

acceligen™

**Breeding tools for breed outcrossing and impact on
sustainable production for tropical climates**

NBCEC “Brown bagger” – October 20, 2021

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Today's Agenda

01

VISION

Best Current Uses of Gene Editing in Cattle

02

GENETIC OPPORTUNITIES

Challenges & Solutions to reach commercialization

For background on Acceligen go to:
www.Acceligen.com

Need to Change Food Animal Production

One Health

Human health concerns for animal disease and vet practices



Functional Data

Measuring Traits Farmers don't get paid for



Conventional breeding & crossbreeding cannot address these problems efficiently



Natural Resources

Global market demands are testing production limitations



Animal Well-Being

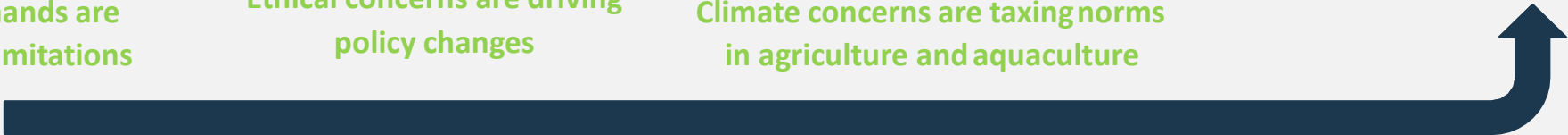
Ethical concerns are driving policy changes



Climate Change

Climate concerns are taxing norms in agriculture and aquaculture

Emergence of alternative animal proteins



Opportunities For Market Impact

- Tropical Beef & Dairy Systems
 - ✓ 70% of the world's cattle
 - ✓ Relatively low to no impact of artificial selection on local breeds
- Rapid & sustainable change by gene editing
 - ✓ Replaces inefficiencies of crossbreeding
 - ✓ Adapt high performance breeds to the tropics
- South America has progressive regulatory pathways
 - ✓ Timelines and risk-based processes that support innovation
 - ✓ Opportunities for investment & business growth

Bovine Focused w/ Commercial Partners

Acceligen's Five Commercial Bovine Traits

POLLED



MILK YIELD
QTL



HEAVY
MUSCLING



COAT COLOR



SLICK



Acceligen's Commercial Bovine Traits - Dairy

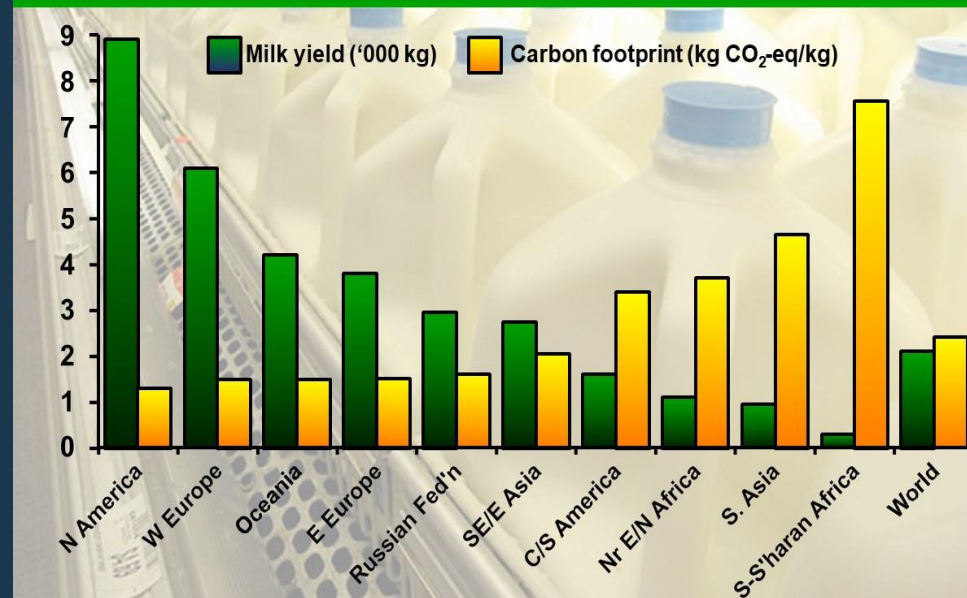
MILK YIELD &
DISEASE QTL



SPECs

- Dairy Traits for Gir/Girlando
- Natural Alleles
- Phenotypes & Food Safety known
- Smallholder impact

A Negative Correlation Exists Between Milk Yield and Carbon Footprint



Sources: Graph created by Dr. Judith L. Capper, 2010; FAO (2010) Greenhouse Gas Emissions from the Dairy Sector.

