Feed Efficiency for Breeding Cattle

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Improving Efficiency in a Cattle Operation

- **Economic efficiency**

  When the cost of producing a given output is as low as possible

- **Biological efficiency**

  Capacity to convert feed into beef

Need to know what you expect a cow to do?

- Calve by 24 or 36 months of age
- Cow must have a calf every 365 days
- Cow must calve without assistance
- Cow must provide sufficient resources for the calf to reach it's genetic potential
- Calf must be genetically capable to perform
- Cows must maintain their body condition score
- Must not be crazy (disposition)

Planning for the future

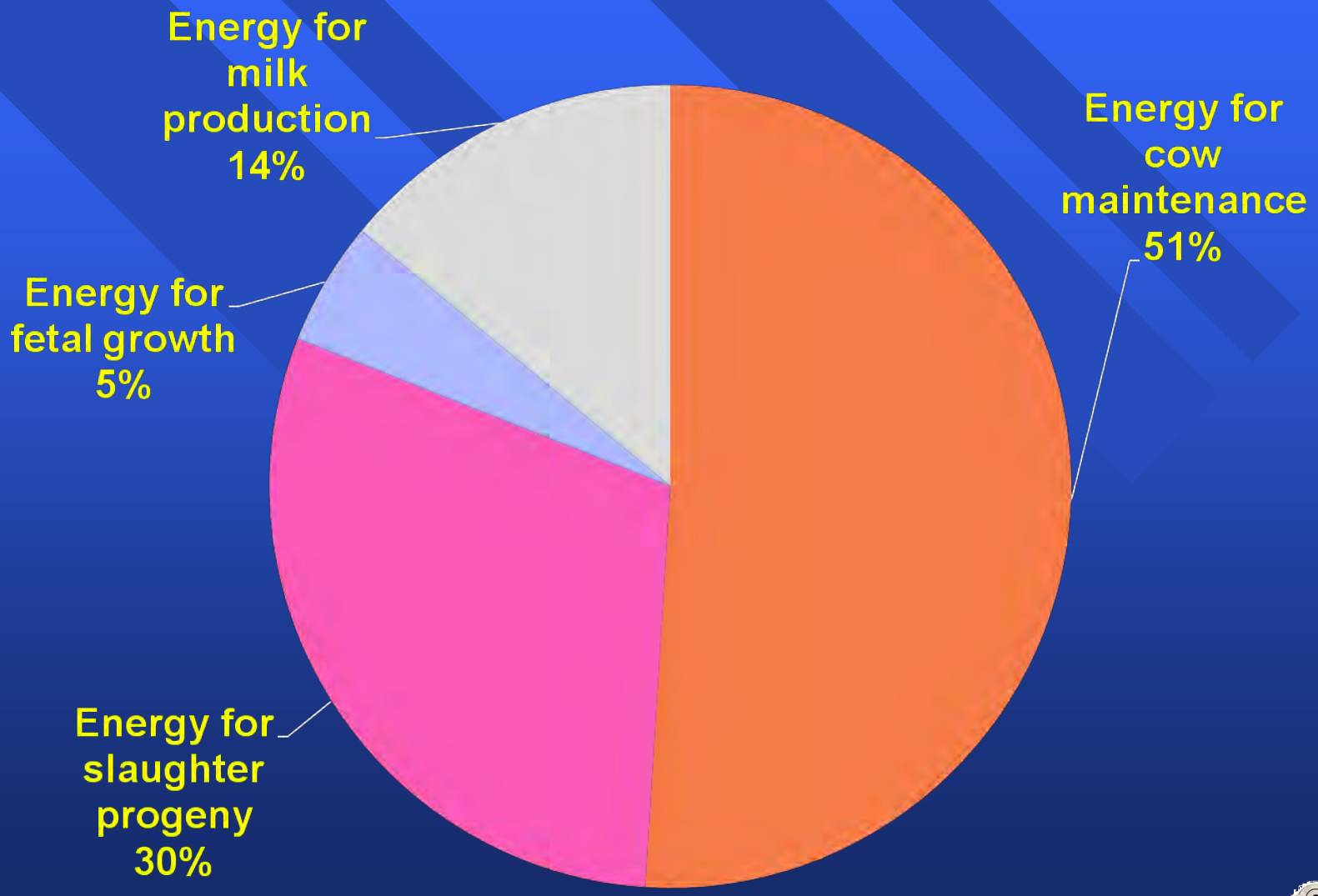
- Beef cattle have long generation intervals (4 to 6 years)
- You cannot make genetic progress by altering directions every year to five years
- Set specific selection goals

Feeding costs comprise 50 to 70% of total annual beef cow enterprise costs!!!!

