Contemporary Group Example

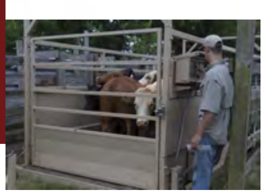
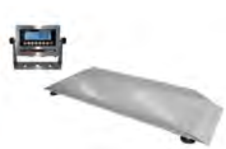
	Group A	Group B	Group C	Group D
Sex	Bull	Heifer	Heifer	Heifer
Age	March	March	March	November
Nutrition	Creep	Creep	Dam Only	Dam Only

Growth Traits

- Growth traits predict the difference, in pounds, for that particular weight
  - Birth Weight (BW)
    - Within approximately 48 hours from birth of calf
  - Weaning Weight (WW)
    - Between 120 – 300 days of age
  - Yearling Weight (YW)
    - Between 300 – 470 days of age

Growth Traits – What You Need

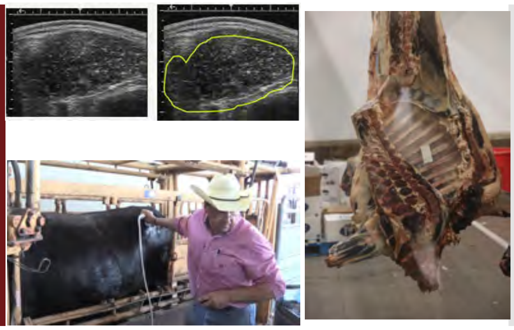


Carcass Traits

- Harvest data is the best, but ultrasound can also be a great tool to aid in collecting carcass records
- Every breed association has a slightly different window of acceptability for ultrasound data (300 – 470 days at SGBI)
  - Ribeye Area (REA)
  - Fat Thickness (FT)
  - Marbling or IMF (MB/MARB)
- Carcass Weight (CW)

Carcass Traits – What You Need



Maternal Traits

- Calving Ease (CE)
  - Calving Ease Direct: probability of calves being born unassisted out of 2 year old heifers
  - Calving Ease Maternal: probability of a parent animal's daughters conceiving to calve at 2 years of age
- Stayability (STAY)
  - Probability of an parent animal's daughters remaining productive until at least 6 years of age
- Heifer Pregnancy (HPG)
  - Probability of heifers conceiving to calve at two years of age
  - 300 – 470 days
- BreedBack (BB)
  - Chance a female bred back at 3 given she calved as a heifer
  - 850 – 1300 days

Maternal Traits – Info That Can Help

Other Traits

- Udder Score
  - Suspension & Teat Size
- Docility
- Foot Score

Indexes and Genetic Tools for Commercial Cattlemen

Indexes

- Economic selection tools that measures multiple traits that pertain to a specific breeding objective.
- Can be used to estimate value of parent animal's future offspring.
- Can be used to help aid in selection/culling decisions.
- "Its Your Turn EPDs and Indexes for the Commercial Cow-Calf Operation" presented by Chip Kemp
  - https://vimeo.com/showcase/10124301/video/811818855

Genetic Tools for Commercial Cattlemen

- Genetic tests available that provide a basic genetic view for in-herd comparisons.
- Typically requires a tissue or blood sample that can be easily collected.
- Will not facilitate a full genetic evaluation that is derived from pedigree and performance information, but is a great tool to provide basic genetic knowledge in a commercial setting.

Genetic Tools for Commercial Cattlemen

- Igenity
  - Genetic panel offered to cattle raisers that measures 16 traits to help aid in your selection/retention/culling decisions
    - Growth, Maternal and Carcass traits
  - All traits reported on a scale of 1 -10
  - Has access to **Encompass** online tool
  - Use primarily for heifer retention decisions

BIF Resources

- For more in depth information on record keeping and data collection, please visit the Beef Improvement Federation wiki page at:
  - guidelines.beefimprovement.org

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EPDs and Their Use in Both Commercial and Seedstock Operations

LANCE W. BAUER, PH.D.
BEEFMASTER BREEDERS UNITED

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What is an EPD?

- Expected Progeny Difference
- A tool for comparison
  - Compare one or more sires or dams
  - Compare a sire or dam to the breed average

2

EPD Misconceptions

- An EPD can be tied to a true phenotypic value
- A maximum or minimum is always the best
- EPDs are just a marketing tool
- Higher accuracy for an EPD means less variation
- Genomic Enhanced EPDs mean the EPD will be better

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History of EPDs

- Have been around since the 1980s
- In the 1990s gained more and more popularity as the genetic selection tool
- Economic Indexes were calculated using EPDs
- Genomic information began to be included in EPD calculation

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Genomically Enhanced EPDs

- Utilize genomic data and Increase the Accuracy of an EPD
- Genomic Data is used with pedigree data
- Useful on younger animals

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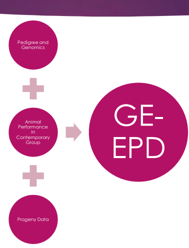
How is an EPD Calculated?



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Growth Traits

- Birth Weight (BW)
- Weaning Weight (WW)
- Yearling Weight (YW)
- Mature Cow Weight (MCW)
- Calving Ease Direct (CED)
- Calving Ease Maternal (CEM)

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Carcass Traits

- Ribeye Area (REA)
- Fat
- Marbling or IMF (MARB)
- Carcass Weight (CW)
- Yield Grade (YG)

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Maternal Traits

- Stayability (STAY)
- Heifer Pregnancy (HPG)
- Age at First Calf (AFC)

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Feed Efficiency Traits

- Dry Matter Intake (DMI)
- Residual Feed Intake (RFI)
- Residual Average Daily Gain (RADG)

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Using EPDs For Selection

- Comparison between two or more animals for breeding purposes
- Can compare two sires or dams for traits to decide which will meet your breeding goals
- Can compare a sire or dam to the breed averages and see how they will help you reach your breeding goals
- NEVER select on a single trait

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Breeding Objective

- Identify what your operation goals are
  - Are you producing replacement females to sell?
  - Are you selling all calves at weaning?
  - Are you retaining ownership on steers through the feed yard?
  - A combination of these or any other system?
- Where is your herd lacking or excelling relative to your goals?
  - Do you need more WW?
  - Do you need to increase quality grade of your steers?
- Which EPDs will help reach goals
- NEVER select on a single trait (This is obviously important)

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Example

Bull A	BW	WW	YW
EPD	-1.0	27	37
ACC	.35	.40	.30
PCV	1.6	8.1	12.9

Bull B	BW	WW	YW
EPD	1.5	20	32
ACC	.85	.90	.85
PCV	0.4	1.4	2.8

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Percentile Rankings

- Allows a producer to see where an animal ranks within the breed
- Published by most breed associations
- If an animal is in the 1 percentile it is higher than 99 percent of the breed for that trait

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Accuracies

- A relationship between the estimated EPD and the "true" transmitting ability of the animal
- Range from 0 to 1 theoretically
- Genomic information can provide accuracy quickly
- Phenotypic data on calves provides accuracy
- Each trait has a Possible Change Value (PCV) associated with accuracy

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Possible Change Values

- Risk Management
- Units of possible change
- Standard deviation
- Does not imply there will be less variation

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Bell Curve Example

Bull A	BW	WW	YW
EPD	-1.0	27	37
ACC	.35	.40	.30
PCV	1.6	8.1	12.9
Bull B	**BW**	**WW**	**YW**
EPD	1.5	20	32
ACC	.85	.90	.85
PCV	0.4	1.4	2.8

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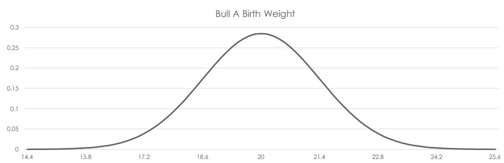
Bell Curve Example



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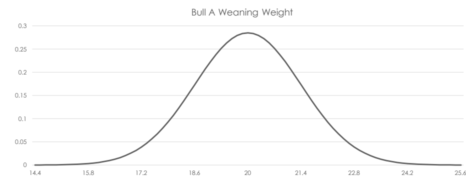
Bell Curve Example 2



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Example

- Trying to select for a higher growth bull with good WW and YW
- Bull A's calves are expected to be 2.5 lbs lighter at birth than Bull B's calves
- Bull A's calves are expected to be 7 lbs heavier at weaning than Bull B's calves
- Bull A's calves are expected to be 5 lbs heavier at yearling than Bull B's calves

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Across Breed EPD

- Calculated by US Meat Animal Research Center yearly
- Every breed has different EPDs and different averages
- These adjustment factors allow producers to compare sires from different breeds when bred to similar cows of another breed

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Across Breed EPD Comparisons

Breed	Birth Wt	Weaning Wt	Yearling Wt	Milk	Marbling Score	Ribeye Area	Fat Thickness	Carcass Wt
Angus	0	0	0	0	0	0	0	0
Hereford	0.8	-14.4	-39.3	-10.6	-0.31	0.01	-0.068	-68.3
Red Angus	2.2	-17.9	-24.8	1.4	-0.09	0.24	-0.035	-10
Shorthorn	3.8	-24.2	-38.6	0.5	-0.13	0.27	-0.04	-10.9
South Devon	3.5	-37.5	-63.4	10.6	-0.07	0.28	-0.068	-17.9
Beefmaster	3.4	26.8	7.4	6.1				
Brahman	9	57.6	15.5	14.9	-0.68	0.09	-0.154	-38.7
Brangus	2.7	20.9	11.6	17.8				
Santa Gertrudis	4.8	40.4	37.2	20.4	-0.45	0.18	-0.071	-5
Braunvieh	3.4	-23.1	-48	25.6	-0.15	0.9	-0.038	-23.3
Charolais	6.4	6.4	-22.7	-1.4	-0.33	0.76	-0.188	6.9
Chiangus	2.3	-22.5	-41.3	6.4	-0.42	0.52	-0.108	-23.7
Gelbvieh	3.3	-10	-20	7.1	-0.57	0.73	-0.116	-20
Limousin	1.8	-9.3	-32.1	-2.7	-0.29	0.63	-0.067	-11
Maine Anjou	1.9	-27.3	-55.5	-7	-0.51	0.92	-0.166	-38
Salers	2	-17.6	-30	10.8	-0.19	0.47	-0.078	-20.6
Simmental	1.8	-13.3	-24.3	-0.6	-0.16	0.45	-0.056	-4.5
Tarentaise	2.4	28	-5.6	13.3				

US Meat Animal Research Center

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Example of Across Breed EPD Comparison to Achieve Breeding Goals

- You want to increase WW in your herd of commercial Angus cows and are choosing between a Charolais and a Simmental bull.
  - Charolais WW- 60 lbs + 6.4 = 66.4
  - Simmental WW- 60 lbs + 1.8 = 61.8
- The calves of the Charolais sire are expected to be 4.6 lbs heavier at weaning on average

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Indexes

- Use economically relevant traits to develop economic indexes for breeding objectives.
- Very robust
- Breeds have developed indexes for many breeding objectives
- Help to avoid Single Trait Selection

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Using an Index

- Determine breeding objectives and use the correct index to achieve that objective
- If you are marketing all calves and not retaining females use a terminal type index
- If you are making females use a maternal type index

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Future of EPDs and Indexes

- More EPDs will be available through the ability to measure more novel traits
- Indexes will become more and more personalized

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Final Thoughts and Implications

- EPDs are the best tool available to make genetic progress
- Make sure the EPDs you select for help with breeding objectives
- Avoid Single Trait Selection

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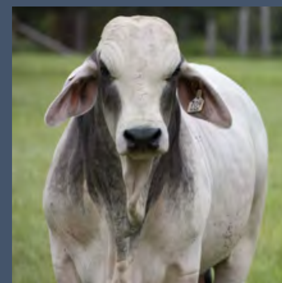
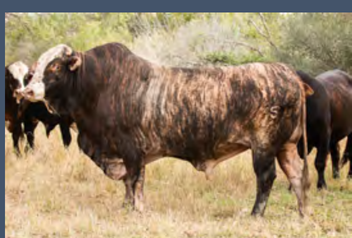
Genomic Selection: A Cattleman's Guide

Selection is Easy!




Selection is Easy!




Selection is Easy! Or is it?


What is the price of being wrong?

Unrealized production (Fewer/lighter/ lower quality calves)

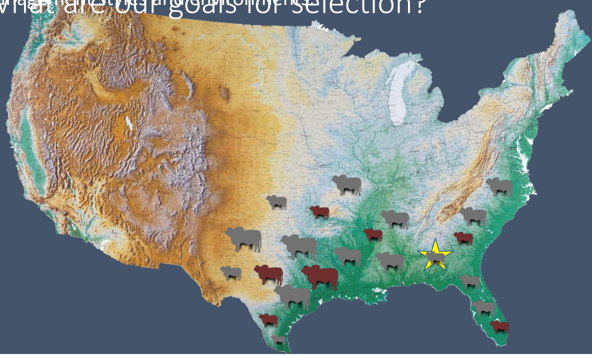
No Production at all (no calves weaned)

Selective breeding pays!