Precision Breeding for African Dairy Production Systems

Primary outcome -

Breed dairy animals that improve production gains for smallholders

- ✓ Multiplex gene editing of stem cells
- ✓ Optimized crossbreeds = Better milk yield
Gir + adapted Holsteins
- ✓ Double smallholder revenue \$\$ = Shared Value



Finding best tools - Samples

EU-Cont (56)

European Continental

- ✓ Simmental
- ✓ Charlolais
- ✓ Limousin
- ✓ Gelbvieh
- ✓ Salers
- ✓ Chianina
- ✓ Brauvieh
- ✓ Tarentaise
- ✓ Holstein
- ✓ Maine-Anjou

USMARC Panel

EU-IsI (24)

European Island

- ✓ Angus
- ✓ Red Angus
- ✓ Jersey
- ✓ Hereford
- ✓ Shorthorn

USMARC Panel

Holstein (14)

Donors only

Jersey (14)

TOG

EASZ (29)

ILRI

US-Crl (8)

US Creole

- ✓ Longhorn
- ✓ Corriente

USMARC Panel

LA-Crl (158)

Latin American Creole

- ✓ Bon
- ✓ Harton
- ✓ Caracu
- ✓ Criollo Leite

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Boran (8)

Bradley Lab

WA-t (91)

West African taurine

- ✓ Baoule
- ✓ N'Dama
- ✓ Muturu
- ✓ Laguinaire

Nigeria

EA-t (37)

East African taurine

- ✓ Mashona

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Sanga (51)

- ✓ Ankole
- ✓ Ngandi

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US-cross (17)

- ✓ Brahman
- ✓ Beefmaster
- ✓ Brangus
- ✓ Santa Gertrudis

USMARC Panel

LA-Gir (245)

Latin American Gir
Fazendas do BASA

WA-Cross (30)

West African Cross

- ✓ Keteku

Nigeria

WA-Zebu (30)

West African Zebu

- ✓ Bunaji

Nigeria

Baoule (75)

88-100% Baoule

BOKU-Burkina Faso

Bao-cross (22)

Baoule Cross

63-88% Baoule

BOKU-Burkina Faso

Baobu (9)

Baoule Zebu

37-63% Baoule

BOKU-Burkina Faso

Zebu Cross (50)

12-37% Baoule

BOKU-Burkina Faso

Zebu (89)

0-12% Baoule

BOKU-Burkina Faso

Finding best tools – Gene Targets

✓ Heat Tolerance

- Gene: *PRLR*
- Target: *SLICK1*, *SLICK2*, *SLICK3*, *SLICK4*, *SLICK5*

✓ Milk Production

- Gene: *GHR*
- Gene: *DGAT*
- Target: High Milk Allele

✓ Size/ Fertility

- Gene: *PLAG1*
- Target: Small stature / High Fertility

✓ Trypanosoma Tolerance

- Gene: *DHRS4*
- Gene: *FDX2*
- Target: Tryps Tolerance

✓ Tuberculosis Resistance

- Gene: *IFI16*
- Target: Zebu Allele
- Gene: *IL1A*
- Target: Zebu Allele
- Gene: *IRF3*
- Target: Taurus, Zebu Allele, Recombinant Allele
- Gene: *NOD2*
- Target: Taurus, Zebu Allele, Recombinant Allele
- Gene: *MARCO*
- Target: Taurus Allele, Deleterious Allele
- Gene: *NLRP3*
- Target: Zebu Allele

Acceligen's Commercial Bovine Trait – Coat Color

MILK YIELD &
DISEASE QTL



COAT COLOR



SPECs

- **Natural alleles**
- **Phenotypes & Food Safety known**
- **What is the opportunity?**

Commercial Relevance of Black & Red

- The Angus Breed is Almost 200 yrs old
- #1 Breed in the USA – Top marketing Program based on Coat Color
 - Other breeds adopt black
- Red Angus is #3 Breed in USA – Limited Genetic Diversity
- A Commercial Opportunity based on Precision Breeding?
 - A perfect Red cow marks Armageddon?
 - Black coat color has been labeled inhumane – M. Moss (NY Times)
 - Red bulls that perform the same as their Black founders
 - More diversity & opportunity for genetic improvement!!

Apocalypse Now: Birth of Red Heifer in Israel Signals End of the World

SEPTEMBER 13, 2018 By SET TEAM — 5 COMMENTS

Share Tweet Pin In Share



A group of messianic Jews in Israel have announced the birth of a much-anticipated red heifer, which they believe is a divine sign that the so-called Third Temple will be built and the [world will come to an end](#):



1824 McCombie

acceligen™



1954

The "red" genes in Angus came from other breeds – 19th century?