Factors that Affect Nutrient Requirements

- Body Weight
- Breed or Genotype
- Age
- Temperature
- Physiological State
- Previous Nutrition

Energy Requirements in a Herd



Factors Contributing Female Efficiency

- Nutrition
- Reproduction
- Management

Feed Efficiency Facility (FEF)

Capacity:
480 head

No. of pens:
24 pens

Feed Efficiency Facility and Equipment

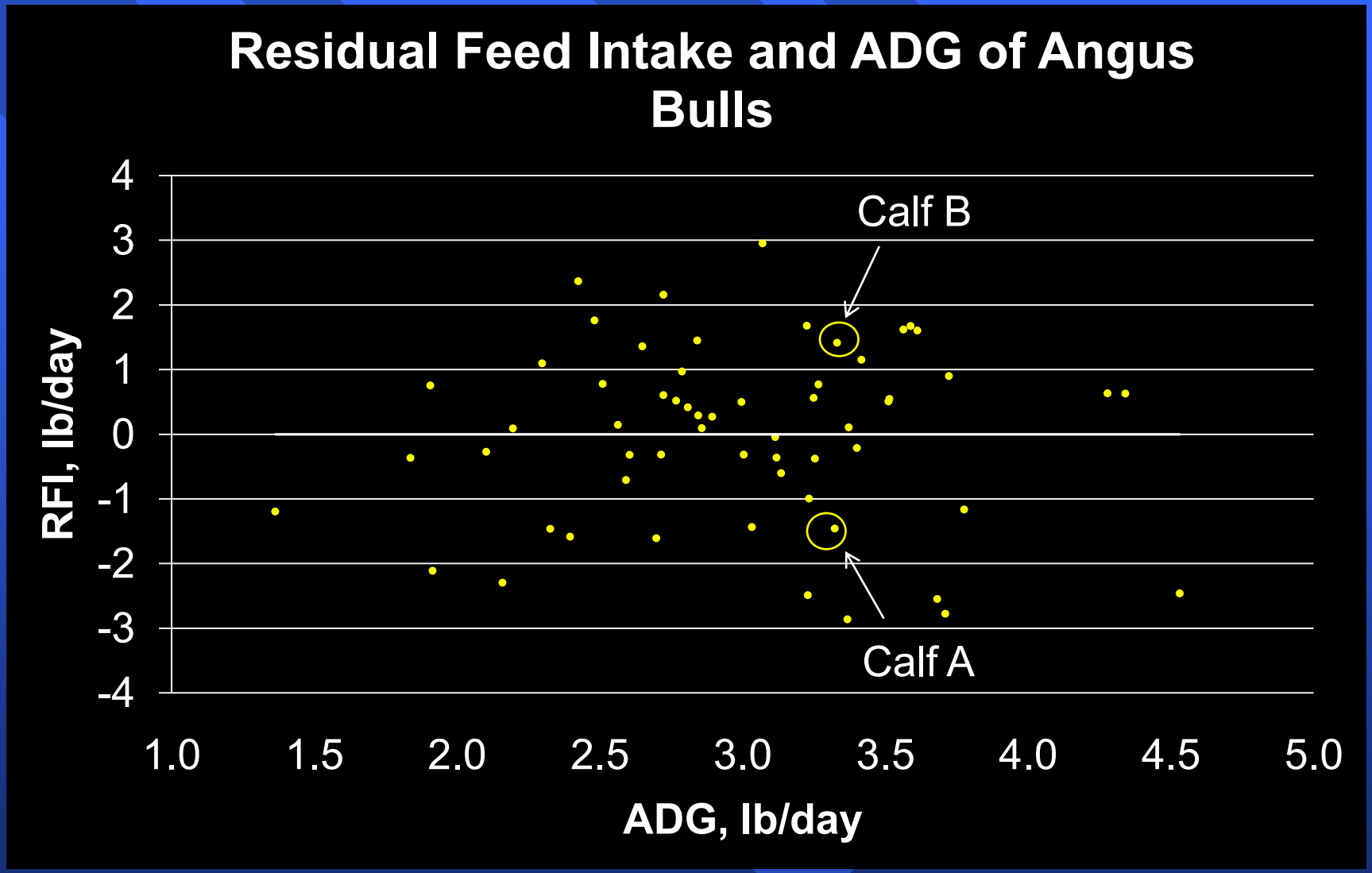
GrowSafe Feed and water intake system

Selecting Genetics for Feed Efficiency

Top 25 Active ABS Sires for Feed Efficiency

Name	Feed Efficiency Index	Feed Efficiency Rank	ADG EPD (lb/day)	ADG Rank	Intake EPD (lb/day)	Intake Rank
29AN1569 BANDWIDTH	$ 26.38	Top 1%	+.20	Top 1%	-.04	Top 30%
29AN1610 MAJOR DESIGN	$ 19.77	Top 1%	+.16	Top 1%	+.04	Top 50%
29AN1530 POWER DESIGN	$ 19.34	Top 1%	+.22	Top 1%	+.48	
29AN1623 ALLIANCE I87	$ 16.33	Top 1%	+.10	Top 10%	-.19	Top 15%
29AN1650 DAYBREAK	$ 15.89	Top 1%	+.16	Top 1%	+.25	
29AN1646 POUNDMAKER	$ 15.03	Top 2%	+.11	Top 10%	-.05	Top 30%
29AN1616 NEW LEVEL	$ 12.98	Top 2%	+.12	Top 4%	+.13	
29AN1606 EXCEED	$ 12.65	Top 3%	+.09	Top 10%	-.06	Top 30%
29AN1664 PREFERENCE	$ 12.30	Top 3%	+.24	Top 1%	+1.00	
29AN1619 MORGANS DIRECTION	$ 11.11	Top 4%	+.14	Top 3%	+.37	
29AN1633 SHEAR FORCE	$ 10.23	Top 5%	+.10	Top 10%	+.14	
29AN1620 4 POINT 8	$ 9.73	Top 5%	+.05	Top 35%	-.18	Top 15%
29AN1653 MAINLINE	$ 9.63	Top 10%	+.15	Top 2%	+.52	
29AN1634 INNOVATOR	$ 9.20	Top 10%	+.03	Top 50%	-.29	Top 5%
29AN1644 EXTRA K205	$ 9.10	Top 10%	+.12	Top 4%	+.34	
29AN1524 TRAVELER 234D	$ 9.03	Top 10%	+.02		-.35	Top 3%
29AN1618 PRIME CUT 0145	$ 8.78	Top 10%	-.09		-1.10	Top 1%
29AN1574 OBJECTIVE	$ 7.66	Top 15%	+.09	Top 10%	+.21	
29AN1589 FORESIGHT	$ 6.62	Top 15%	+.03	Top 50%	-.15	Top 15%
29AN1671 GRAHAM 52170	$ 6.06	Top 20%	+.03	Top 50%	-.12	Top 20%
29AN1608 ANALYST	$ 5.62	Top 25%	+.10	Top 10%	+.39	
29AN1617 CONNECTION X15	$ 4.61	Top 30%	+.01		-.18	Top 15%
29AN1597 RITO PRIME	$ 4.56	Top 30%	+.05	Top 35%	+.10	
29AN1640 IN FOCUS	$ 3.44	Top 40%	+.06	Top 25%	+.23	
29AN1551 DESTINATION 928	$ 3.25	Top 40%	+.07	Top 20%	+.31	