More than acting as insurance, we increase genetic gain. When we are able to reach our production goals faster, economic sustainability of the operation is maximized.

What are our goals for selection?

To identify animals with superior genetic potential across an array of management styles and environments



How can we track our progress?

$$\Delta G/year = \frac{r_{BV,\hat{BV}}\, i\sigma_{BV}}{L}$$

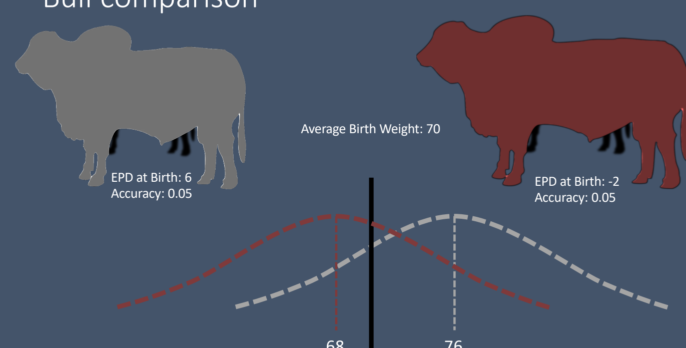
- Breeder's Equation
- One of the main components is accuracy. How well do our estimated metrics relate to actual genetic merit?
- What is our estimated metric in animal breeding? EPDs!

EPDs, A Review

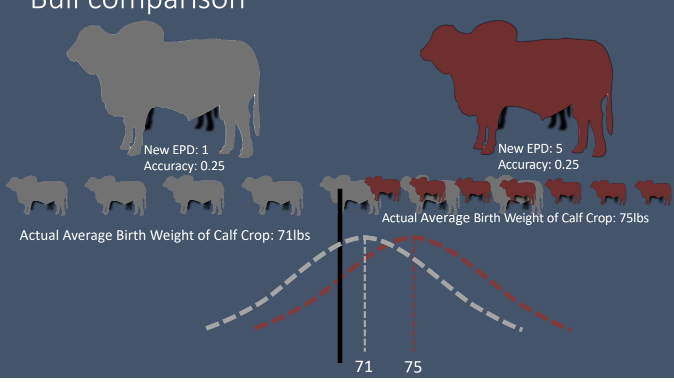
Phenotype = Genotype + Environment

- In the context of animal breeding,
  - Individual Performance = Genetic Makeup + Life Story
  - Through the use of statistical comparisons, we can remove the effect of that animal's life story, leaving us with individual performance based on genetics alone.

Bull comparison



Bull comparison



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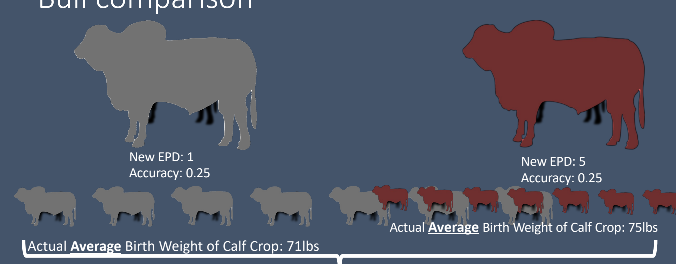
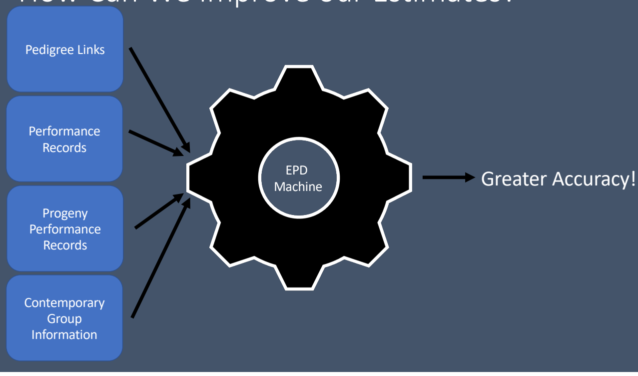


EPD's are a statistical **estimate** of an animal's **potential**

How Can We Improve our Estimates?

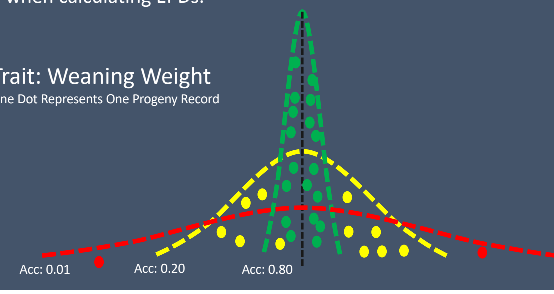


All EPDs are not created equal

- We have seen that having more data translates into greater accuracy when calculating EPDs.

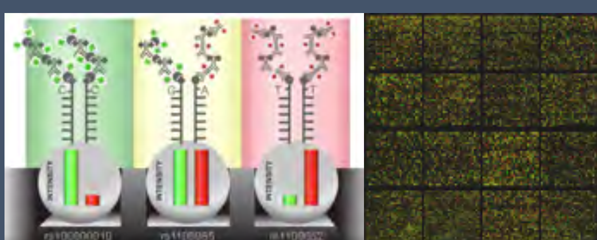
Trait: Weaning Weight

One Dot Represents One Progeny Record



Genomics has the solutions!

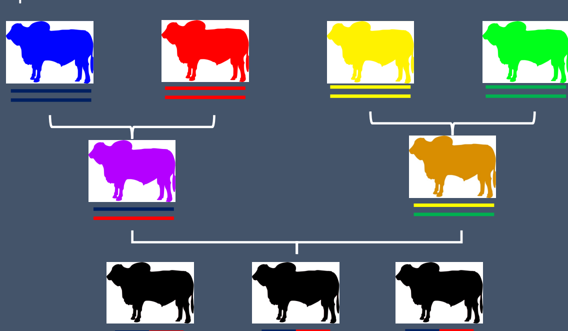
- Direct observation of the underlying genetics allows us to resolve these issues!



Problem 1: Pedigree Relatedness

- Relatedness isn't exact! Some of those animals aren't even related!
- Problem 1: The traditional method of EPD estimation relies on average relatedness between individuals. When relatedness differs, accuracy suffers

Expectation:

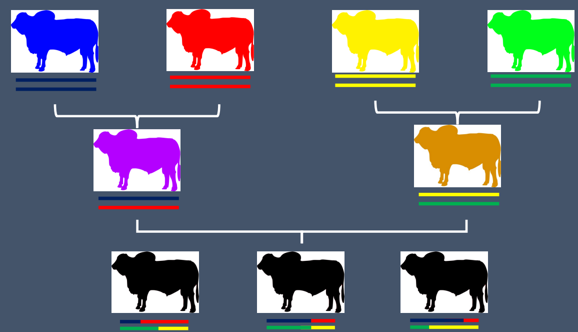


Pedigree Relationship Matrix (A)

	Paternal Grandsire	Paternal Granddam	Maternal Grandsire	Maternal Granddam	Sire	Dam	Animal
Paternal Grandsire	1	0	0	0	0.5	0	0.25
Paternal Granddam	0	1	0	0	0.5	0	0.25
Maternal Grandsire	0	0	1	0	0	0.5	0.25
Maternal Granddam	0	0	0	1	0	0.5	0.25
Sire	0.5	0.5	0	0	1	0	0.5
Dam	0	0	0.5	0.5	0	1	0.5
Animal	0.25	0.25	0.25	0.25	0.5	0.5	1

Our Pedigree Relationship Expectations

Reality:



Genomic Relationship Matrix (G)

	Paternal Grandsire	Paternal Granddam	Maternal Grandsire	Maternal Granddam	Sire	Dam	Animal
Paternal Grandsire	1	0	0.17	0	0.57	0	0.20
Paternal Granddam	0	1	0	0	0.57	0	0.30
Maternal Grandsire	0.17	0	1	0	0	0.55	0.33
Maternal Granddam	0	0	0	1	0	0.51	0.17
Sire	0.57	0.57	0	0	1	0.11	0.5
Dam	0	0	0.55	0.51	0.11	1	0.5
Animal	0.20	0.30	0.33	0.17	0.5	0.5	1.07

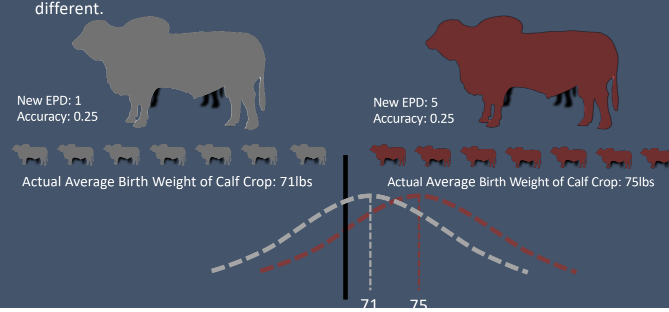
Realized Genomic Relationships

Genomics to the Rescue!

- Utilizing genomic technology allows us to directly account for differences in relatedness by observing how much genetic material is present from each ancestor.

Bull comparison

Problem 2: Through the force of random chance (Mendelian Sampling), even when everything externally between two siblings is equal, the genetic makeup will be different.



Problem 2: Random Chance

- Genetics is random!
- How many have a sibling? How many are not twins but look identical to their siblings?
- Mendelian sampling, or the randomness associated with genetic inheritance, accounts for over 50% of genetic variation in complex traits!

Genomics increases EPD accuracy in unproven animals

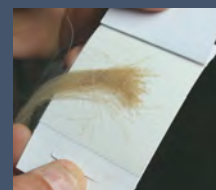
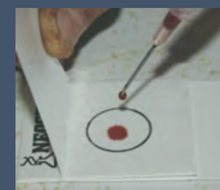
- Genomic testing unlocks new opportunities for selection!
  - Complex traits
    - Fertility, Immune Function
  - Phenotypes taken after harvest or impossible to measure
    - Carcass measurements, Sire milking ability/Female scrotal circumference
  - Hard to measure phenotypes
    - Feed efficiency, GHG emissions

Genomics gives us a jump start on unproven animals

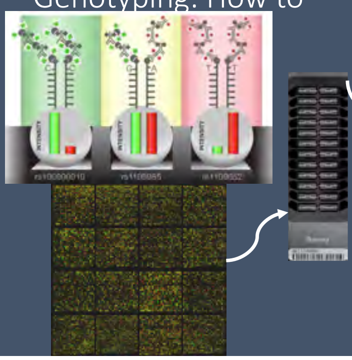
- Progeny Equivalents

Genomics: How?

- DNA Sampling/extraction
  - Blood or hair card
  - TSU

Genotyping: How to



	Paternal Grandsire	Paternal Granddam	Maternal Grandsire	Maternal Granddam	Sire	Dam	Animal
Paternal Grandsire	1	0	0.17	0	0.57	0	0.20
Paternal Granddam	0	1	0	0	0.57	0	0.30
Maternal Grandsire	0.17	0	1	0	0	0.55	0.33
Maternal Granddam	0	0	0	1	0	0.51	0.17
Sire	0.57	0.57	0	0	1	0.11	0.5
Dam	0	0	0.55	0.51	0.11	1	0.5
Animal	0.20	0.30	0.33	0.17	0.5	0.5	1.07

EPD Comparison: Traditional vs Genomic enhance

Pedigree EPDs

$$\begin{pmatrix} X'X & X'Z \\ Z'X & Z'Z + A^{-1}\lambda_G \end{pmatrix} \begin{pmatrix} \hat{\beta} \\ \hat{u} \end{pmatrix} = \begin{pmatrix} X'y \\ Z'y \end{pmatrix}$$

Genomic EPDs

$$\begin{pmatrix} X'X & X'Z \\ Z'X & Z'Z + G^{-1}\lambda_G \end{pmatrix} \begin{pmatrix} \hat{\beta} \\ \hat{u} \end{pmatrix} = \begin{pmatrix} X'y \\ Z'y \end{pmatrix}$$

Marker Effects Models

0.2 0.5 0 -0.1 0.2 0 1.2 0.3 -0.9 -0.6 1.1

B A A B B A A B A B B

$\boxed{1.2 \quad 0 \quad 0 \quad -0.2 \quad 0.6 \quad 0 \quad 2.8 \quad 0.3 \quad -0.1 \quad -0.8 \quad 2.4}$ 6.2

A B B B A A A A B B A

1.0 -0.5 0 -0.1 0.4 0 1.6 0 0.8 -0.2 1.3

B A A A A B B B A B B

4

A B B B A A B A B B A

Dollar values

- Value of genetics, accuracy of selection

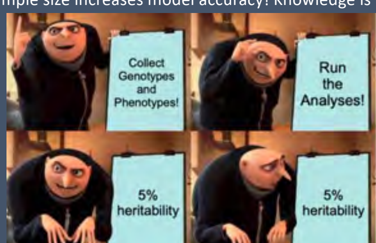
Genomic Testing: Who?

