

WTAMU PrimeOne

T. Lawrence¹, D. Lust¹, J. Sperber¹, F. Francis¹, G. Veneklasen², D. Hawkins¹

¹Beef Carcass Research Center, West Texas A&M University, Canyon, TX.

²Timber Creek Veterinary Clinic, Canyon, TX

Throughout history, animal breeding choices have predominantly utilized phenotypic selection. We have undertaken a unique crossbreeding project beginning with rare carcasses that exhibit highly desirable yet antagonistic traits – USDA Prime and yield grade 1. We utilized cloning technology to produce five live animals from three beef carcasses that were USDA Prime and yield grade 1. We have conducted 3 experiments to date to evaluate the carcass outcomes of progeny produced from direct clones and their offspring. In experiment 1, seven Alpha x Gamma steer calves were fed a standard commercial feedlot ration at the WT Research Feedlot for 182 days. Steer carcasses exhibited 45% more marbling concomitant with 29% lower yield grades as compared to the average U.S. beef carcass. In experiment 2, Alpha was compared to 3 reference sires in a terminal sire study. Steer and heifer calves (n = 424) were fed (176 to 257 days on feed) according to standard industry practice at a commercial feedlot and harvested at a commercial beef processor. Alpha progeny performed similar to high performing reference sires for terminal sire production traits. In experiment 3, AxG1 was compared to 4 reference sires in a terminal sire study. Steer and heifer calves (n = 392) were fed according to standard industry practice at a commercial feedlot and harvested at a commercial beef processor. AxG1 outperformed his sire and the other high performing reference sires for terminal sire production traits. This project has allowed us to highlight the role of technology in animal production, develop genetics to simultaneously improve quality and yield, and provide our students with unique learning opportunities.



PrimeOne

PrimeOne: A Public/Private Partnership

- WTAMU
 - Beef Carcass Research Center
 - Nance Ranch
 - Research Feedlot
- Timber Creek Veterinary Clinic
- Mendota Ranch
- Viagen and TransOva
- Cactus Feeders



Quality Grading

- **Marbling**
 - subjective evaluation of the quantity of intramuscular fat in the *longissimus* muscle between the 12th and 13th ribs

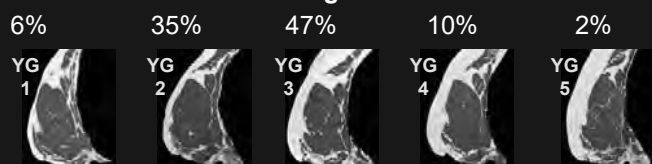
PRIME	PREMIUM CHOICE	CHOICE	SELECT	NO ROLL
8%	28%	41%	17%	6%

- **Maturity**
 - Number of permanent incisors present at harvest
 - Subjective evaluation of the extent of ossification (conversion of cartilage to bone) of the vertebral column



Yield Grading

- **Fat Thickness**
 - Linear measure of backfat
- **Rib eye Area**
 - Cross-section area of *longissimus* muscle
- **Hot Carcass Weight**
 - Weight of the freshly dressed carcass immediately prior to chilling
- **Estimated % of Kidney Pelvic and Heart Fat**
 - Subjective evaluation of weight of internal fat in relation to carcass weight