ABS sires currently range from a high of +$26.38 to a low of -$20.19.

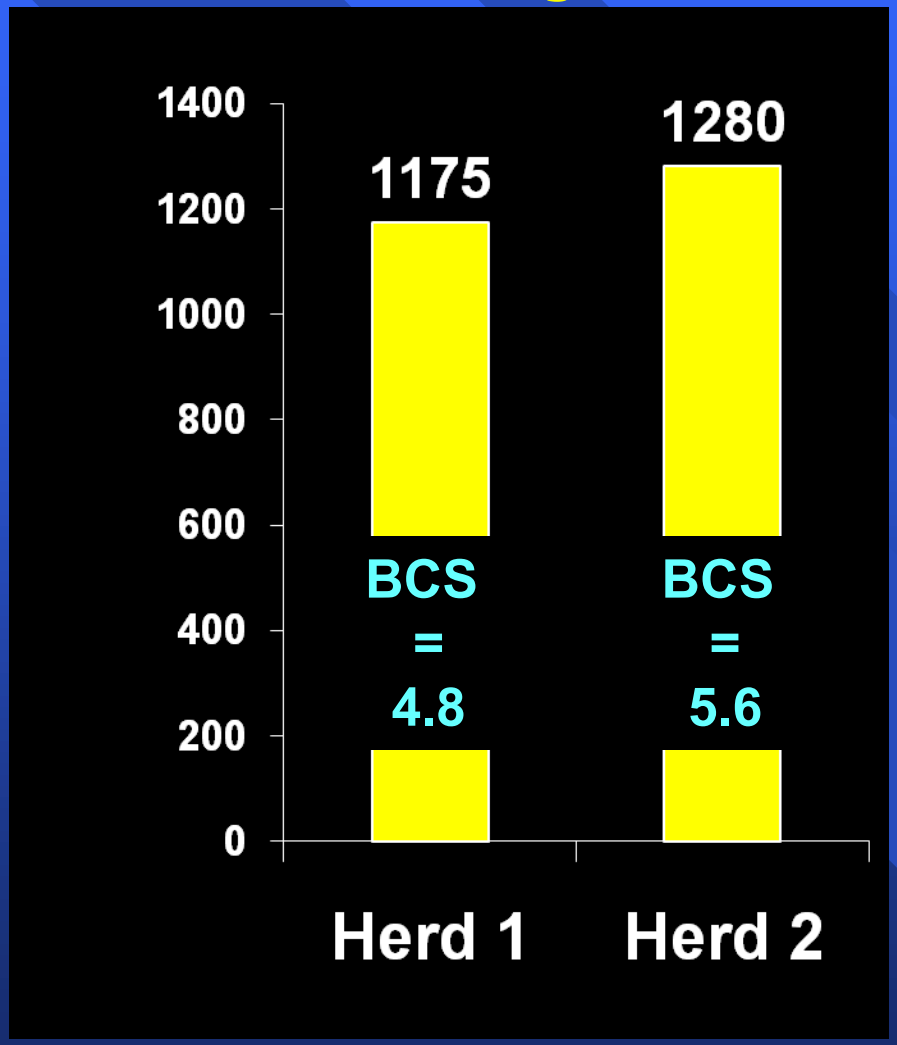

Residual Feed Intake and ADG of Angus Bulls
RFI, lb/day
4
3
2
1
0
-1
-2
-3
-4
Calf B
Calf A
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
ADG, lb/day