- Logos from genomics labs and who they're for
  - Seedstock down to igenity

How can we increase power of research?

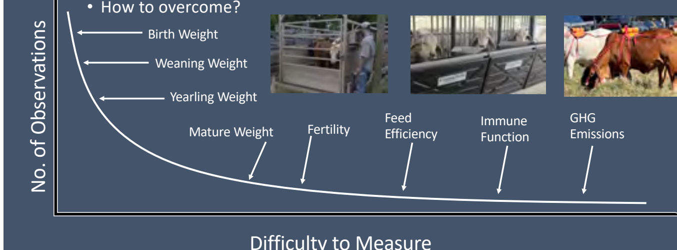
- More phenotypes!
  "In the age of genotyping, phenotype is king!" – mike coffey, SRUC

- Genotype is largely meaningless without a production trait to tie it to.
  - Increasing sample size increases model accuracy! Knowledge is power!



Phenotyping paradox

- The more expensive/hard to measure, the less observations we'll see.
  - Humans want to count, we aren't so good at describing things in the gray area
  - How to overcome?



Can we squeeze more information from genetics?

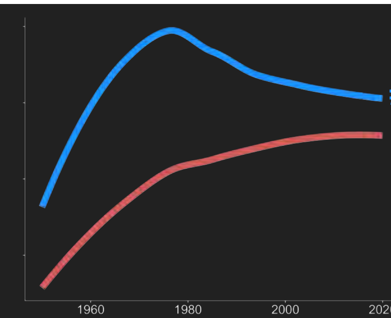
- Sequencing/low pass and imputation
  - Gwas with varying number of markers/animals
  - Mention research programs

How can we keep getting better?

- Variant discovery
- Function research
  - Transcripts/single cell/etc

Tools for breeding a more efficient and sustainable cow

Troy Rowan
University of Tennessee - Animal Science
Texas A&M Beef Cattle Short Course
August 8, 2023



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Sustainable, plant-based protein

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The traits that drive sustainability are (almost all of) the same traits that drive profitability

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Grass units vs. Cow units

Forage resources

Weaned calf lbs. or Feedlot/carcass performance

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Grass units vs. Cow units

Number of cows

Weaned calf lbs. or Feedlot/carcass performance

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Mature Cow Size: Same forage, more cows

Table 1. Grazing costs and excretion values with varying mature cow size.

Cow Weight, lbs	1,000		1,250		1,500	
	Individual	Total Herd	Individual	Total Herd	Individual	Total Herd
Daily DMI, lb	22.34	3,017	26.41	3,037	30.29	3,029
Annual DMI, lb	8,154	1,100,790	9,640	1,108,600	11,056	1,105,600
Relative cow #'s	1	135	1	115	1	100
Forage cost, $/cow	$220.16	$29,721.60	$260.28	$29,932.20	$298.51	$29,851.20
Manure Output, lb/yr	3,419	461,565	4,082	469,430	4,713	471,300
Nitrogen excretion, lb/yr	88.2	11,907	104.4	12,006	119.6	11,960
Methane Emissions, lb/yr	167.2	22,572	198.7	22,851	230.8	23,080

Lalman et al. 2018

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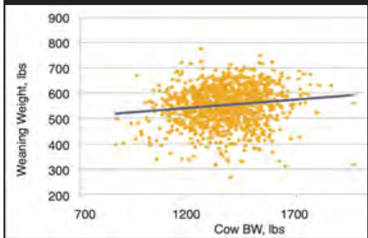
Mature Cow Size



Lalman et al. 2018

100 pound heavier cow = $6-$30 additional revenue from calves

100 pound heavier cow = $42 additional costs for maintenance

THESE NUMBERS ARE INDEPENDENT OF STOCKING RATE!

Developing heifers is EXPENSIVE!

Cow-longevity **is the most important component of efficiency, sustainability, and profitability!**

BUT… Mature cow size doesn't tell the full story

Long-lived cows are the cornerstones of a commercial herd!

		Year							
		1	2	3	4	5	6	7	8
Variable Cost per Female	$450	$-1220	-883	-546	-209	128	465	802	1139
	$550	$-1320	-1083	-846	-609	-372	-135	102	339
	$650	$-1420	-1283	-1146	-1009	-872	-735	-598	-461

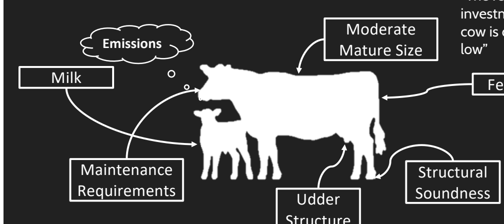
- Females the last 10 years average $770/hd (initial cost)
- Average revenue for a calf was $1.48/lb ($787.05/hd)

Boyer et al. 2020

UT Center of Farm Management THE UNIVERSITY OF TENNESSEE

What does a profitable or sustainable cow look like?
An EFFICIENT Cow!

"The return on investment of an open cow is depressingly low"



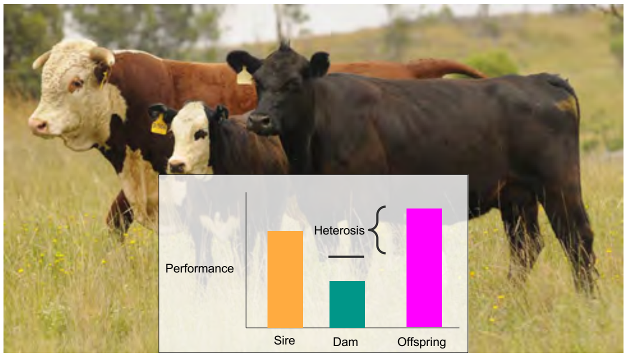
Two-fold advantage of crossbreeding

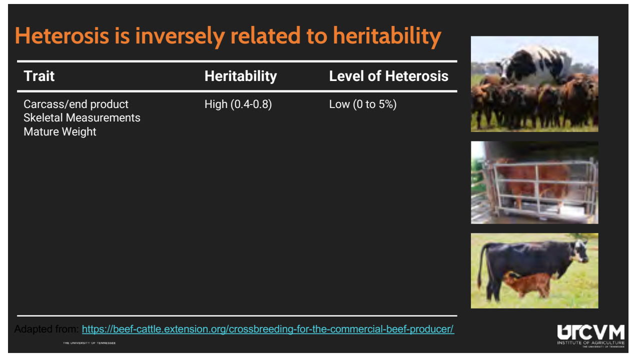
1) Breed complementarity
   - Align multiple breed strengths
   - e.g. Charolais lean growth, Red Angus fertility, etc.
   - *Bos indicus* environmental adaptation

1) Heterosis
   - Superior performance of crossbred offspring compared with parent-average
   - Complex mechanism, clear results

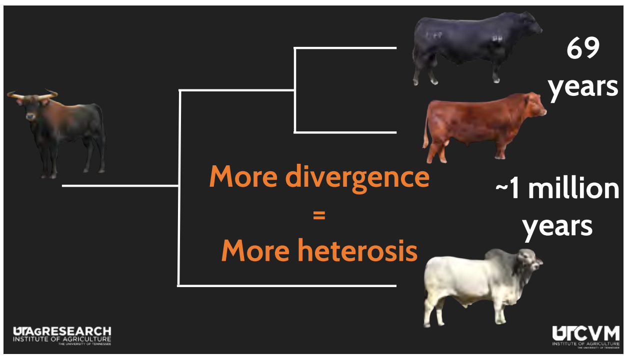
The easiest way to improve cow efficiency traits:

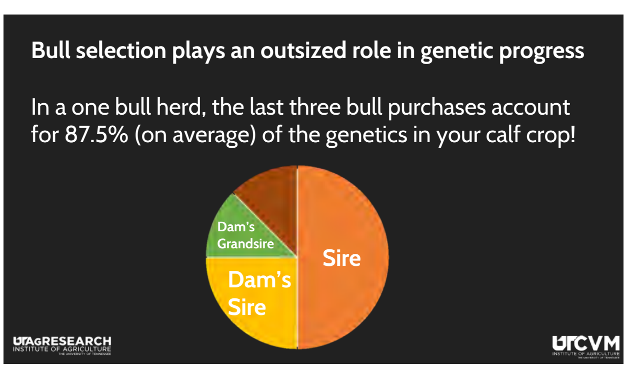
CROSSBREED!

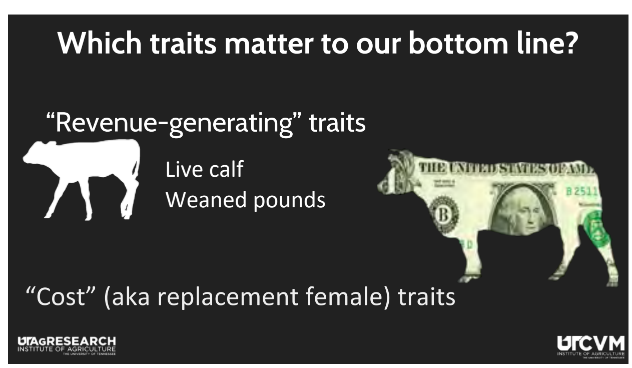


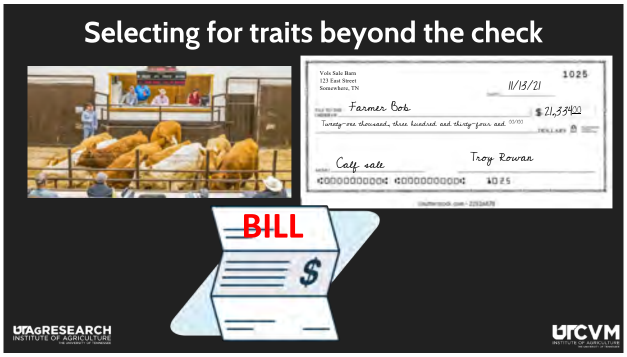


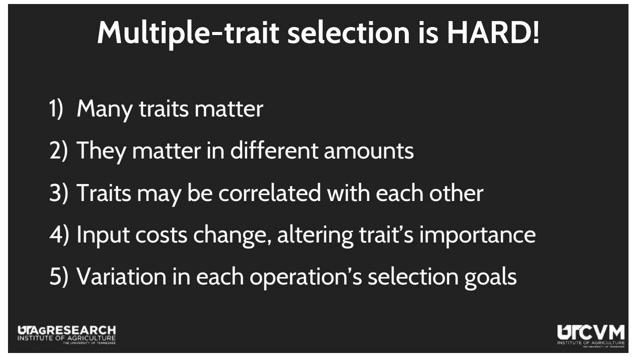
Trait	Heritability	Level of Heterosis
Carcass/end product Skeletal Measurements Mature Weight	High (0.4-0.8)	Low (0 to 5%)








Selecting for traits beyond the check
Farmer Bob
Calf sale
Troy Rowan
BILL
$
UTAGRESEARCH
UTCVM


Multiple-trait selection is HARD!
1) Many traits matter
2) They matter in different amounts
3) Traits may be correlated with each other
4) Input costs change, altering trait's importance
5) Variation in each operation's selection goals
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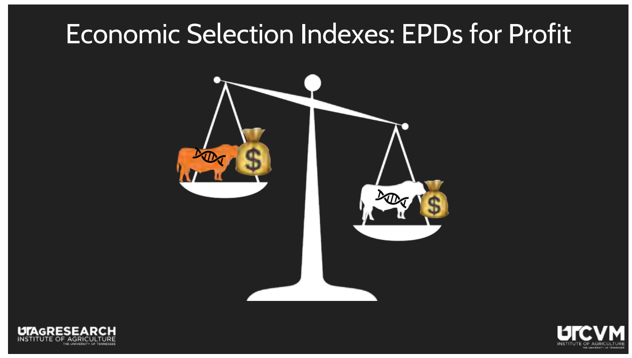
UTCVM