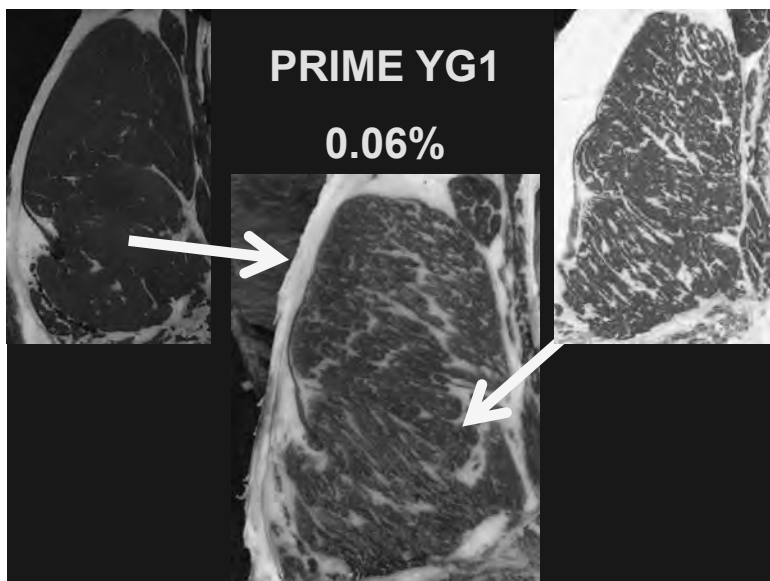
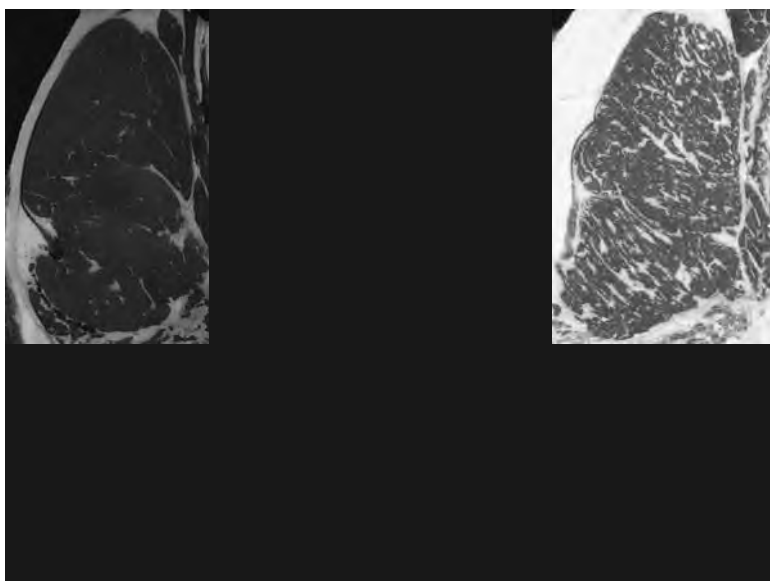
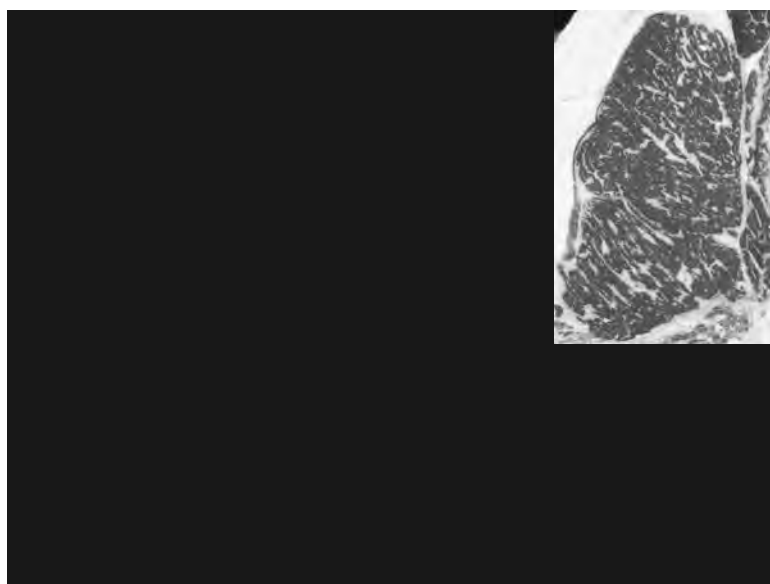
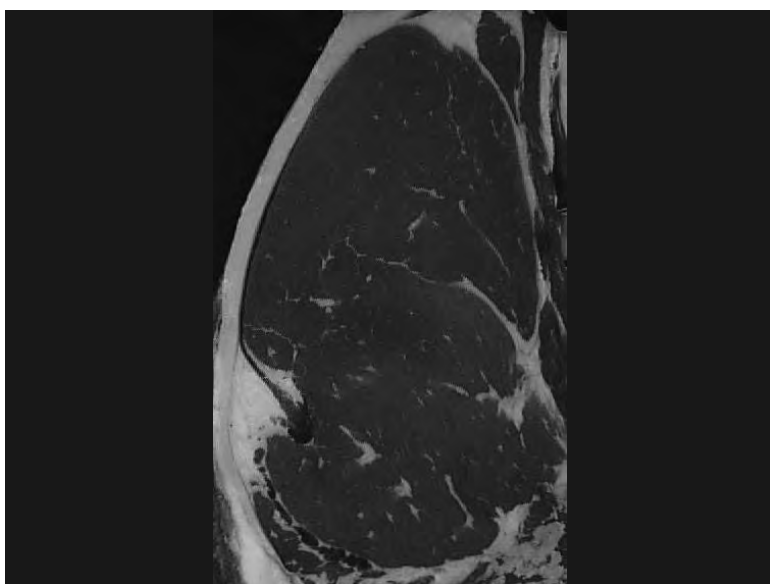
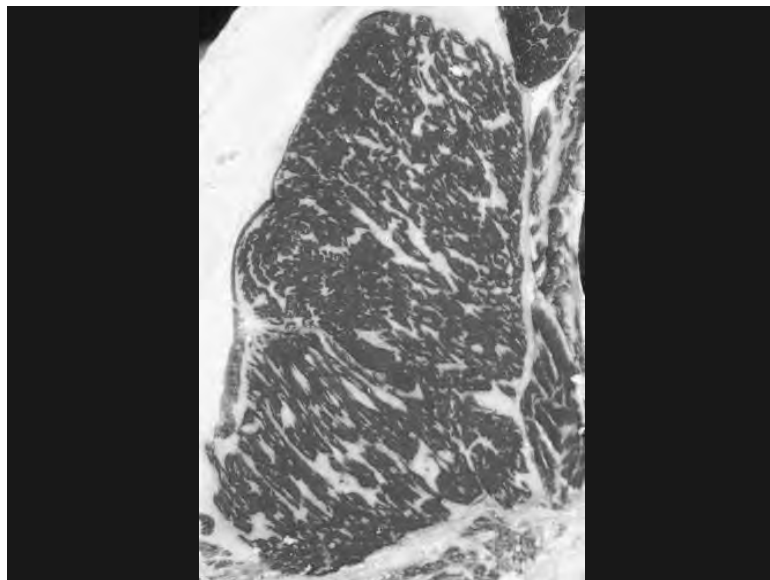