Differences between Calf A and Calf B

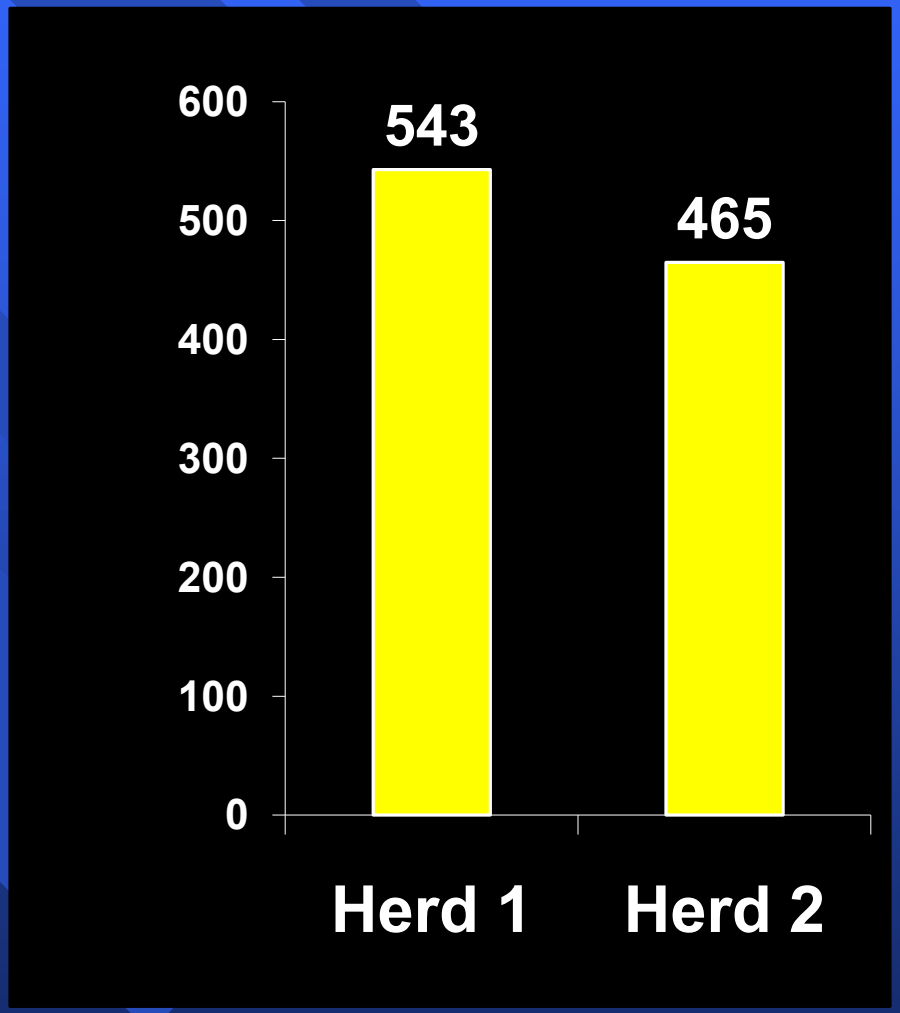
Item	CALF A	CALF B
Initial wt, lbs	819	819
Final wt, lbs	1,051	1,051
ADG, lbs/d	3.32	3.32
Daily intake	22.86	25.76
Feed consumed in 70 d, lbs	1,600	1,803
Difference in Feed consumed In 70 d, lbs		203