Dominant Red



1980

Red Charlie gene



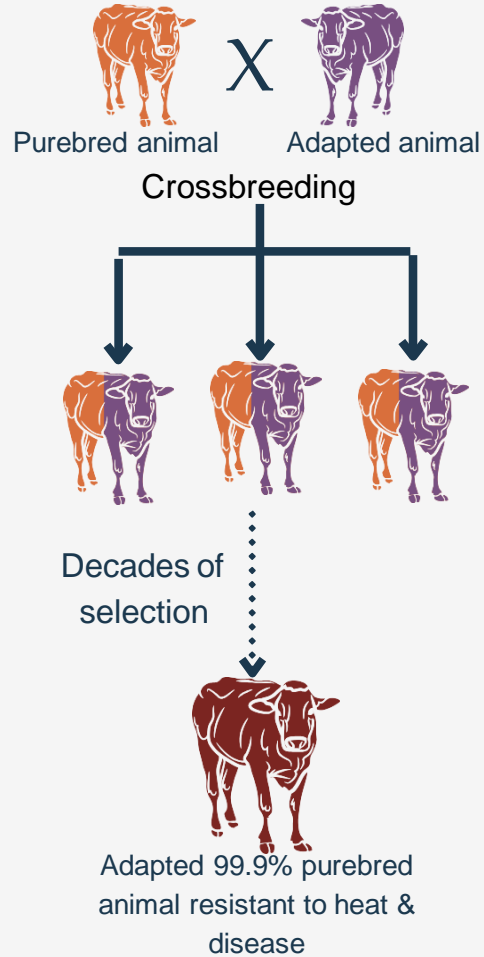
2015

Today in USA
2 Breed Associations

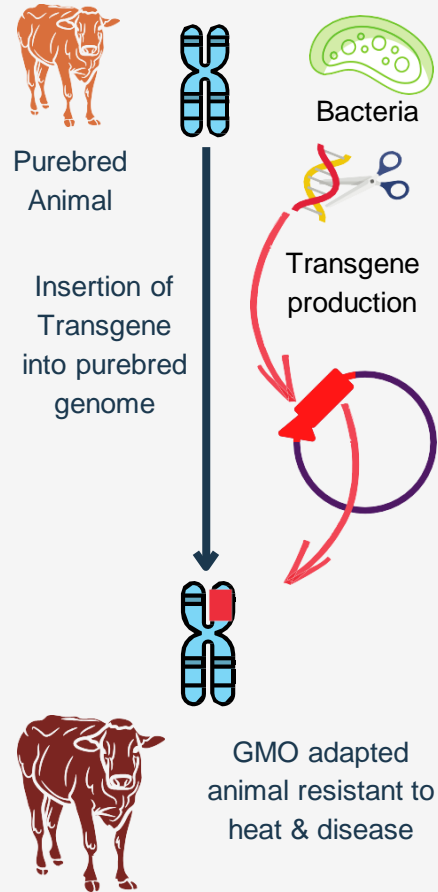


Comparison of Breeding Methods

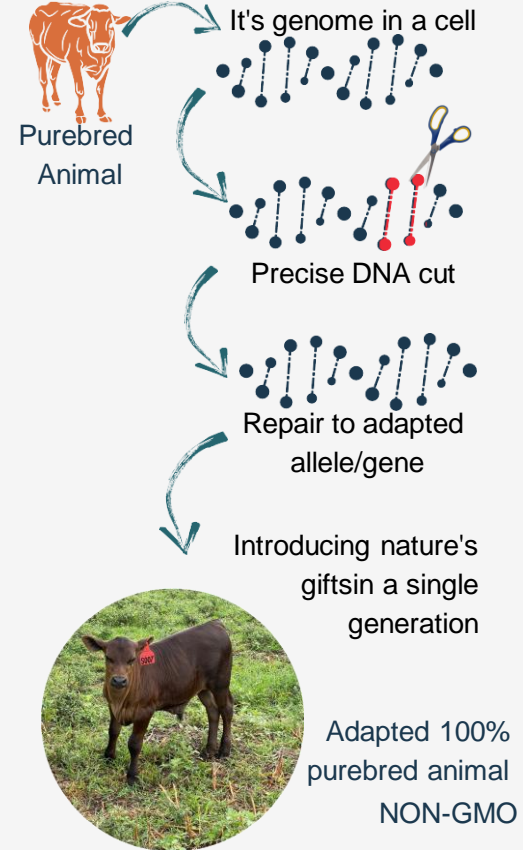
Conventional Breeding



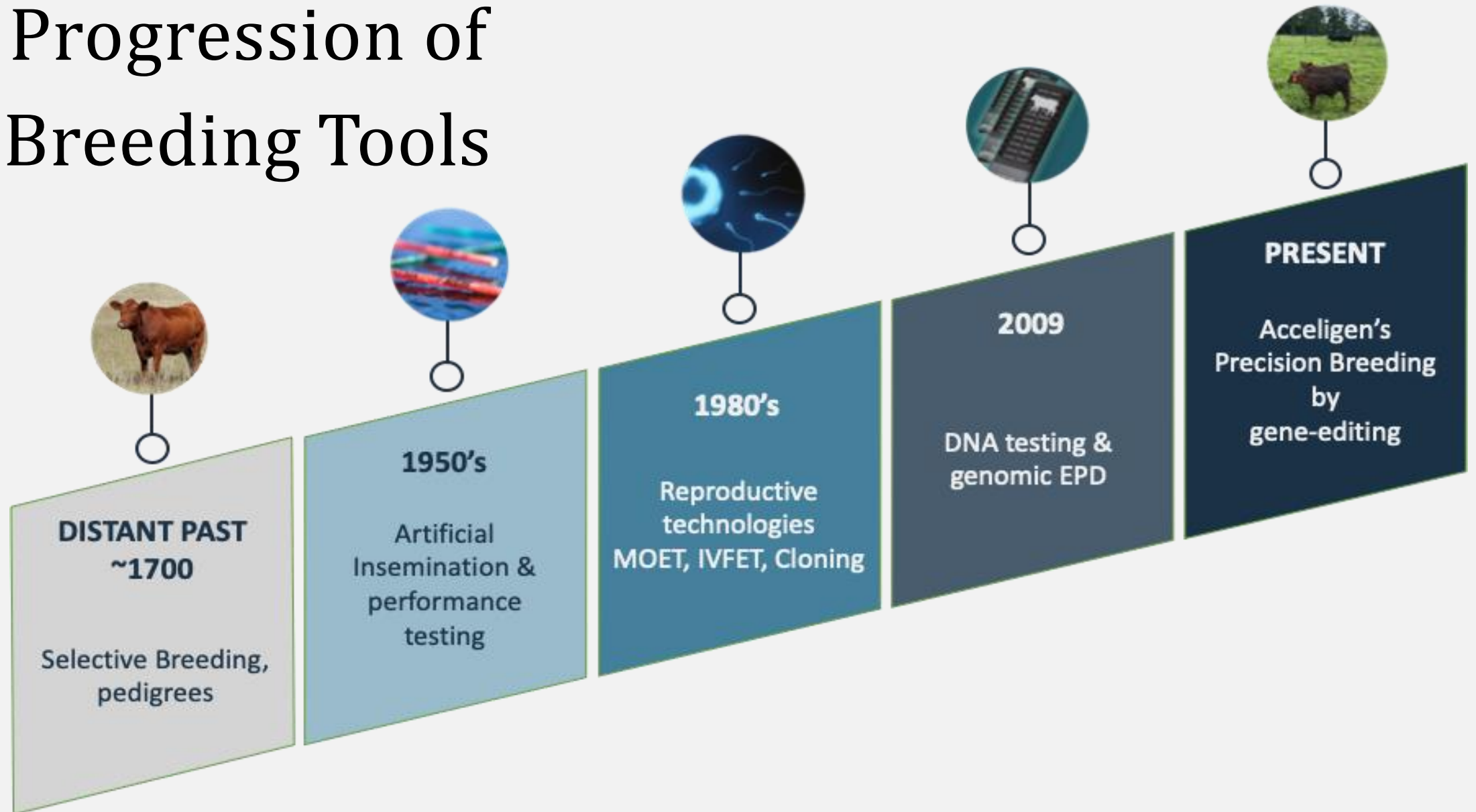
GMO Breeding



Precision Breeding



Progression of Breeding Tools



US Angus Breeders Officially Accept Gene Editing



September 10, 2021

Dear Angus Breeders:

The American Angus Association (Association) Board of Directors met this week in St. Joseph, MO. The last few weeks have been filled with committee meetings and we had great discussion on several important topics.