Distribution matrix of USDA QG x YG

Cumulative = 100%

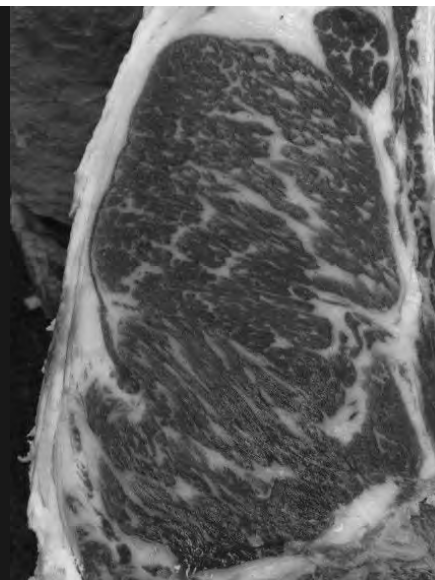
	Prime	Choice	Select	Standard	Commercial	Utility
YG 1	0.06	2.46	2.89	0.00	0.00	0.00
YG 2	1.45	24.18	9.10	0.00	0.01	0.13
YG 3	5.33	36.82	5.02	0.00	0.05	0.34
YG 4	1.76	7.81	0.55	0.00	0.04	0.14
YG 5	0.48	1.24	0.08	0.00	0.01	0.03