Herd Efficiency - Example

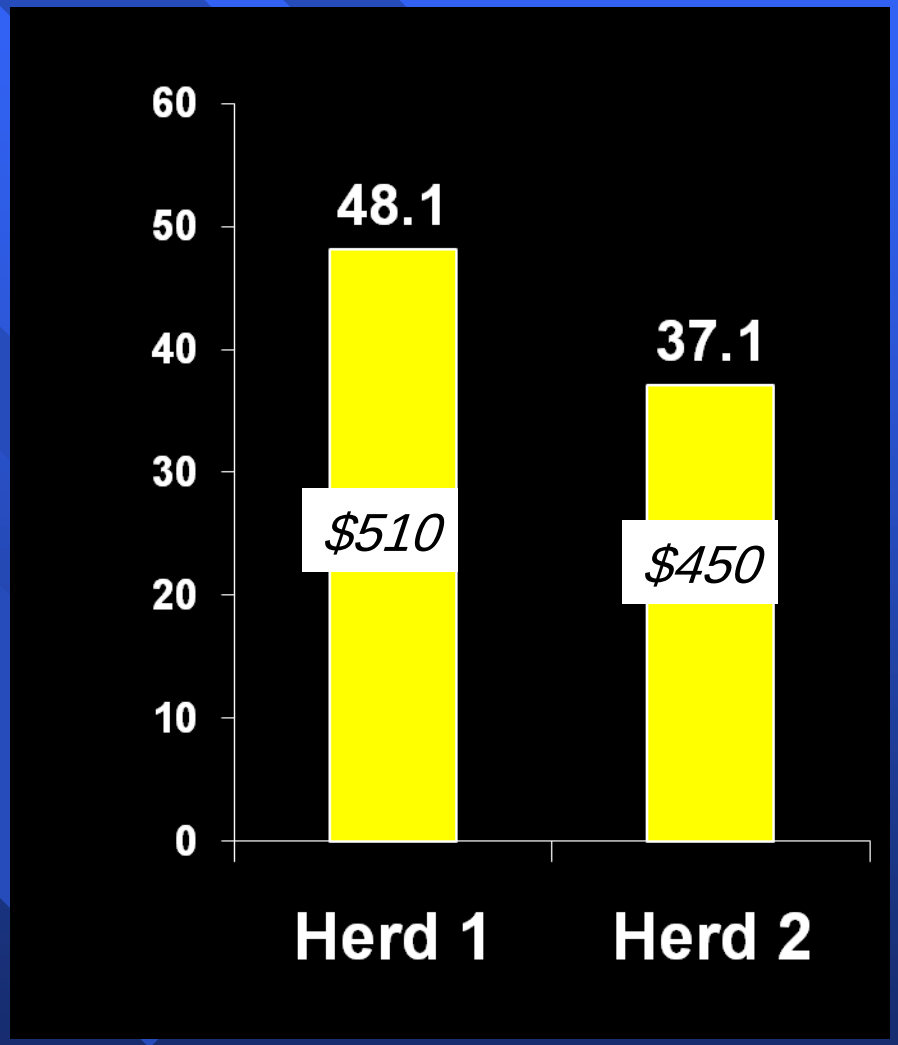
Cow weight



Calf weaning weight



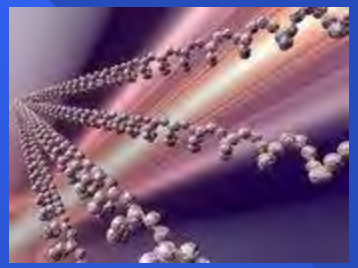
Herd Efficiency



Weaning Efficiency = Calf weaning wt/Cow wt x 100

PHENOTYPE

=



Genotype

+

Environment

+

Random variation

Using Genetic Markers as Selection Tools

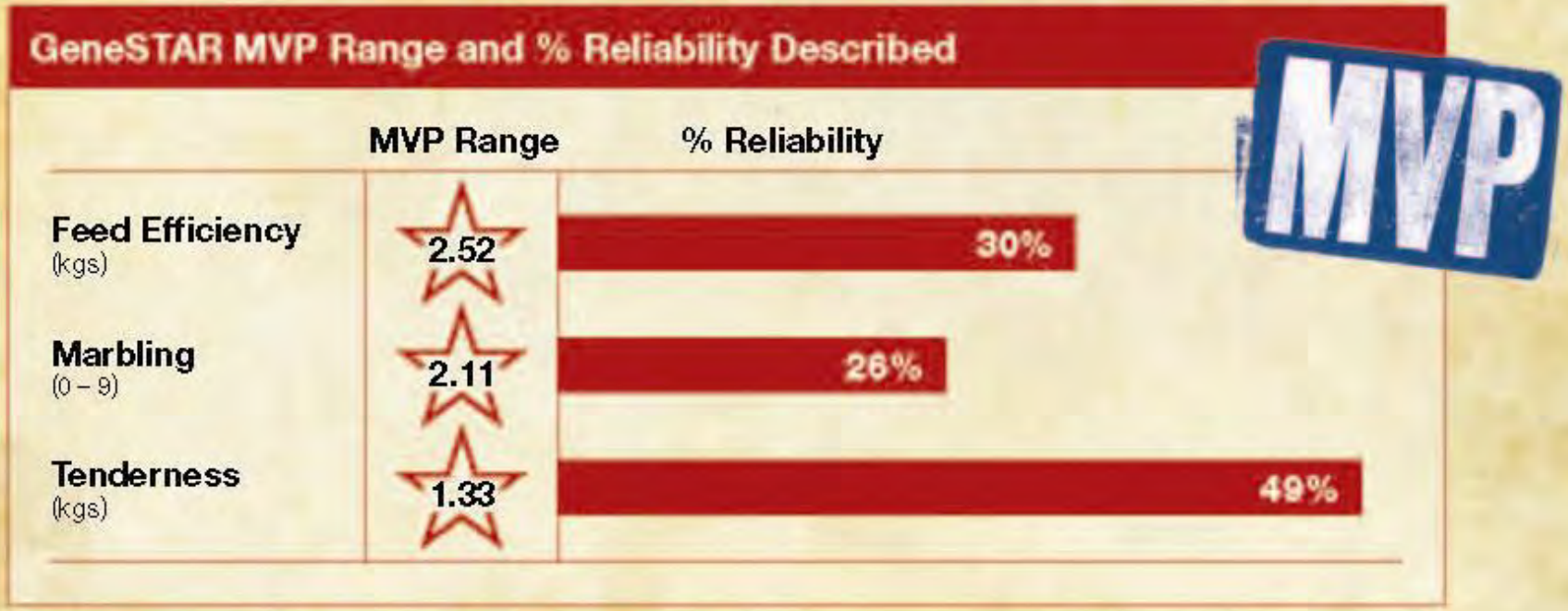
GeneSTAR®

igenity®

Pfizer Pfizer Animal Health

MERIAL

Reliability of Gene Markers?