Financial Matters: With the conclusion of the fiscal year the Board reviewed year-end financial statements and approved budgets for the coming year for the Association and each entity. We are proud to share that each entity is financially sound and compliment staff on managing costs to stay in line with revenue. Looking ahead to the next fiscal year, the Board approved the first balanced

- ✓ ***87% of the US Seedstock Market for beef cattle has accepted editing as a viable breeding tool***
- ✓ ***Opportunities to commercialize slick and coat color changes and be export eligible***



A screenshot of the BEEF website. The top navigation bar is dark red with white text for "Quotes", "Weather", "Seedstock 100", "Health Ranch", "Blog: Beef Daily", "LISTEN: Max Armstrong's Daily Updates", and "More". Social media icons for Twitter, Facebook, YouTube, LinkedIn, and RSS are on the right. The main header features the "BEEF" logo in large red letters, a search bar, and "Register Now" and "Log In" buttons. Below the header is a secondary navigation bar with categories: "Animal Health", "Market Reports", "Management", "BEEF Vet", "Cow-Calf", "BEEF VX", "News", and "Our Events". The breadcrumb trail reads "Home > Livestock > Beef > Beef breed approves gene-edited traits for animal registration". On the left is a vertical menu with items: "Animal Health", "Animal Rights", "Antibiotics", "Reproduction", "Stocker Backgrounding", "Animal Welfare", "Beef" (highlighted in red), "Beef Quality", "Breeding", "Calving", "Cow-Calf", and "Feed". The main content area shows the article title "Beef breed approves gene-edited traits for animal registration" and a photograph of three brown Angus cattle in a field. A "Red Angus Association" logo is visible in the bottom right corner of the image.

Acceligen's Commercial Bovine Trait – Heat Tolerance

MILK YIELD &
DISEASE QTL



COAT COLOR



SLICK



Specs

- **Natural Alleles**
- **Phenotypes & Food Safety Known**
- **What is the Opportunity?**