The Problem: QUALITY AND YIELD ARE ANTAGONISTS



Our Hypothesis: CROSSBREEDING PRIMEONE ANIMALS WILL IMPROVE QUALITY AND YIELD

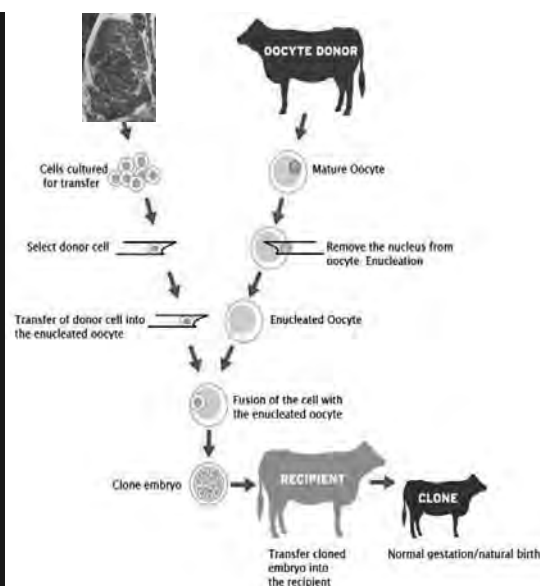
Carcasses
Found
n=45



Further DNA-based selection

- Tissue sample from clone candidates are sent to a lab that processes DNA looking for growth, quality, and palatability traits

- **Phenotype**
 - Prime-YG1
 - 1 per 1,667
- **Genotype**
 - Refine
 - 1 per 15,555



What is a Clone?

- An animal that is genetically identical to its donor, having developed from a single donated cell
- An **identical twin** from different points in time

WT

Alpha 2012



PHENOTYPIC

Sex: Steer
HCW: 782
12th rib fat: 0.44
REA: 15.9
REA/HCW: 2.03
YG: 1.98
Marbling: Slab⁷⁰
Hide: 51% Blk

Alpha 2013



GENOTYPIC

Color: EDED (Homozygous black)
Feed efficiency: MVP = -0.76 (10 percentile)
Marbling: MVP = +0.15 (30 percentile)
Tenderness: MVP = -0.59 (6 percentile)
Palatability: MVP = 429 (8 percentile)

WT

Alpha 2016

WT

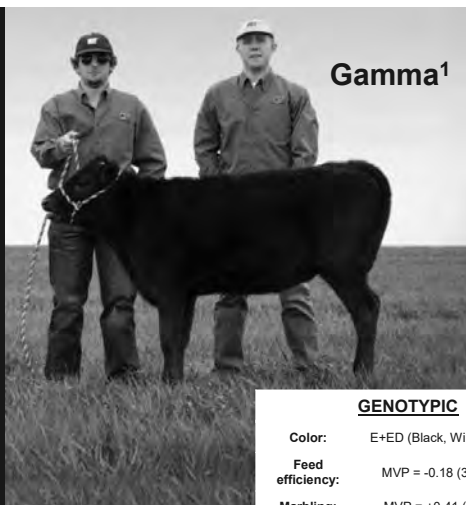


Photo by David Lust

PHENOTYPIC

Sex: Heifer
HCW: 708
12th rib fat: 0.16
REA: 15.5
REA/HCW: 2.19
YG: 1.03
Marbling: Slab¹⁰
Hide: 51% Blk

Gamma¹



GENOTYPIC

Color: E+ED (Black, Wild type carrier)
Feed efficiency: MVP = -0.18 (30 percentile)
Marbling: MVP = +0.41 (5 percentile)
Tenderness: MVP = -0.28 (30 percentile)
Palatability: MVP = 454 (6 percentile)

WT

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12th rib fat: 0.16
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Gamma^{2,3}