MVP = Molecular Value Predictions

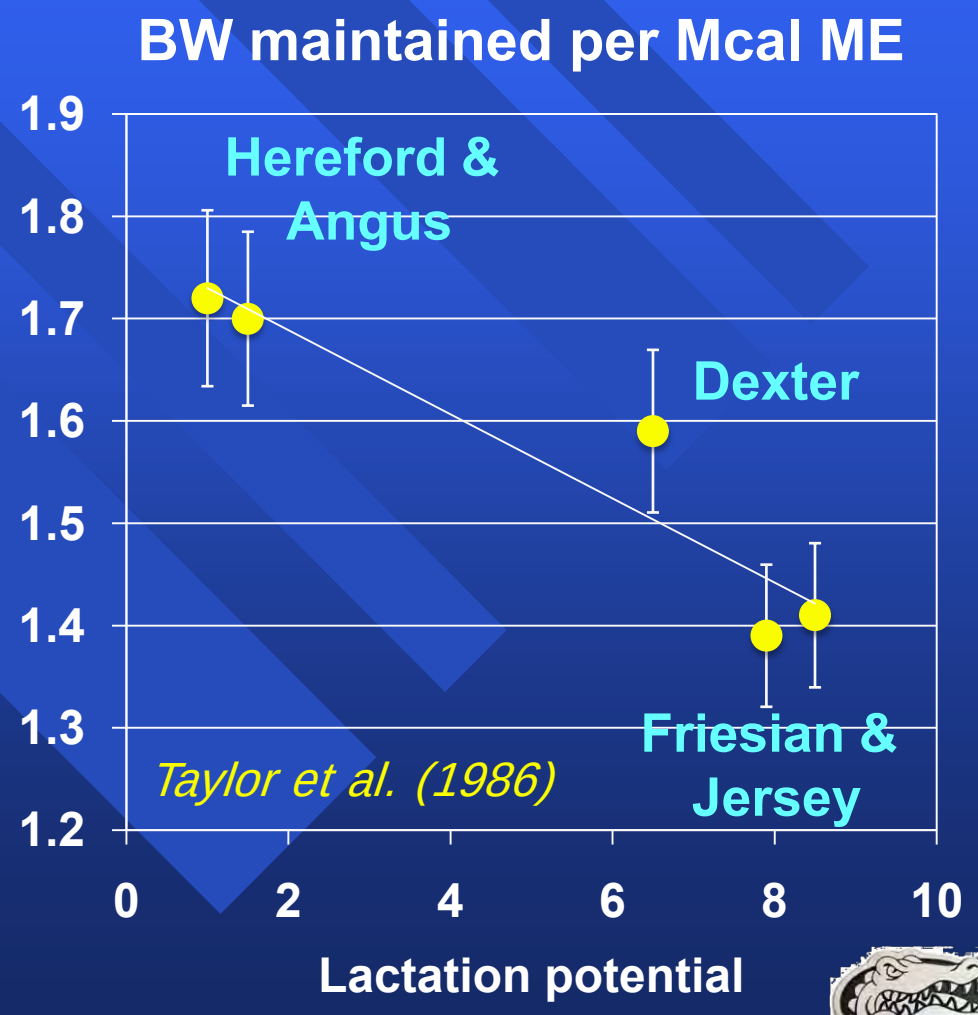
Measuring Feed Efficiency

Trait	Definition	Formula	Favorable phenotype
Gross efficiency	Weight gain per unit DMI	ADG ÷ DMI	High
Feed Conversion Ratio (FCR)	Actual DMI per unit gain	DMI ÷ ADG	Low
Residual feed intake (RFI)	Actual DMI net expected DMI based on MBW and ADG	Expected DMI from linear regression of DMI on MBW and ADG	Low

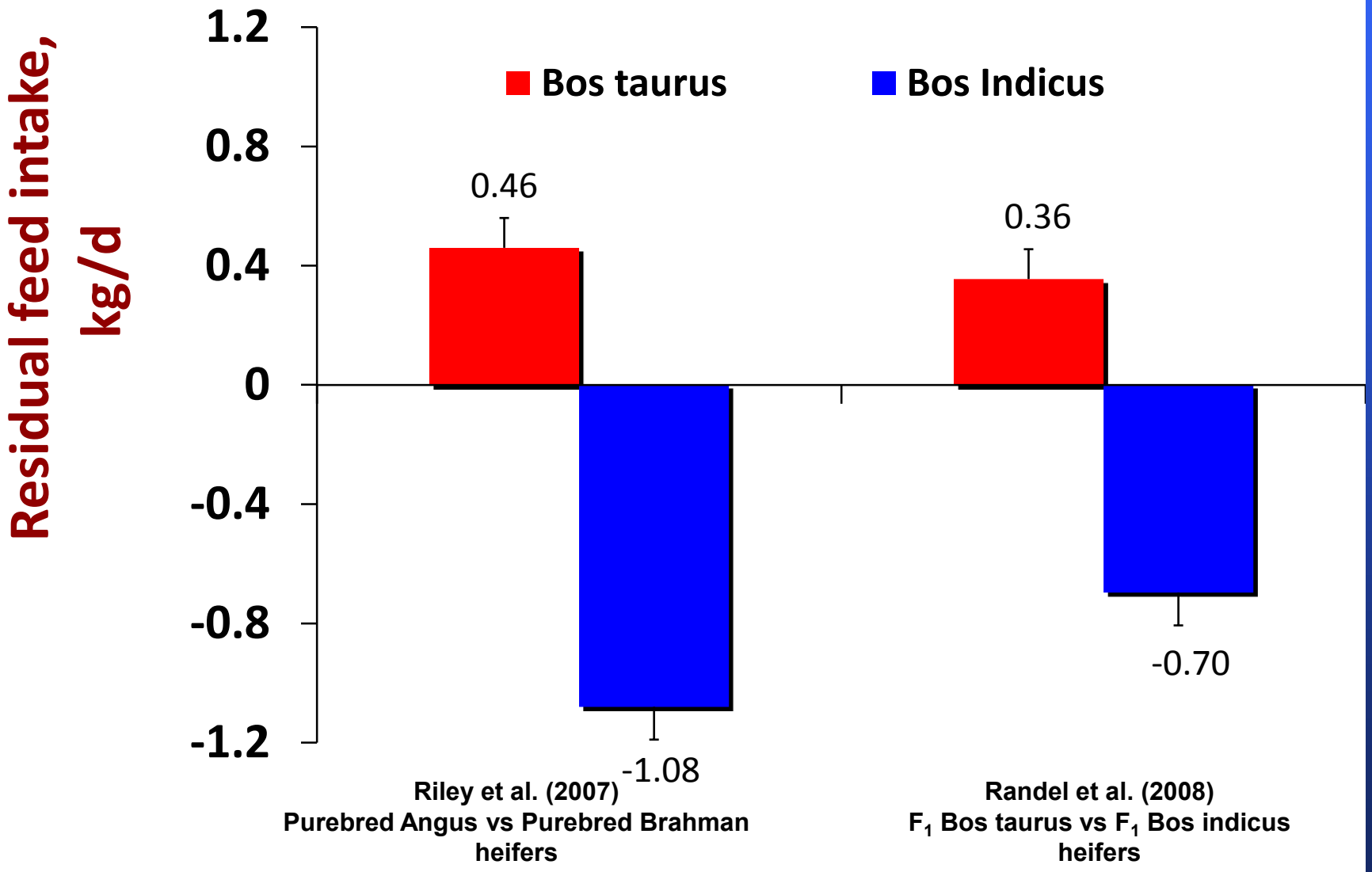
Genetics of maintenance energy requirements: Between-Breed Variation