Expand Use of Angus Genetics in Tropics



Adapted cows



Carcass Quality sires

X

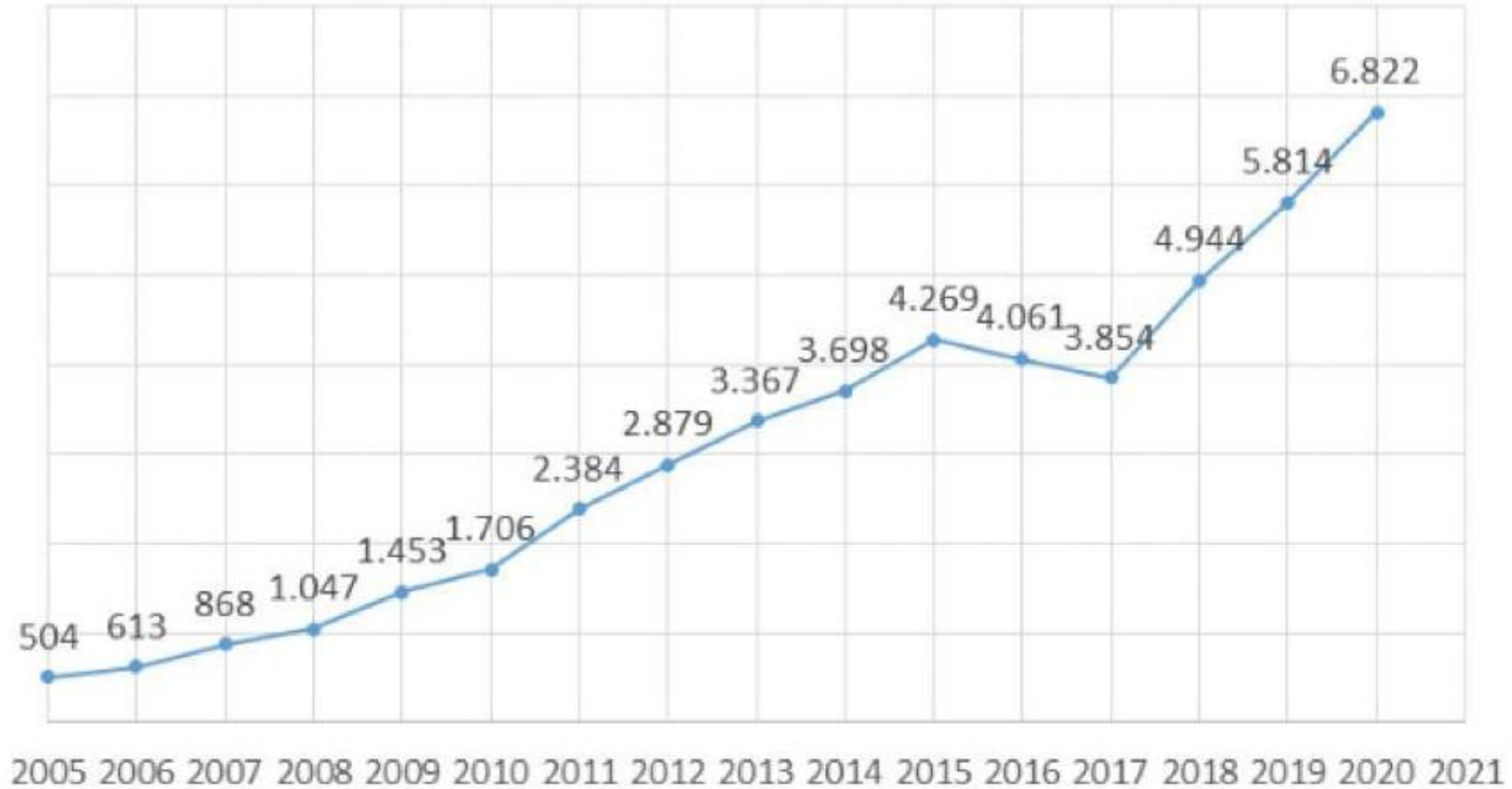


F1 – “Brazil’s Brangus” produced by FTAI

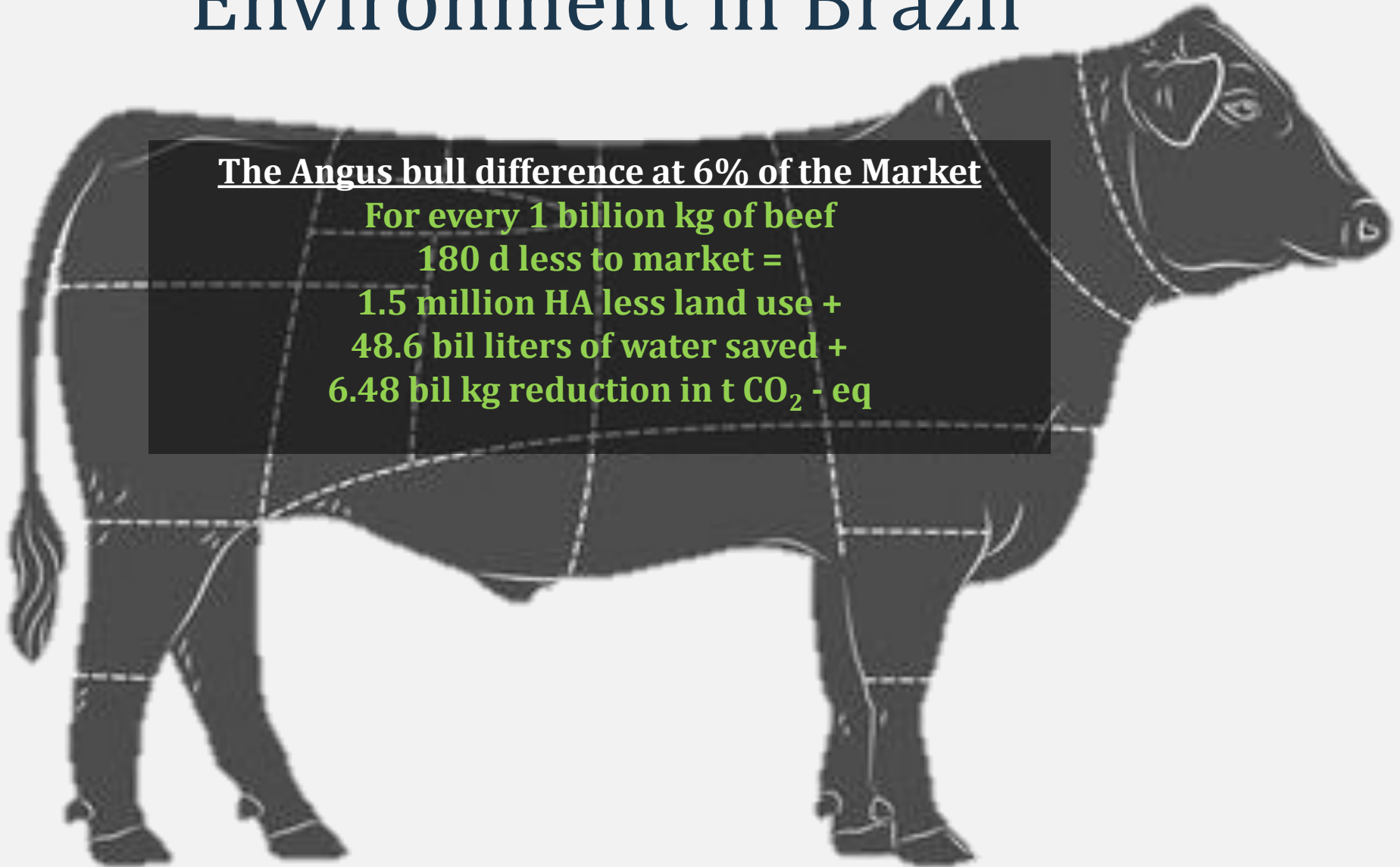


Vendas de Sêmen Angus

(em milhares de doses)