Experiment 1: Alpha x Gamma¹²³



Alpha x Gamma calves

9 bulls
(7 steers)
4 heifers

WTAMU Research Feedlot



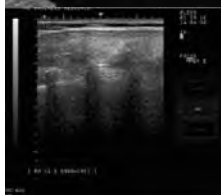
Alpha x Gamma Calves

7 steers



Alpha x Gamma Calves

7 steers

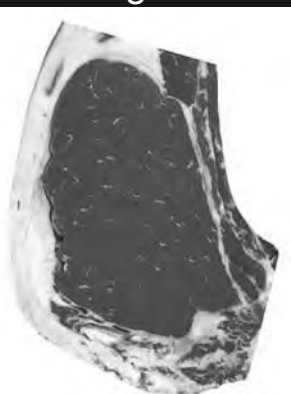


DOF	BW	Backfat	IMF	Prime	REA
77	916	0.34	8.2%	3/7	12.0
137	1095	0.42	8.7%	4/7	12.9
180	1222	0.50	8.9%	5/7	14.1

MARBLING SCORE

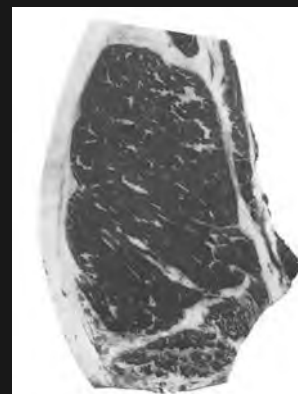
Average steer

AxG steers



Small⁴⁰

+
45%

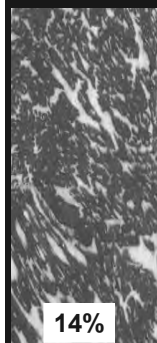


Moderate³⁰

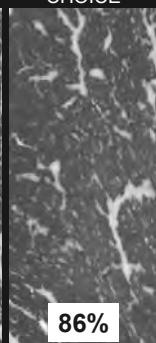
AxG Quality Grades

PRIME

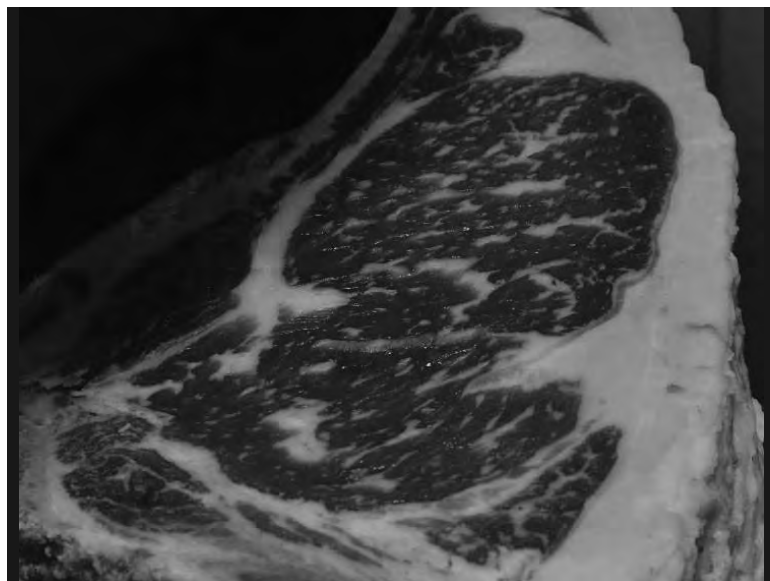
PREMIUM
CHOICE



14%



86%



RIBEYE AREA

Average steer

AxG steers

+ 9%

13.76 in²

15.03 in²

REA:HCW¹⁰⁰

Average steer

AxG steers

+
18%

1.67 in²

1.96 in²

YIELD GRADE

Average steer

AxG steers

- 28%

2.9

2.1

AxG Yield Grades

1

2

14%

86%



Experiment 2: Terminal Sire Comparison



Alpha



WTAMU "Alpha" clone of USDA P1 Carcass

Angus



29AN1688 RITO REVENUE

CW	Marb	REA	FAT
+29	+1.53	+42	+0.82
.80	.78	.75	.78
65%	1%	50%	95%

ABS Global, 2018

Simmental



29SM0390 SURE BET

CW	YG	Marb	BF	REA
+16.6	-.49	+36	-.109	+78
.84	.62	.83	.78	.82
95%	40%	2%	65%	65%