Breed differences exist in cow maintenance efficiency:

- Dairy breeds >
- Beef Bos taurus breeds >
- Bos indicus breeds
- Genetic antagonisms between maintenance energy requirements and level of productivity (e.g., growth, milk)

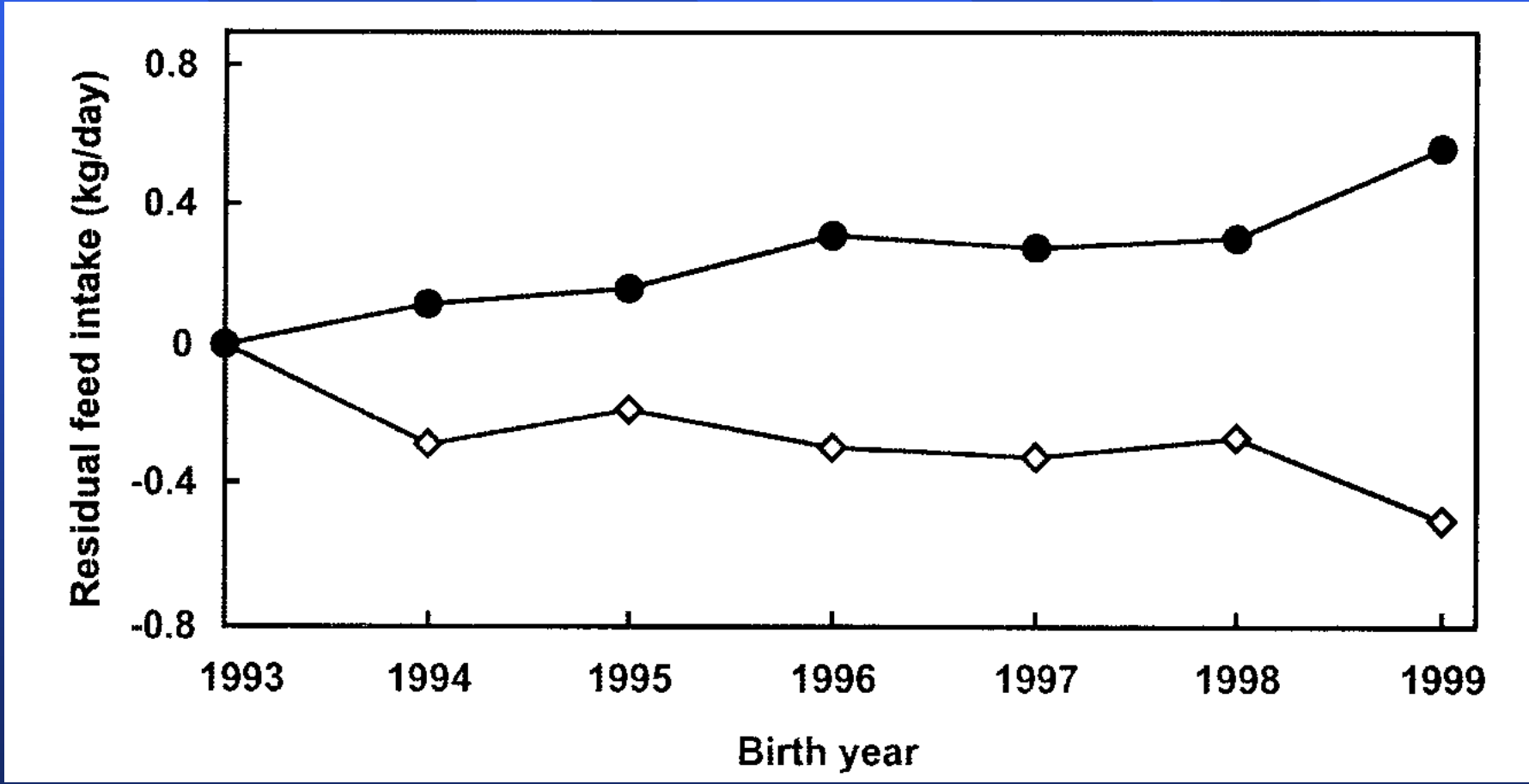


Between-breed variation in RFI of growing bulls



Response to selection for postweaning RFI in Angus cattle

Direct selection response (high vs low line) = 0.25 kg/d per year



Arthur et al. (2001)