Economic Selection Indexes: EPDs for Profit
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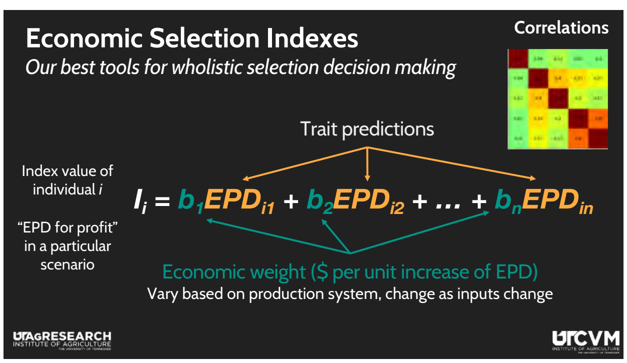
Economic Selection Indexes
Our best tools for wholistic selection decision making
Correlations
Trait predictions
Index value of individual i
"EPD for profit" in a particular scenario
$I_i = b_1EPD_{i1} + b_2EPD_{i2} + \dots + b_nEPD_{in}$
Economic weight ($ per unit increase of EPD)
Vary based on production system, change as inputs change
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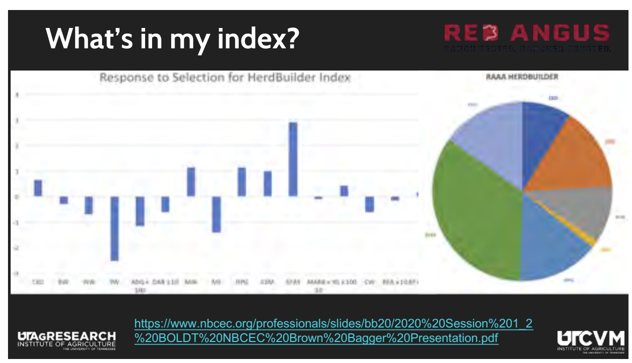
What's in my index?
RED ANGUS
Response to Selection for HerdBuilder Index
https://www.nbcec.org/professionals/slides/bb20/2020%20Session%201_2%20BOLDT%20NBCEC%20Brown%20Bagger%20Presentation.pdf
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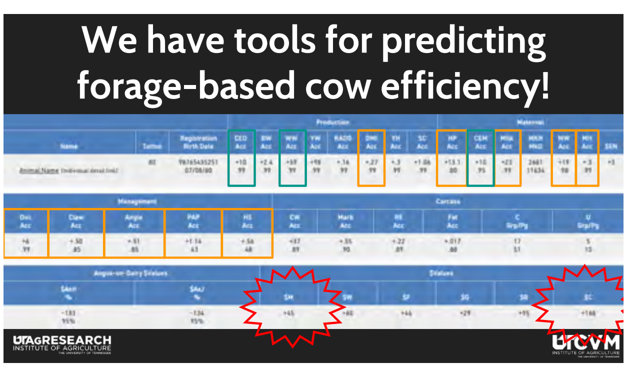
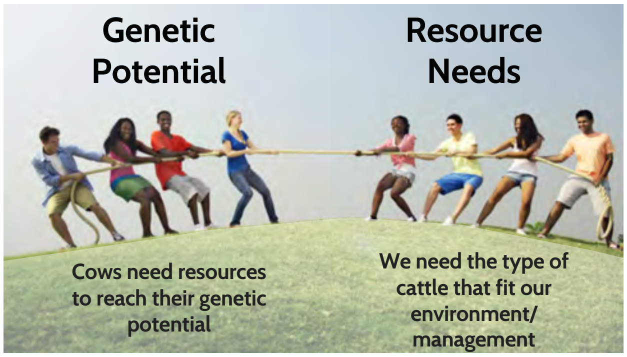
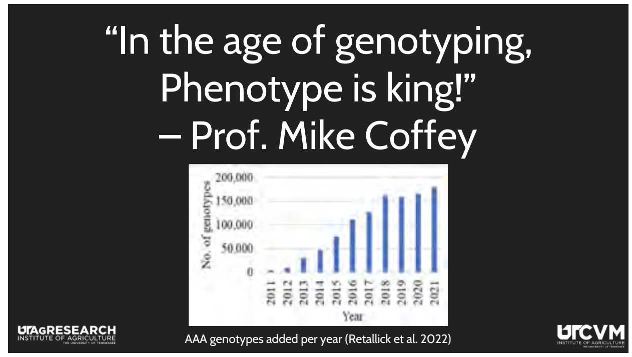
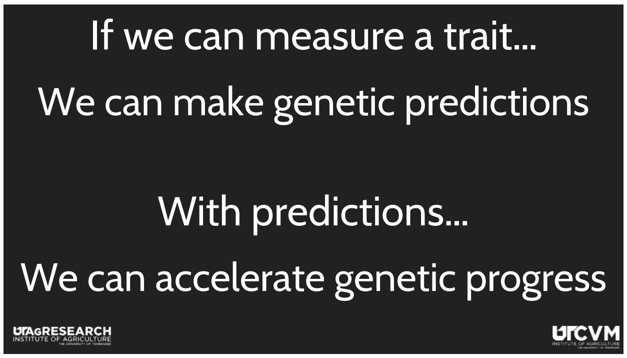

We have tools for predicting forage-based cow efficiency!
UTAGRESEARCH
UTCVM


What's in my index?
AGI
$B
COMMERCIAL HERD
KEEPING REPLACEMENT FEMALES
UTAGRESEARCH
UTCVM


Genetic Potential
Resource Needs
Cows need resources to reach their genetic potential
We need the type of cattle that fit our environment/ management

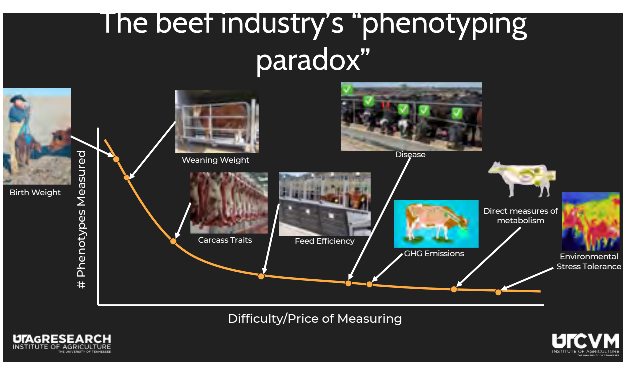

“In the age of genotyping, Phenotype is king!”
– Prof. Mike Coffey
No. of genotypes
200,000
150,000
100,000
50,000
0
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Year
AAA genotypes added per year (Retallick et al. 2022)

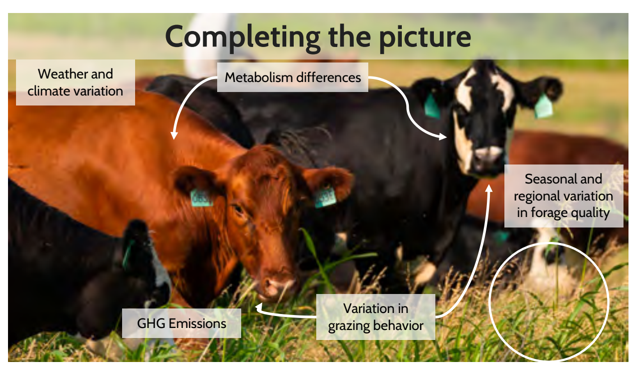

If we can measure a trait…
We can make genetic predictions
With predictions…
We can accelerate genetic progress

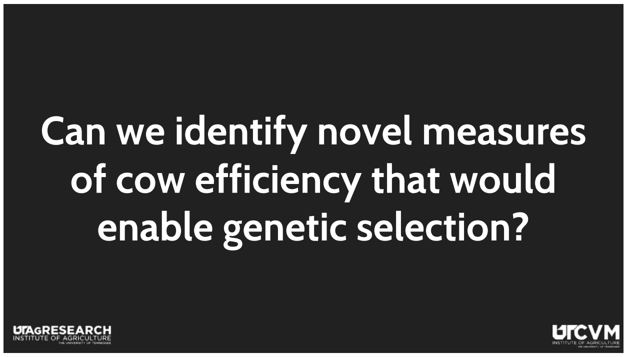

How do we quantify efficiency here?


Or here?


Identify animals adapted to our environment
Measure forage-based cow efficiency

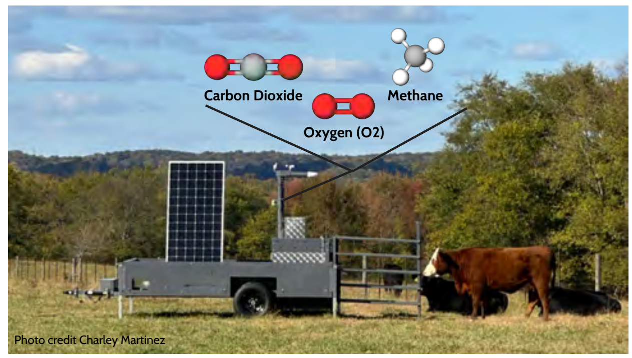

The beef industry’s “phenotyping paradox”
Birth Weight
Weaning Weight
Disease
Carcass Traits
Feed Efficiency
GHG Emissions
Direct measures of metabolism
Environmental Stress Tolerance
Phenotypes Measured
Difficulty/Price of Measuring

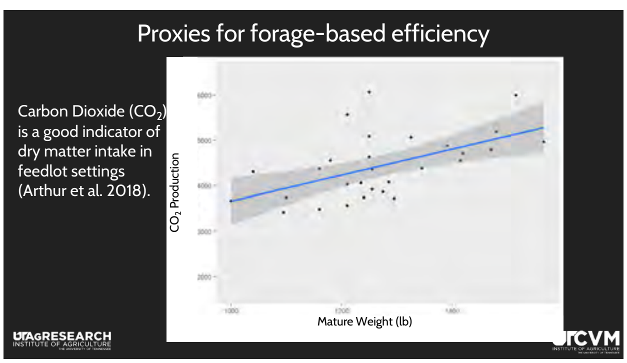

Completing the picture
Weather and climate variation
Metabolism differences
Seasonal and regional variation in forage quality
GHG Emissions
Variation in grazing behavior

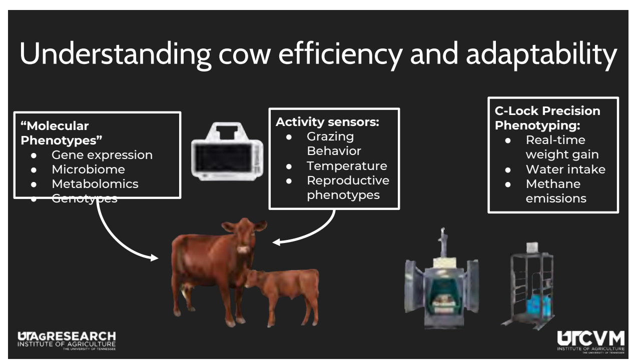

Can we identify novel measures of cow efficiency that would enable genetic selection?

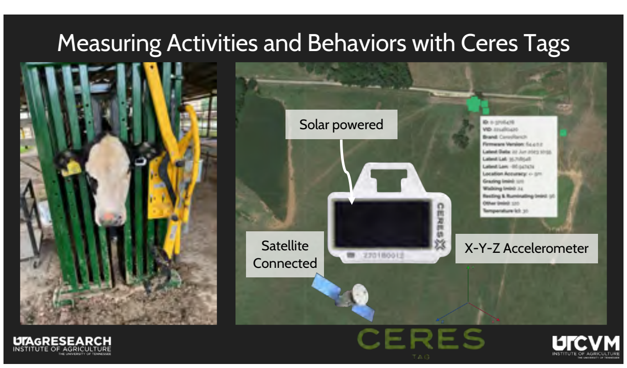

C-Lock GreenFeed Pasture

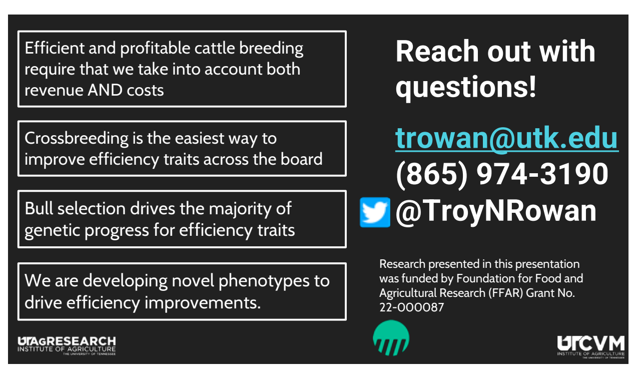

Precision Livestock Technologies
UT PLF


Carbon Dioxide
Methane
Oxygen (O2)
Photo credit Charley Martinez


Proxies for forage-based efficiency
Carbon Dioxide (CO_2) is a good indicator of dry matter intake in feedlot settings (Arthur et al. 2018).
CO_2 Production
Mature Weight (lb)


Understanding cow efficiency and adaptability
"Molecular Phenotypes"
• Gene expression
• Microbiome
• Metabolomics
• Genotypes
Activity sensors:
• Grazing Behavior
• Temperature
• Reproductive phenotypes
C-Lock Precision Phenotyping:
• Real-time weight gain
• Water intake
• Methane emissions


Measuring Activities and Behaviors with Ceres Tags
Solar powered
Satellite Connected
X-Y-Z Accelerometer
CERES


Efficient and profitable cattle breeding require that we take into account both revenue AND costs
Crossbreeding is the easiest way to improve efficiency traits across the board
Bull selection drives the majority of genetic progress for efficiency traits
We are developing novel phenotypes to drive efficiency improvements.
Reach out with questions!
trowan@utk.edu
(865) 974-3190
@TroyNRowan
Research presented in this presentation was funded by Foundation for Food and Agricultural Research (FFAR) Grant No. 22-000087

New Traits for Environmental Resilience

Jared E. Decker
Wurdack Chair of Animal Genomics
University of Missouri

Cattle ranchers will need to produce beef for society more sustainably. Sustainability is described as improved profitability, environmental stewardship, and meeting societal expectations for beef production. From a genetics standpoint, profitability and environmental impact are often intertwined. Anything that improves the efficiency of beef production, especially at the cow-calf sector, increases the profitability and decreases the environmental impact.