ABS Global, 2018

Charolais



ANJOU PURE POWER 184Y

CW	REA	FAT	MARB
26	1.01	-0.011	0.07
0.10	0.10	0.08	0.05
15	4	25	60

AICA, 2018

Cow Facility



Feeding Facility



Table 1. Heifer carcass metrics for all sires in study

Outcome	Alpha	Angus	Charolais	Simmental	SEM	P- Value
n	41	58	74	50	-	-
Feedlot arrival weight, kg	270.8	259.9	269.9	269.0	15.5	0.07
Hot carcass weight, kg	368.5	369.0	373.1	370.4	6.9	0.82
Fat, cm	1.5 ^b	1.8 ^a	1.1 ^c	1.5 ^b	0.1	<0.01
Longissimus muscle area, cm ²	95.2 ^b	90.2 ^c	99.9 ^a	93.3 ^{bc}	1.5	<0.01
Calculated yield grade	2.82 ^b	3.44 ^a	2.22 ^c	2.99 ^b	0.1	<0.01
Marbling score ¹	509 ^b	587 ^a	446 ^c	492 ^b	11.6	<0.01
Empty body fat ² , %	30.4 ^b	33.2 ^a	27.8 ^c	30.7 ^b	0.3	<0.01
Total carcass value	1562.90	1565.71	1583.00	1571.66	29.7	0.81
Carcass value per cwt	192.66	192.55	192.47	192.61	0.1	0.47

¹Marbling score: 400 = small⁹⁰, minimum required for U.S. Low Choice; 500 = modest⁹⁰, minimum required for U.S. Premium Choice.

² $17.76207 + (4.68142 \times 12^{\text{th}} \text{ rib fat, cm}) + (0.01945 \times \text{HCW, kg}) + (0.81855 \times \text{quality grade})$; 4 = Select, 5 = Choice-, 6 = Choice, 7 = Choice+, 8 = Prime) - (0.06754 x longissimus muscle area, cm²); Gulroy et al. (2002).

No difference ($P > 0.05$) was detected between sire groups for liver and lung health.

Table 2. Steer carcass metrics for all sires in study

Outcome	Alpha	Angus	Charolais	Simmental	SEM	P- Value
n	42	50	50	59	-	-
Feedlot arrival weight, kg	293.6 ^a	284.3 ^b	296.9 ^a	297.4 ^a	14.6	<0.01
Hot carcass weight, kg	413.8 ^b	420.6 ^{ab}	431.3 ^a	426.2 ^a	7.6	0.05
Fat, cm	1.5 ^b	2.0 ^a	1.1 ^c	1.6 ^b	0.08	<0.01
Longissimus muscle area, cm ²	96.8 ^b	90.7 ^c	102.6 ^a	96.2 ^b	1.1	<0.01
Calculated yield grade	3.16 ^b	4.05 ^a	2.59 ^c	3.40 ^b	0.1	<0.01
Marbling score ¹	504 ^b	586 ^a	420 ^c	489 ^b	14.1	<0.01
Empty body fat ² , %	31.4 ^b	35.0 ^a	28.5 ^c	32.0 ^b	0.5	<0.01
Total carcass value	1757.91 ^b	1787.41 ^{ab}	1831.42 ^a	1816.22 ^a	31.8	0.04
Carcass value per cwt	192.47 ^a	191.92 ^b	191.82 ^b	192.10 ^b	0.1	<0.01

¹Marbling score: 400 = small⁹⁰, minimum required for U.S. Low Choice; 500 = modest⁹⁰, minimum required for U.S. Premium Choice.

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No difference ($P > 0.05$) was detected between sire groups for liver and lung health.