Angus Genetics - Impact on Resources & Environment in Brazil



The Angus bull difference at 6% of the Market

For every 1 billion kg of beef
180 d less to market =
1.5 million HA less land use +
48.6 bil liters of water saved +
6.48 bil kg reduction in t CO₂ - eq

Discovery of SLICK's Natural Alleles



Senepol
St. Croix



Taino
Puerto Rico



Amarillo de
Quebrada
Arriba



Carora
Venezuela



Limonero
Venezuela

Caracu - Brazil



CLT - Mexico



Colombian Breeds

Breed Diversity of SLICK Trait

Allele (PRLR Amino Acid Truncation)	Senepol (St. Croix Island) SN	Romосinuano (Colombia) RN	Carora (Venezuela) CA	Blanco Orejinegro (Colombia) BON	Costeno con Cuernos (Colombia) CCC	Harton del Valle (Colombia) HV	Limonero (Venezuela) LN	Caracu Caldeano (Brazil) CU	Criollo Lechero Tropical (Mexico) CLT
SLICK1 (461)									
SLICK2 (496)								WA	
SLICK3 (464)									
SLICK4 (426)									
SLICK5 (465)									
SLICK6 (478)									

Breeders know SLICK's Commercial Value in the Tropics

Find more info on each bull at www.STgen.com



Kiwipole SLICK PATHOS

Homozygous SLICK Gene



Dam: BDPH-13-213

New Zealand Registration Code : 516583
Sire x MGS: Super x Ralma Cf O'Man Cricket-ET
DOB: 09/27/2015

Sire: Kiwipole Grazer super
Dam: BDPH-13-213
2-0 258d 1x15125m 3.6 546f 3.5 530p
MGS: Ralma O'man Cf Cricket-ET
MGD: BDPH-09-169
5-0 233d 4x14524m 3.6 523f 3.3 479p

Sexed **ULTRA 4M**



Kiwipole SLICK EROS

Homozygous SLICK Gene



Dam: GHY-12-46

New Zealand Registration Code : 516573
Sire x MGS: Slick Grazer x Cn 6614 "Bello"
DOB: 08/02/2015

Sire: Kiwipole Slick Grazer
Dam: GHY-12-46
3-0 315d 2x17670m 4.5 797f 3.7 652p
MGS: Cn 6614 "Bello"
MGD: Waikare Tyrone Hanna S2J
8-0 267d 7x10516m 5.5 583f 3.9 409p

Sexed **ULTRA 4M**



Kiwipole SLICK HIMEROS

Homozygous SLICK Gene



Dam: GHY-12-41

New Zealand Registration Code : 516574
Sire x MGS: Slick Grazer x Cn 6614 "Bello"
DOB: 08/14/2015

Sire: Kiwipole Slick Grazer
Dam: GHY-12-41
3-0 339d 2x15875m 4.9 776f 4.3 695p
MGS: Cn 6614 "Bello"
MGD: Waikare Maestro Carlene
5-11 277d 5x9760m 6.3 616f 4.72 461p