Cattle are likely losing genetic adaptation providing resilience to environmental stress. This is no fault of farmers and ranchers, but it does reflect a lack of tools to select for environmental adaptation and resilience. New genetic predictions (EPDs) are being developed so that beef producers can proactively select for resilience to environmental stress.

Hair Shedding

Hair shedding is when cattle replace their winter coat with a summer coat. Hair shedding scoring is a simple to collect trait. Hair shedding scoring is a 5 to 1 scoring system, with a score of 5 denoting 0% of winter hair shed off, a score of 4 being approximately 25% shed off, a score of 3 being 50% shed off, a score of 2 being 75% shed off, and a score of 1 being complete shedding of winter hair. Cattle tend to shed from head to tail and from top to bottom.

Hair shedding and hair coat are different traits. Hair coat scores reflect how long and rough versus how short and smooth a hair coat is. Hair shedding is how rapidly the hair is shed at the transition from winter to summer.

Hair shedding is a moderately heritable trait, with heritability estimates from 0.35 to 0.45. However, the repeatability of hair shedding scores from year to year are only slightly higher than the heritability estimates. Thus, from year to year, a single hair shedding score reflects the current management, age, and nutrition of the animal. Thus, beyond genetic prediction, hair shedding may be a valuable data point for management decisions. Further, each individual hair shedding record helps us better estimate the genetic potential of that animal and its progeny. The ease of recording hair shedding, the repeated nature of the trait, and the moderate heritability make it easy for breed associations to create genetic predictions for hair shedding.

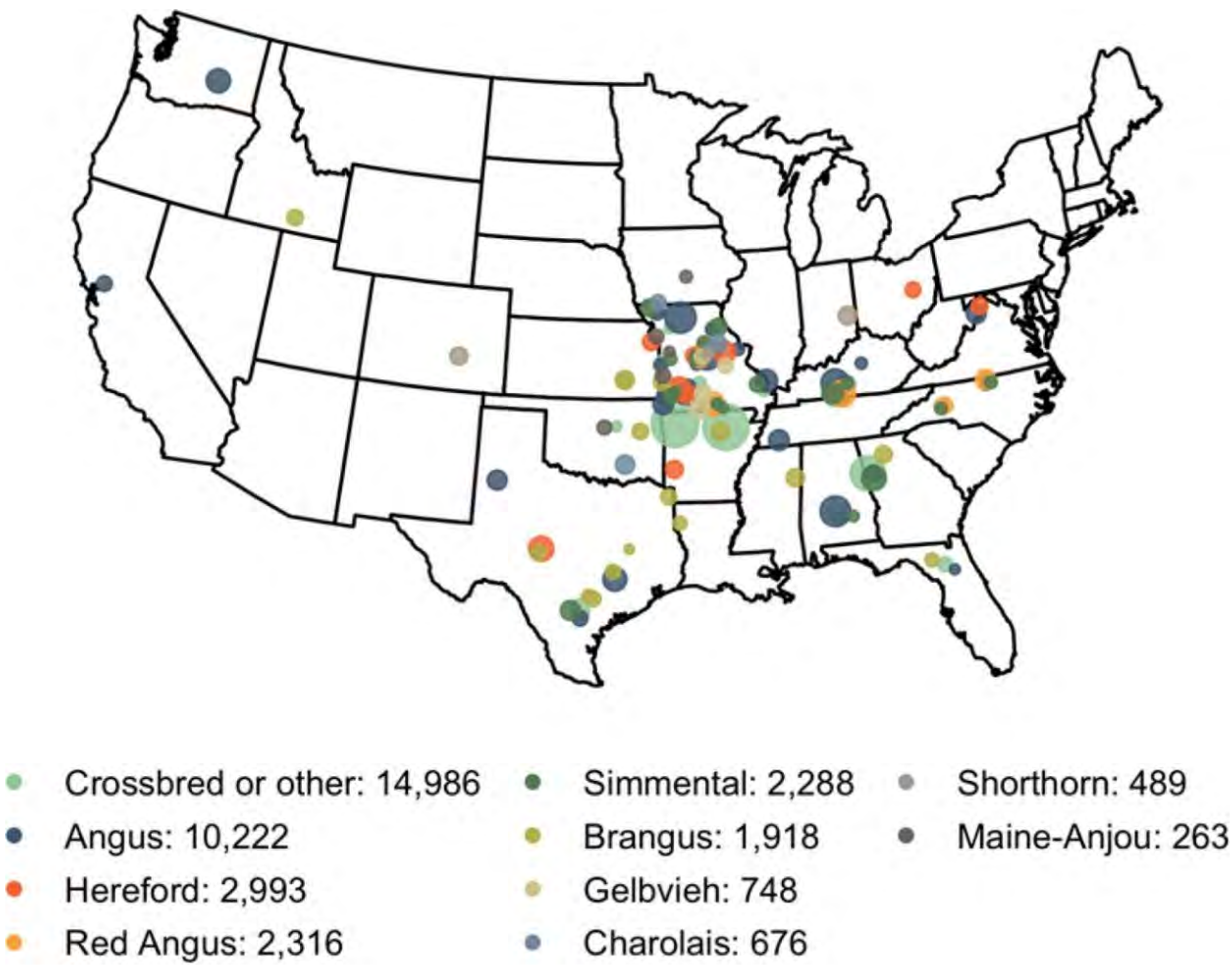
Hair shedding EPD (Expected Progeny Difference) is a genetic prediction currently published for American Angus Association cattle to assess the genetic potential of animals for hair shedding. In the case of Angus cattle, hair shedding EPD predicts the genetic merit of an animal's progeny regarding their ability to shed their winter hair coat. This trait is important because cattle with better hair shedding abilities are more efficient in adapting to warmer environments and have reduced heat stress, resulting in improved productivity and overall well-being.

The hair shedding EPD is expressed in numerical values, reported in units of 1 point hair shedding scores. A smaller EPD indicates that an animal is more likely to produce offspring with improved hair shedding abilities compared to the breed average. Conversely, a larger EPD suggests that the animal's progeny may have poorer hair shedding abilities.

To calculate hair shedding EPD, pedigree information, phenotypic data, and contemporary group information from thousands of animals are analyzed using advanced statistical models. The EPD values are generated based on the heritability of the trait, the performance of the individual animal, and the performance of its relatives.

Breeders can use hair shedding EPD to make informed decisions when selecting animals for breeding. By choosing animals with lower hair shedding EPDs, breeders can improve the hair shedding abilities of their Angus herd, leading to more heat-tolerant and adaptable cattle.

The University of Missouri, through USDA NIFA funding, has publicly released a dataset of approximately 12,000 cattle with 38,000 hair shedding scores. The following breeds are represented in the dataset: Angus, Hereford, Red Angus, Simmental, Brangus, Gelbvieh, Charolais, Shorthorn, and Maine-Anjou. These data allow genetic prediction service providers and breed associations to rapidly create EPDs for these breeds.



See Durbin et al. 2022 for more information. https://doi.org/10.1101/2022.12.14.520472

August 8, 2023
TAMU Beef Cattle Short Course

Genetics of meat quality in *Bos indicus*-influenced cattle

UF IFAS UNIVERSITY of FLORIDA

Raluca Mateescu |
Professor, Animal Genomics

Department of Animal Sciences
UF UNIVERSITY of FLORIDA
@RalucaUF https://www.ralucamateescu.com

1

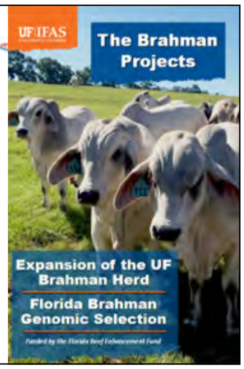
Carcass and Meat Quality

FL Brahman Genomic Selection

- Started in 2018
- **Goal:** improve 3 target traits
  - Tenderness
  - Marbling
  - Reproductive Tract Score

- **Medium/high heritability** ~ 0.3 - 0.6 (tenderness, marbling)
- **Variation** among animal genomic EBV

→ Selection - tangible genetic progress



2

Marbling & Tenderness

Top priority for Beef Industry

- Great power to influence **demand**
- Can be improved

Very important for Brahman crosses

- Routinely penalized for relatively lower **marbling** score.
- Routinely penalized for perceived inadequate **tenderness**

3

Meat Quality

USDA grading system	Genomic Tests
Based on marbling and maturity	Developed on *B. Taurus* data
Limited in predicting eating quality	Limited prediction *B. Indicus* - influenced
Tenderness	Need to be breed specific

4

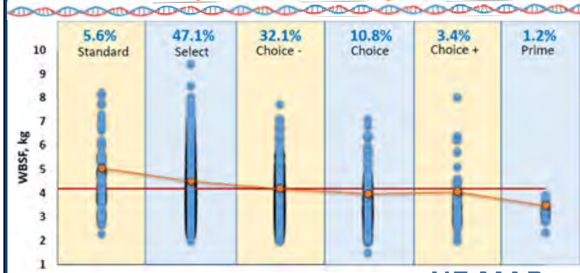
Tenderness by USDA Quality Grade

Breed Group	Angus %	Brahman %
1	100	0
2	75	25
3	62.5	37.5
4	50	50
5	25	75
6	0	100

UF MAB
(N = 1,366)

5

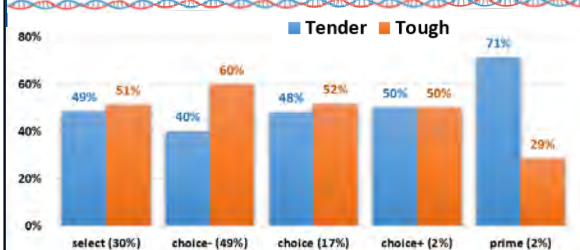
Tenderness by USDA Quality Grade



UF MAB
(N = 1,366)

6

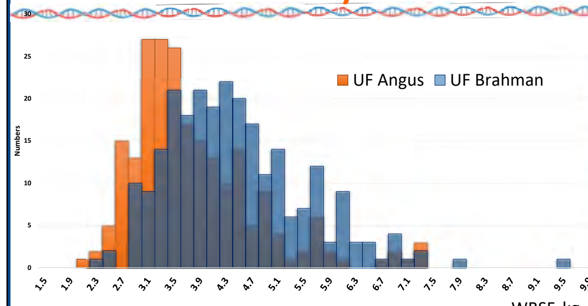
Tender/tough % within quality grade



UF MAB
(N = 1,366)

7

Variation in WBSF – by breed



8

Genetic tests
Tenderness

9

Genomics Tests

SNP – genetic marker

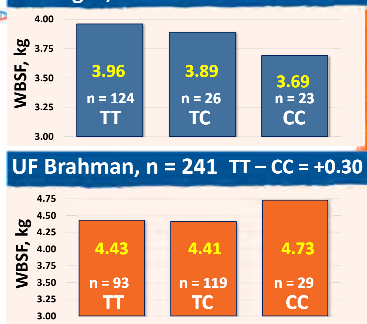
..GACG**C**CGTGG..
..GACG**T**CGTGG..

C C | C T | T T

3 possible genotypes

UF Angus, n = 153 TT – CC = -0.27

UF Brahman, n = 241 TT – CC = +0.30



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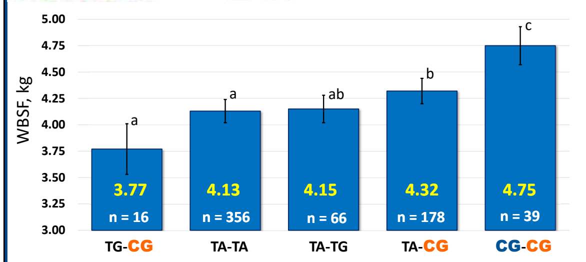
Combination of markers in calpastatin



11

Population specific tests

- Current marker panels (genetic tests) are likely to work best in the populations where discovery occurred
- Predictive power decreases as the target population becomes more genetically distant

Discovery	Target	
Angus	Angus	**Closest** relationship
Angus	Charolais	⬇
Angus	Brahman	**Most distant** relationship

- **Usefulness of genetic markers for selection is mostly limited to the breed used for their discovery and validation**
- **Breed-specific markers used in a different breed or crossbred pop. ~ 0% accuracy**

12

Genomic
Selection

13

Potential Benefits of Genomic Selection

Which traits?