Table 3. USDA carcass yield and quality grades of heifers

Outcome	Alpha	Angus	Charolais	Simmental	P- Value
n	41	58	74	50	-
Quality grade, %					
Prime	2.4	19.0	0	0	0.25
CAB ¹	42.9 ^a	43.1 ^a	1.4 ^b	48.1 ^a	<0.01
Choice	47.6 ^b	31.0 ^b	79.7 ^a	50.0 ^b	<0.01
Select	7.1	6.9	18.9	1.9	0.06
Yield grade, %					
1	2.4 ^b	1.7 ^b	47.3 ^a	7.7 ^b	<0.01
2	71.4 ^a	31.0 ^c	47.3 ^{bc}	57.7 ^{ab}	<0.01
3	26.2 ^{ab}	46.6 ^a	5.4 ^c	23.1 ^b	<0.01
4	0	20.7	0	0	0.66
5	0	0	0	0	1.0

Table 4. USDA carcass yield and quality grades of steers

Outcome	Alpha	Angus	Charolais	Simmental	P- Value
n	42	50	50	59	-
Quality grade, %					
Prime	2.4	22.5	0	0	0.19
CAB ¹	35.7	42.9	0	35.1	0.85
Choice	59.5 ^a	32.7 ^b	70.0 ^a	54.4 ^a	0.02
Select	2.4 ^b	2.0 ^b	28.0 ^a	10.5 ^b	0.01
Yield grade, %					
1	2.4	0	20.0	3.5	0.06
2	35.7 ^{ab}	2.0 ^c	56.0 ^a	29.8 ^b	<0.01
3	57.1 ^a	44.9 ^a	22.0 ^b	54.4 ^a	0.02
4	4.8 ^b	46.9 ^a	0 ^b	12.3 ^b	<0.01
5	0	6.1	0	0	1.00

Genetic Evaluation -EPDs

Sire	CW	YG	Mrb	BF	REA
Surebet	16.2	-0.47	0.29	-0.105	0.75
Rito Revenue	30.2	0.33	1.32	0.118	0.17
PurePower	19.9	-1.02	-0.38	-0.256	1.32
ALPHA	16.2	-0.3	0.56	-0.031	0.78

Experiment 3: Terminal Sire Comparison



Alpha x Gamma¹ Bull



Photo by Jessica Sperber

Preliminary Results

Carcass characteristics for steer and heifer progeny					
Outcome	Alpha	AxG1	Rampage	Surebet	Protege
n	79	105	72	91	45
HCW, kg	381	387	404	388	396
12 th rib fat, cm	1.62	1.55	1.66	1.60	1.65
LM area, cm ²	90.9	93.6	92.7	93.2	89.8
Yield grade	3.29	3.14	3.44	3.23	3.51
Marbling score	Mt 61	Md 10	Mt 46	Mt 32	Mt 28
Prime, %	11.4	23.5	4.1	2.2	4.4
CAB, %	54.4	53.9	42.3	53.9	37.8
Choice, %	34.2	21.6	46.6	42.9	48.9
Select, %	0	1.0	6.9	1.1	8.9
YG 1, %	1.3	6.9	2.7	2.2	4.4
YG 2, %	36.7	30.4	23.3	33.0	15.6
YG 3, %	44.3	53.9	52.1	50.6	51.1
YG 4, %	16.5	8.8	20.6	14.3	28.9
YG 5, %	1.3	0	1.4	0	0

Summary

- Alpha progeny performed comparably to high performing reference sires for terminal sire production traits
- AxG1 progeny outperformed high performing reference sires for terminal sire production traits

Our Goals

- Develop genetic opportunities to improve beef quality and yield
- Improve beef production efficiency
- Highlight the role of technology in agriculture
- Provide unique learning opportunities for students



For More Information

Ty Lawrence, Ph.D.
 Professor of Animal Science
 Director, Beef Carcass Research Center
 West Texas A&M University
 WT Box 60998
 Canyon, TX 79016
 Office – 806-651-2560
 Mobile – 806-681-9861
 BCRC – 806-651-2275
 Meat Lab – 806-651-2565
 Fax – 806-651-2938
 Email – tlawrence@wtamu.edu