Sexed **ULTRA 4M**

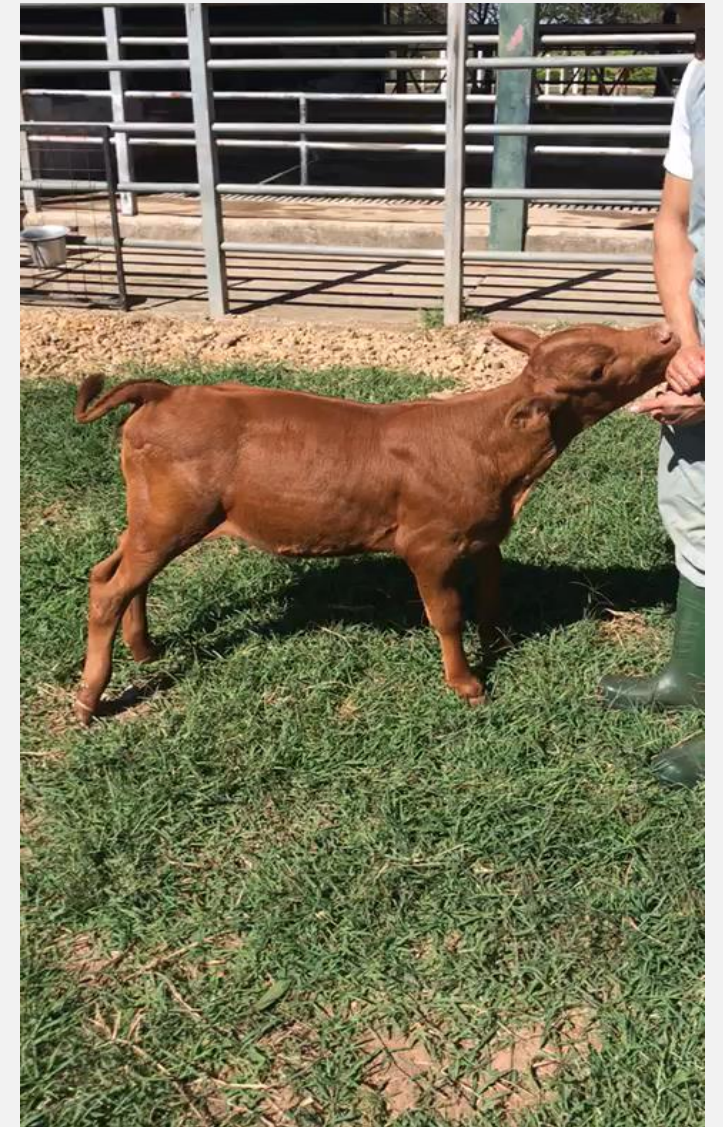


Can SLICK protect Angus in Brazil?



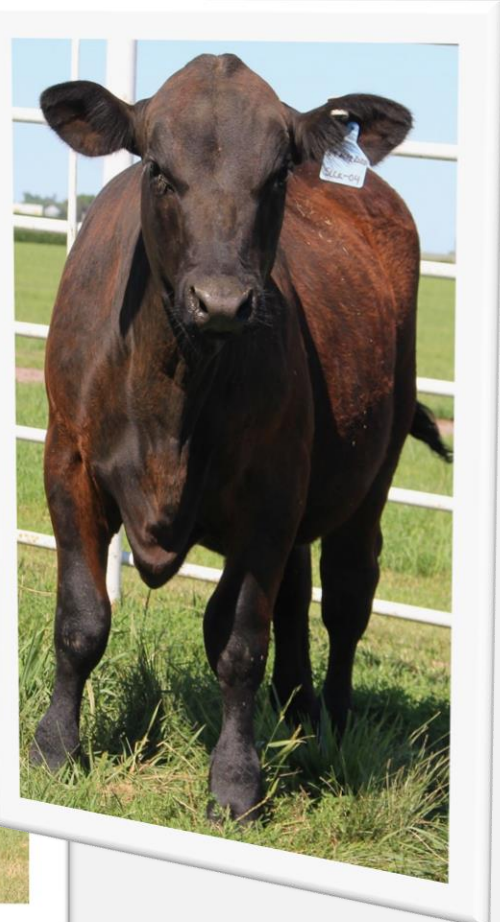
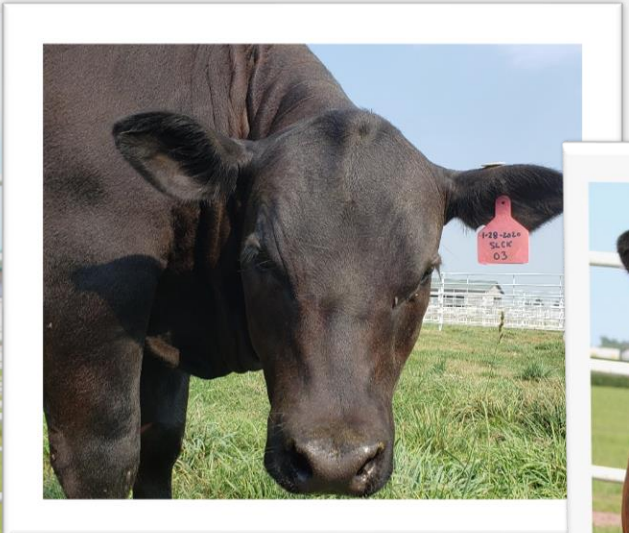
High Performance Angus – heat stress at 27°C

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Angus GnEd clone adapted to tropical heat

Outcomes from 2020!





Elsa & Hurricane



Summary on Commercialization Processes



Thank You



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Acknowledgements/Partners



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Questions ?