Benefits - **greatest** for economically important traits that:

- Are **difficult** or **expensive** to measure
- Measured **late** in life or after death
- Have **lower heritability**
- Not currently selected for because are **not routinely measured**

Benefits

- Determine the value of animal **at birth**
- Increase **accuracy** of selection
- Reduce **generation interval**
- Increase selection **intensity**
- Increase **rate of genetic gain**

14

Incorporation of genomic information

For traits with routine genetic evaluations obtained from phenotypic and pedigree information: enhanced accuracy of genetic evaluations

Pedigree estimated EPDs, no ultrasound data

Old	WT	MARB	REA	BF
EPD	I +15	I +.79	I +.41	I -0.001
Acc	.05	.05	.05	.05

Genomics added

New	WT	MARB	REA	BF
EPD	+18	+.71	+.50	+0.004
Acc	.30	.38	.35	.28

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Opportunities

Genomic Selection

Can result in a **30%** improvement in **accuracy** compared to parental average breeding values

Current Accuracies

Extremely **low** – especially for **young** and unproven **males**.

EBV accuracy	Genomic EBV accuracy
0	0.20

~ **4 progeny** for a **highly** heritable trait (**carcass**)

~ **7 progeny** for a **moderately** heritable trait (**growth**)

16

Opportunities

Genomic Selection

Can result in a **30%** improvement in **accuracy** compared to parental average breeding values

Current Accuracies

Extremely **low** – especially for **young** and unproven **males**.

For this program to succeed and ensure genetic improvement for tenderness and marbling, it is imperative to increase the number of animals with these traits recorded in our database.

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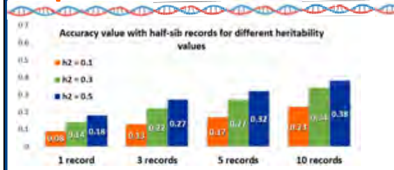
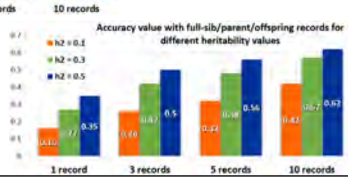
Impact of number of records



Accuracy

- Heritability
- No. records
- Genetic relationship



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Take-home points

- Usefulness of genetic markers for selection is mostly limited to the breed used for their discovery and validation
  - Breed-specific markers used in a different breed or crossbred pop. – close to % accuracy
- Enhanced accuracy of genomic evaluation: more pronounced in **young** animals with no recorded progeny – high value for selection of replacement animals.
- The increase in **accuracy** will depend on:
  - Available records on relatives
  - Heritability of the trait
  - Proportion of variation accounted for by the test

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Acknowledgements

Financial Support

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NEOGEN

Florida CATTLEMEN'S ASSOCIATION

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Strategic Use of Crossbreeding to Exploit Heterosis

T.A. Thrift
Department of Animal Science
University of Florida

Is Crossbreeding to Blame?

Too many breeds?

Is crossbreeding the problem?

Or is it inappropriate use of breed diversity?

Have we always been upfront about strengths and weaknesses of breeds?

We wholesale promoted crossbreeding in the 1970's-1990's without regard to the system or breeds used in each system

Why has crossbreeding has failed to have universal adoption in the beef industry?

1. Single trait selection focusing on "bigger is better"
2. Measuring outputs is easier than measuring inputs
3. "Purebreds are better/more uniform"-Historical resistance to crossbreeding from some purebred producers and breed associations
4. Solid color (black) calves bring more money
5. Heterosis is very difficult to visualize and even more difficult to measure

modified from Daley 2009

Why has crossbreeding has failed to have universal adoption in the beef industry?

6. Crossbreeding systems are complex
7. We often modify the environment in order to "get heavier calves or a higher calf crop percentage"
8. Inappropriate use of breed diversity
9. Crossbreeding research was done predominantly in the 1950-1980's
10. Crossbreeding research is EXPENSIVE and long term

modified from Daley 2009

Benefits of Crossbreeding

Hybrid vigor/Heterosis

Breed complementarity

Rapid incorporation of desirable genes

Crossbreeding is the most rapid means of meeting changes in market demand.

What is Heterosis?

The difference in performance between crossbreds and the AVERAGE of their parental breeds.

The opposite of inbreeding depression.

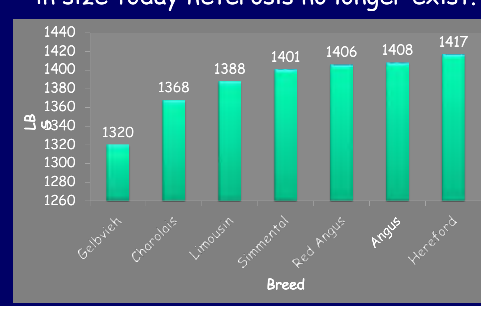
Highest when breeds are more biologically diverse.

What is Heterosis?

By-Product Heterosis

Does Heterosis Still Exist?

It has been suggested since many breeds are similar in size today heterosis no longer exist.



Does Heterosis Still Exist?

Breed complementarity would be reduced as a result of breeds being similar in size but heterosis should not be reduced!

Hybrid Vigor-Are We Ignoring the Facts?

- Is highest in factors affecting efficiency of cows
  - Fertility
  - Calf survival
  - Longevity
- Is intermediate in growth traits
  - Milk Production
  - Weight gain
- Is low in carcass traits
  - Fat thickness
  - REA

Hybrid vigor for most traits seems to be greatest in sub-optimal environments

Heterosis

Trait	Individual	Maternal	Total
Calving rate	0	6	6
Weaning rate	0	8	8
Pubertal at 15 months	15	-	15
Survival to weaning	3	1	4
Birth weight	4	2	6
Weaning weight	5	6	11
Milk production	-	6	6
Weaning weight/cow exposed	-	-	18
Cow longevity	-	-	38
Cow lifetime productivity	-	-	23

Adapted from Taylor 2007 and Kress 1999

Straightbreeding

2+2= 4

Crossbreeding

2+2= 5

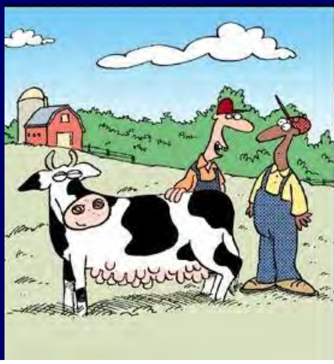
Crossbreeding with the Brahman cross female

2+2=6

Lbs of calf weaned per cow exposed can be increased 25-35% or more due to the cumulative effects of hybrid vigor!

Crossbred cows produce more calves, bigger calves, and do it for more years

The Dairy Industry Uses Straightbreeding



"We were able to lay off the other cows when we got Betsy."

Fertility in Dairy Cattle

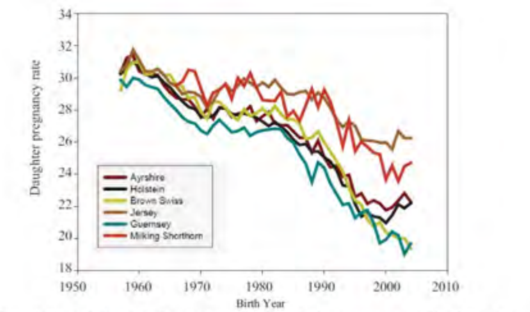


Figure 1. Historical changes in phenotypic measurements of daughter pregnancy rate in United States dairy breeds from 1957-2005. Data were obtained from United States Dept. of Agriculture Animal Improvement Program Laboratory (http://aipl.arsusda.gov/eval/summary/trend.cfm).

How much should we modify the environment?

Too often we select animals in a favorable environment with the hope that they will be productive in a harsh environment.

Or we feed more!

What does it cost?

What are the long term consequences?

Which traits have the most monetary reward?

Trait	REV	h^2	%HV	REV*
Reproduction	10	<20	10	5
Production	2	20-40	5	2
Product	1	>40	0	2

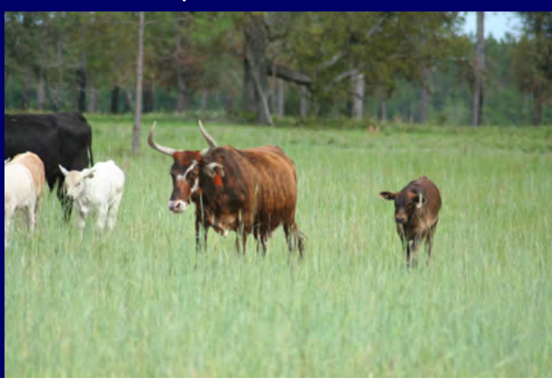
*Adjusted based on current trends towards product

Adapted from Willham, 1967, Melton 1995

Select for Growth and Carcass

and Crossbred for Reproduction and Longevity

Gulf Coast Priorities



Performance of the Brahman cross female (F1 Brahman x British)

As compared to straightbreds

- Calving rate +10%
- Calf survival +5%
- Weaning rate +12.5%
- Calf weight at weaning +70 lbs

Louisiana - Franke, 1980

Performance of the Brahman cross female (F1 Brahman x British)

As compared to straightbreds

- Calving rate +16%
- Calving interval -9%
- Weaning rate +19%
- Weaning weight +13%

Florida – Riley et al., 2007, 2014

The Brahman F1 is the Cadillac

Red Cadillac

Black Cadillac

Spotted Cadillac

Twenty-one year old F_1 Brahman-Hereford cow with eighteenth calf at the East Texas Pasture Laboratory, Lufkin. Lifetime average adjusted 205 day weaning weight of her calves was 505 lbs.

Cow Longevity

Breed	Age
Angus	10.3
Hereford	9.8
Brahman	9.7
Angus x Hereford	11.7
Brahman x Angus	14.7
Brahman x Hereford	13.2

Texas - Rohrer et al., 1988a

The increased longevity of these Brahman crossbred females results in fewer replacement females being required thus allowing for more intense selection?

Thrift and Thrift, 2003

Factors to Consider in a Choosing a Crossbreeding System

Which System Fits My Beef Cattle Operation?

Terminal versus Rotational

First Question when Choosing a Crossbreeding System?

Do I raise or purchase my replacements?

Depends on the size of the operation

Most producers are going to raise their own replacement heifers even if they should not!

Terminal Sire (purchasing all females)

- Maximizes hybrid vigor
- Takes advantage of complementarity
- Works on small and large operations
- Often expensive to purchase females
  - Can purchase a very specific type

Breed heifers purchased → Charolais x AxB → All calves sold

Terminal Sire (raising females)

- Maximizes hybrid vigor (only in terminal calves)
- Takes advantage of complementarity
- Works large operations
- Must raise heifers in a separate herd

Only 50% of cows are crossbred (Herd 3)

Herd 1		Herd 2		Herd 3
(150hd) Brahman x Brahman	→	(350 hd) Angus x Brahman	→	(500 hd) Charolais x AxB

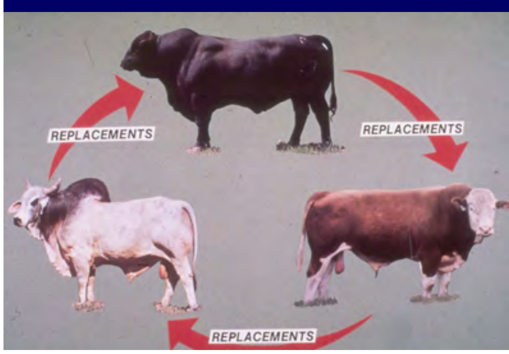
Terminal sire does not always mean lbs?

Small Producer Scenario

- 30 "Ideal" cows (one bull herd)
  - Purchase F1 or"Ideal type" bred replacement heifers
  - Mate cows to Continental bull (terminal sire)
- Maximizes hybrid vigor
- Cow type adapted to the environment
- Requires only one pasture

Crossbreeding systems do not have to be based on the F1 cow

She is the CADILLAC, but she is expensive to produce!



Rotational systems produce crossbred heifers for replacements

2 Breed Rotation

Herd 1	Herd 2
B type cows 2/3 Brahman 1/3 Angus X Angus bull	A type cows 1/3 Brahman 2/3 Angus X Brahman bull

Additional Suggested Breed Combinations for 2 Breed Rotations for the Gulf Coast

- Santa Gertrudis x Herford
- Santa Gertrudis x Red Angus
- Beefmaster x Angus
- Beefmaster x Red Angus
- Braford x Angus
- Braford x Red Angus
- Brangus x Hereford
- Brangus x Beefmaster (maternal)

Systems that Produce Replacement Females

Breed	heterosis relative to F1 (%)
2 breed rotation	67
3 breed rotation	86
2 breed composite 3/8 5/8	47
3 breed composite $\frac{1}{2}$ $\frac{1}{4}$ $\frac{1}{4}$	62.5
4 breed composite $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$	75
Terminal with F1 female purchased	100

Second and Third Question when Choosing a Crossbreeding System?

How many pastures are available during the breeding season?

Do you have the ability to AI?

Systems that Produce Replacement Females

Breed	number of pastures
2 breed rotation	2
3 breed rotation	3
2 breed composite 3/8 5/8	1
3 breed composite $\frac{1}{2}$ $\frac{1}{4}$ $\frac{1}{4}$	1
4 breed composite $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$	1
Terminal with F1 female purchased	1

What about Composites?

MARC I	1/4 Braunvieh, 1/4 Charolais, 1/4 Limousin, 1/8 Hereford, 1/8 Angus
MARC II	1/4 Gelbvieh, 1/4 Simmental, 1/4 Hereford, 1/4 Angus
MARC III	1/4 Pinzgauer, 1/4 Red Poll, 1/4 Hereford, 1/4 Angus
RX3	1/4 Hereford, 1/4 Red and White Holstein, 1/2 Red Angus
CASH	23% Hereford, 23% Angus, 34% Brown Swiss, 20% Charolais
Santa Cruz	1/2 Santa Gertrudis, 1/4 Gelbvieh, 1/4 Red Angus
Stabilizer	1/4 Red Angus, 1/4 Hereford, 1/4 Gelbvieh, 1/4 Simmental
Rangemaker	1/2 Angus, 1/4 South Devon, 1/4 Tarentaise
Rangecalver	Red Angus, Polled Jersey, El-Monterey, Salers, South Devon, Wagyu
Noble Line	3/8 Brahman, 3/8 Angus, 1/4 Gelbveih
Senegus	3/8 Senepol, 5/8 Angus
Hotlander	3/16 Brahman, 5/16 Simmental, 3/16 Senepol, 5/16 Angus
CGC	1/2 Red Angus, 1/4 Charolais, 1/4 Tarentaise
Alpine Black	3/4 Angus, 1/4 Brown Swiss
Profit Maker	?
Rangelander	Angus,Brahman,Hereford,Jersey,Red Poll, Shorthorn???
Beef Machine	Hereford, Red Poll, Dutch Friesian, Angus, Brown Swiss, Simmental

American Breeds/Composites

Straightbreeding using "American breeds"
example-Brangus x Brangus (Hi=47%, Hm=47%)

Advantages
-simple-only requires one pasture and one breed of bull
-uniformity in color ?
-produces replacement females
-takes advantage of some heterosis
-can utilize breeds that are adapted to hot climates

Disadvantages
-does not take full advantage of heterosis
-does not take advantage of breed complementarity
-uniformity in color ?

Simple system – Composite Terminal

- 100 Brangus type cows
  - 30 favorite cows mated to Brangus bull to generate females
  - 70 mated to Continental bulls (terminal sire)
- Produces replacements
- Provides hybrid vigor
- Cow type adapted to the environment
- By-product – Brangus steers - Black
- Requires only two pastures

Composite Terminal Simplified

- 100 Brangus type cows
  - 30 mated to Brangus bull to generate females
  - 70 mated to Continental bulls (terminal sire)
- Turn Brangus bull out for 30 days to make heifers
  - Heifers come from early calving cows
- Turn two Charolais bulls out for last 60 days
- Only one herd and one pasture
- Also potential to AI to Brangus bull to produce heifers

Crossbreeding systems do not have to start with purebred cows

---

Crossbreeding systems do not have to start with purebred

Phenotype cows

Angus type
Herford type

British type
Continental type

Red
Black

With ear
Minimal ear

Sire Rotation

- Looks a lot like a rotation but can be used in a single herd
- Breed A bull used for 4 years
  - Replacement heifers only kept in years 3 and 4
- Breed B bull used for 4 years
  - Replacement heifers only kept in years 3 and 4
- Produces replacements
- Provides hybrid vigor
  - usually slightly less than a true rotation
- Cow type adapted to the environment
- Requires only one pasture

Sire Rotation Variation

- Looks a lot like a rotation but can be used in a single herd
- Breed A bull 1 used for 2 years
- Breed A bull 2 used for 2 years
- Breed B bull 1 used for 2 years
- Breed B bull 2 used for 2 years
- Breed A bull 3 used for 2 years
- Breed A bull 4 used for 2 years..........etc
- Only allows for 2 years use from bull

---

2 Breed Roto-Terminal

Herd 1
B type cows
2/3 Brahman
1/3 Angus

Herd 2
A type cows
1/3 Brahman
2/3 Angus

Herd 3 terminal
A and B type cows
Crossed with
Charolais bull

Utilization of a Roto-Terminal Crossbreeding System

- Approximately 50% of cows (older, less productive, late calvers) can be mated to terminal sire bulls to produce calves with more weight and value.
- Takes advantage of HV and breed complementarity
- Produces adapted replacements in the rotational herd.
- Requires a large number of cows to make this system work (500 hd min).
- Must market multiple types of calves
- Requires multiple pastures

There is not just one way…many producers are very successful with a straightbreeding program

Straightbreeding Concerns

Use of a small number of sires via AI

Use of a small number of dams via OPU and In-vitro fertilization

Narrow the genetic pool in the search for the "PERFECT ONE"

Crossbreeding studies require time and resources that are often not available today.

Just because the data is old doesn't mean heterosis doesn't exist anymore.

Crossbreeding Systems Considerations Summary

-Purchase or raise replacement females
-Heterosis is greatest
for factors
affecting cows
Reproduction
C

A SEEDSTOCK BREEDER: USE OF DATA, DNA AND ULTRASOUND!

August 7, 2023
Tommy Perkins, Ph.D., PAS

1

SAV AMERICA 8018

- $1.51 Million (February 2019).
- Last embryo from an 18-year old dam.
- WWT – 1107 pounds (205-days)
- SAV focuses on "high quality performance and maternal cattle that are productive and profitable for the commercial cattlemen".

2

NEW SEEDSTOCK BREEDERS

- In the business 5 years or less before getting out.
- Why do they get out?
  - No Business Plan
  - Breed Politics
  - Don't Understand Genetics or Mating Schemes
  - Forget the Importance of Additional Record Keeping
  - Failure to use Technologies (AI, ET, Ultrasound, DNA, etc.)
  - Follow Trends or Fads

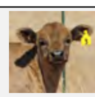
3

PRIORITIES OF THE NEW SEEDSTOCK BREEDER

- Purchase the highest quality females you can afford.
- Utilize the best bulls in the breed using AI.
- Pedigree matters.
- Participate in THR.
- Maintain flawless data.
- Submit birth and weaning data on every calf produced.
- Don't market inferior animals to other seedstock breeders.
- Have a few "Front Pasture Kind" but not 100% of them.

4

THR



- Annual Assessment for all mature, breeding age females.
- Entitles each assessed cow to have a calf registered.
- It generally includes one free transfer of the calf up to 24 - 30 months of age.
- Requires a reported weaning weight or disposal code of every calf born.

5

CONTEMPORARY GROUP

Calf ID	Adj.WWT	WWT Ratio	Adj.YWT	YWT Ratio
101	475	95	650	104
102	525	105	600	96
104	500	100	625	100

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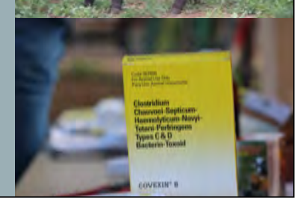
CONTEMPORARY GROUP

Calf ID	Adj.WWT	WWT Ratio	Adj.YWT	YWT Ratio
101	475	99	650	107
102	525	109	600	99
103	450	93	580	95
104	500	104	625	103
105	460	95	590	97

7

TRAITS TO BE REPORTED

Calving Ease Score
Birth Weight
Weaning Weight
Yearling Weight
Mature Weight
Scrotal Circumference



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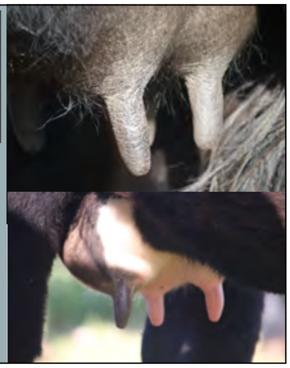
CONVENIENCE TRAITS TO REPORT

- Feet and Leg Scores
- Teat and Udder Scores
- Temperament Scores
- Carcass Data
- Ultrasound Data



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DNA TECHNOLOGY

- Parent Validation
- Genomic Enhanced EPD's
- Genetic Defects

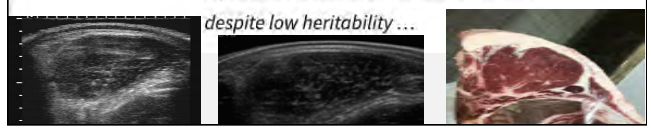
10

Phenotypes are king*

Can I just DNA test my cattle instead of ultrasounding them?

Genomic evaluation of new traits like Mortality, Gestation length,Health traits, **Feed efficiency**, …

If you can measure it, you can select for it, despite low heritability …



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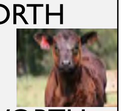
REPRODUCTION IS THE MOST ECONOMICALLY IMPORTANT TRAIT IN BEEF CATTLE!

THE WORST CALF YOU EVER SELL IS WORTH MORE THAN A DEAD ONE!



REPRODUCTION IS ESTIMATED TO BE WORTH:
10 TIMES MORE THAN GROWTH TRAITS
20 TIMES MORE THAN CARCASS TRAITS

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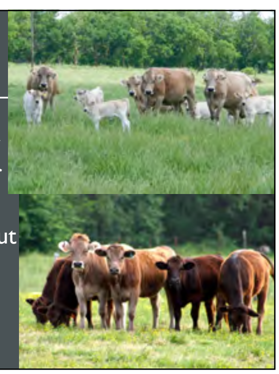
THE EFFECTS OF EXTREME SELECTION FOR OTHER TRAITS ON REPRODUCTION

- Selecting for extreme growth may result in larger mature size and older age at puberty. Calves may be heavier at birth.
- Selecting for milk production without adequate feed supplies to support it may result in longer calving intervals.
- Selection for certain carcass traits may result in later sexual maturity



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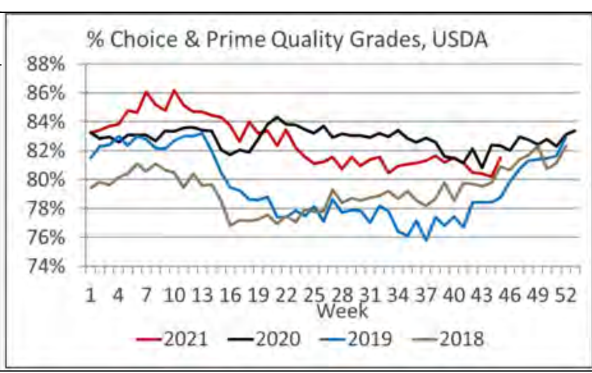

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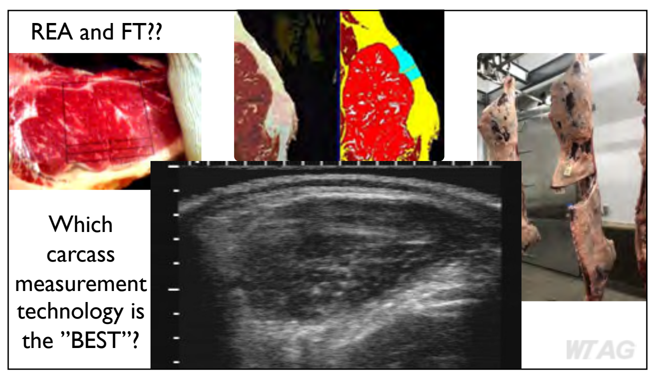
REA and FT??



Which carcass measurement technology is the "BEST"?

15

MS or %Fat??

Which carcass measurement technology is the "BEST"?

16

CAMERA GRADING ISN'T PERFECT

17

UPDATED ALGORITHMS FOR ULTRASOUND

CARCASS DESCRIPTIVE DATA

Trait	Min.	Max.	Avg.
HCW	485	1016	801
REAC	11.49	21.33	15.44
FTC	0.04	1.08	0.74
EE	.15	15.85	6.06

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UPDATED ALGORITHMS FOR ULTRASOUND

ULTRASOUND MACHINES TESTED

Unit	FT	REA	MARB
ALOKA 500	0.81	0.69	0.85
EVO 2	0.94	0.69	0.87
EVO 3	0.94	0.74	0.88

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20

UF UNIVERSITY of FLORIDA
Department of Animal Sciences

2024 TAMU Beef Cattle Short Course

Genetic Selection for Horn Fly Resistant Cattle

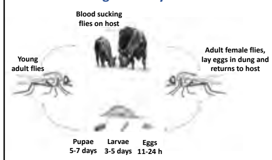
Fernanda Rezende, PhD
Assistant Professor
Statistical Genetics and Quantitative Genomics

UF IFAS Extension UNIVERSITY of FLORIDA

Aug 7-9, 2023

Horn fly general biology

Life stages and cycle



- **Cool temperate regions**: 6-9 generations/year
- **Subtropical zones**: 12-14 generations/year
- **Temperate areas**: 1st peak late spring/early summer and 2nd peak late summer/early fall
- **Northeastern Brazil**: 30 generations/year

Feeding behavior

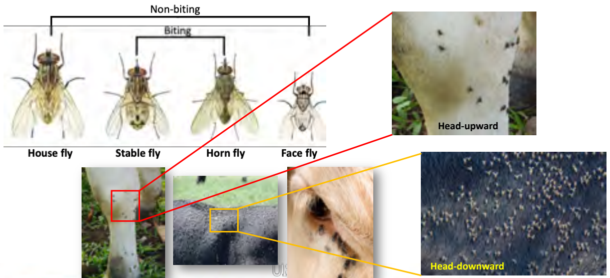
- Blood-sucking flies
- Intermittent feeders
- Feed 20-40 times/day
- **Bloodmeal size**: males (0.5-1 mg) and females (1.7-2.7 mg)
- **Feeding time**: males (96 min/day) and females (163 min/day)

Behavior

- Remain day and night on the host
- Clustered on the back, sides and withers
- Migrate to belly and legs at the hottest times

Brewer et al. (2021) J. Integr. Pest Manag.

Horn flies and other common flies



Direct effects on host

Effect of Horn Flies on Weight Gains of Beef Cattle
T. L. Harvey, J. R. Brethour 1979

GROWTH OF RANGE CATTLE PROTECTED FROM HORN FLIES (*Haematobia irritans*) BY EAR TAGS IMPREGNATED WITH FENVALERATE 1982
W. G. HAUFE

Influence of horn flies on weight loss in cattle, with notes on prevention of loss by insecticide treatment. 1984

Horn Fly (Diptera: Muscidae) Control and Weight Gains of Yearling Beef Cattle 1995

Effect of Horn Fly (*Haematobia irritans*) Control on Growth and Reproduction of Beef Heifers 2003

Growth and Reproductive Performance of Rangeland Beef-Cattle as Influenced by Controlled and Uncontrolled Populations of Horn Flies (Diptera: Muscidae) 2019
Brandon G Smythe, Mark E Wise, Andres F Cibils, Dawn VanLeeuwen, Adam F Summers, Mike G Fletcher, Eric J Scholljegerdes

Horn fly control impact on weight gain

Steers: +17.7% and **Heifers**: +14%

Steers: +9.8 lb and **Mature cows**: +34 lb

No effect on host pregnancy rate, postpartum interval, days to pregnancy and calving interval due to horn fly infestation

Indirect effects on host

Effect of Horn Fly Control on Cows as Expressed by Increased Weaning Weights of Calves 1976

Horn Fly (Diptera: Muscidae) Control on Beef Cows with Permethrin-Impregnated Ear Tags and Effect on Subsequent Calf Weight Gains 1984

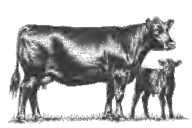
Effects of horn fly control with λ cyhalothrin ear tags on weight gains in weaning calves in Texas. 1989

Growth and Reproductive Performance of Rangeland Beef-Cattle as Influenced by Controlled and Uncontrolled Populations of Horn Flies (Diptera: Muscidae) 2019
Brandon G Smythe, Mark E Wise, Andres F Cibils, Dawn VanLeeuwen, Adam F Summers, Mike G Fletcher, Eric J Scholljegerdes

Horn fly control impact on weight gain of calves paired with treated cows

Average daily gain: +0.13 lb/day

Weaning weight: +12.8-35.9 lb



Impact on host physiological response

Item	Horn flies/animal 0	100	500
Heart rate/min[b]	76.6	89.1	101.1
Respiration rate/min[b]	44.6	52.7	62.1
Rectal temp., °C[b]	38.8	39.0	39.1
Water intake, L/d	16.7[c]	16.3[c]	24.9[d]
Urine output, L/d	3.8[c]	4.2[c]	12.1[d]
Feed intake, kg DM/d	5.6	5.6	5.6
Nitrogen intake, g/d	119.1	118.0	119.1
Fecal nitrogen, g/d	30.9	34.5	34.8
Urine nitrogen, g/d	24.6[c]	31.1[cd]	34.7[d]
Nitrogen retained, g/d	63.6[c]	50.2[d]	49.5[d]

Schwinghammer et al. (1986)

May increase metabolic rate, reducing the amount of metabolizable energy for production

Impact on host behavior

Effect of Horn Flies on Behavior of Cattle
T. L. Harvey, J. L. Launchbaugh 1982

Impact of Horn Flies, *Haematobia irritans* (L.) (Diptera: Muscidae), on the Behavior of Beef Steers 2008

Horn fly infestation causes animal distress

- increase fly avoidance behaviors
- increase visits to feeding stations
- reduce bite rate
- reduce mastication
- increase rumination
- spent more time walking (+0.3 miles/days)

Disrupting grazing patterns and additional energy expenditure may explain reduced weight gains

Impact on host health

Mastitis in dairy heifers: initial studies on prevalence and control 1995

Role of horn flies (Haematobia irritans) in Staphylococcus aureus–induced mastitis in dairy heifers 1998

Prevalence, Risk Factors, and Strategies for Controlling Mastitis in Heifers During the Periparturient Period 2005

Horn fly is vector of *Staphylococcus aureus*

- Mastitis-causing bacteria
- Source of *S. aureus*: scabs and lesions on teats
- Higher incidence of *S. aureus* in heifers from herds using no fly control
- *S. aureus* isolate colonizing horn flies and present on teats and mammary secretion

Impaired milk production have direct impact on calf weaning weight

Vector of other pathogens

Development of Stephanofilaria stilesi in the horn fly

1966

- nematode that causes a granular dermatitis
  - belly, scrotum, prepuce and udder
- skin lesions increase susceptibility to other infections and reduce hide market value

Study of horn flies as vectors of bovine leukemia virus 2019

- oncogenic retrovirus, no vaccine available
- development of tumors (lymphosarcoma)
- largest single reason of carcass condemnations

Monitoring horn fly infestation

Economic threshold for intervention: 200 flies/animal in beef cattle

Visual observations

Direct count of flies
- entire animal (Steelman et al., 1991)
- sunny side and/or upper body (Lysyk, 2000)
- one side (Lima et al., 2002)

Infestation score (Fraga et al., 2005)
- *score 1*: ≤ 100 flies
- *score 2*: > 100 and ≤ 200 flies
- *score 3*: > 200 and ≤ 300 flies
- *score 4*: > 300 and ≤ 400 flies
- *score 5*: > 400 flies

Digital techniques

Count from video recording (Lima et al., 2002)

Count from photograph (Fraga et al., 2005)

Automated counting (Smith et al., 2020, Psota et al., 2020)

Economic impact of horn fly infestation

Fly Species	Original Estimate	Adjusted Estimate	Source
Horn Fly	$730 million	$2,196 million	Drummond et al. 1981
	$876 million	$1,702 million	Kunz et al. 1991
Face Fly	$52 million	$157 million	Drummond et al. 1981
	$50 million	$97 million	Kunz et al. 1991
Stable Fly	$399 million	$1,199 million	Drummond et al. 1981
	$432 million	$840 million	Kunz et al. 1991
	$2,000 million	$2,310 million	Taylor et al. 2012

Values adjusted for inflation using United States Bureau of Labor Statistics (2021)

Smith et al. (2022) J. Integr. Pest Manag.

Horn fly control methods

Chemical delivery methods
- ear tags
- pour-ons
- sprays
- dusts
- feedthroughs
- injections
- air-projected capsules

Non-chemical methods
- biological controls
- pasture management
- fly traps
- back rubbers

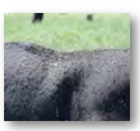
Nontraditional methods
- painted zebra stripes
- vaccine
- semiochemical
- **breeding for resistant animals**

Brewer et al. (2021) J. Integr. Pest Manag.

Factors associated with cattle susceptibility and resistance

Breed
- *Bos indicus* vs *Bos taurus*
- Chianina more resistant than other European breeds

Coat color
- Darker coat color more flies



Sex
- Males are more susceptible

Body size
- Smaller size associated with innate resistance

Blood clotting protein
- High thrombin level lower fly load

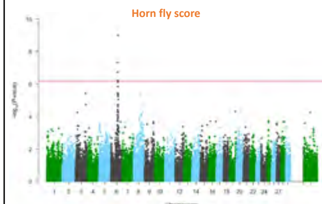
Hair density
- Highest number of hairs per square centimeter and greater amount of sebum more resistant

Immune response
- Anti-IT5 regulates the blood intake

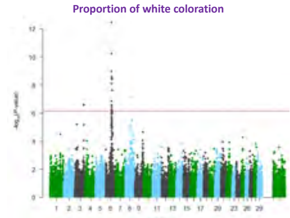
Brewer et al. (2021) J. Integr. Pest Manag.

Genome-wide scan in Holstein cattle

Horn fly score



Proportion of white coloration



KIT is a candidate gene to play a role in coat coloration and fly resistance in Holstein cattle

Basiel et al. (2021) JDS

Genetic parameters of resistance to horn flies

	Brown et al. (1992)	Fraga et al. (2005)	Ling et al. (2020)	Basiel et al. (2021)
Breeds	Angus, Charolais, Chianina, Hereford, Polled, Hereford and Red Poll	Caracu	-	Holstein
Counting method	Direct	Printed image	Digital image	Digital image
N	215	718	-	252
h²	0.78	0.08	0.22	0.25
r	0.47	0.12	-	0.71

Research population

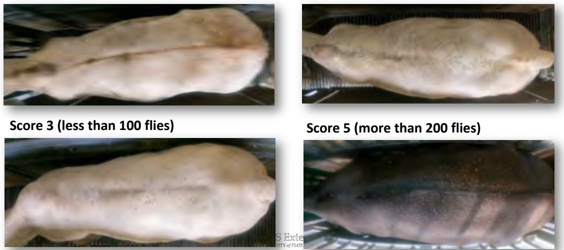
UF purebred Brahman herd

- 200 mature cows, 50 2-year heifers, and 50 yearling heifers
- 210 calves per year
- **no fly control on calves from birth to weaning**

UF Multibreed Angus-Brahman herd

- 220 mature cows, 65 2-year heifers, and 65 yearling heifers
- 100% Brahman to 100% Angus
- 310 calves per year
- **no fly control on calves from birth to weaning**

Visual score of fly infestation



Coat color

Coat score

Skin color

Chute behavior and temperament

Chute score
1. Calm, no movement
2. Slightly restless
3. Squirming, occasionally shaking the chute
4. Continuous, very vigorous movement
5. Rearing, twisting of the body

Exit score
1. Slow exit, calm
2. Jump, trot or run

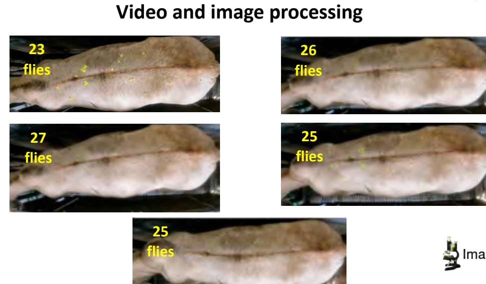
Video and image processing

Media Player

ImageJ

Video recording

Video and image processing



ImageJ

Correlation fly count between frames

Correlation	Frame 1	Frame 2	Frame 3	Frame 4
Frame 2	0.98			
Frame 3	0.98	0.98		
Frame 4	0.98	0.97	0.98	
Frame 5	0.97	0.96	0.98	0.98

One frame per animal may be sufficient

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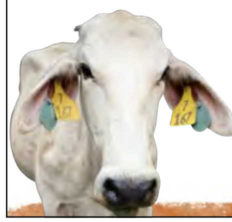
Department of Animal Sciences

Rezende Lab
Animal Statistical Genetics & Quantitative Genomics



Thank you for your attention!

Fernanda Rezende
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Data description

Total number of calves with records by herd and sex

	BRA	MAB	Total
Males	172	297	469
Females	189	329	518
Total	**361**	**626**	**987**