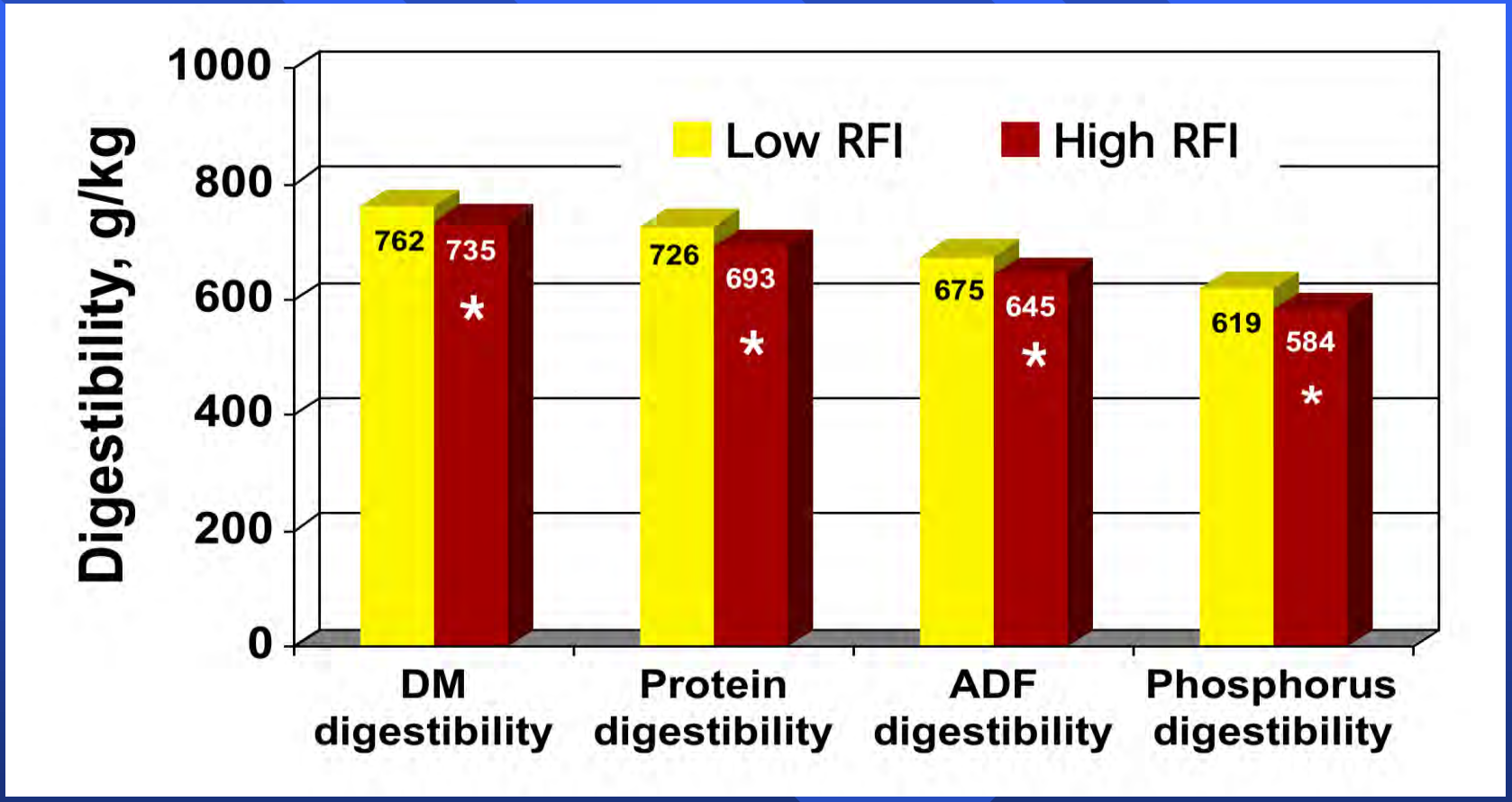
Performance and efficiency traits for Brangus heifers with low and high RFI phenotypes

Trait	Low RFI	High RFI	SE	High vs Low RFI
No. of heifers	150	142	---	---
Weaning BW, lbs	530	519	5.7	---
Initial BW, lbs	598	596	6.8	---
ADG, lbs/day	2.22	2.22	0.04	---
DMI, lbs/day	**19.3[a]**	**22.7[b]**	**0.20**	**18.4%**
RFI, lbs/day	**-1.72[a]**	**1.83[b]**	**0.08**	3.55 lbs/d
Feed:gain ratio	**8.75[a]**	**10.42[b]**	**0.13**	**19.1%**

[a,b]Means differ at $P < 0.001$

Lancaster et al. (2007)

Nutrient digestibilities of Brangus heifers with divergent RFI phenotypes



Low RFI heifers:

- ✓ **Excreted 32% less ($P < 0.05$) fecal DM**
- ✓ **Excreted 36% less ($P < 0.05$) fecal nitrogen**

(Krueger et al., 2008)

Associations between feed efficiency in feedlot progeny and mature forage-fed cows

- ✓ *Calves ranked by RFI phenotype on fed high-grain diet*
- ✓ *Intake of cows that produced calves with divergent RFI calves measured while fed high-roughage diet*

	Calf RFI phenotype group		
Trait	Low	Medium	High
No. of calves tested	63	83	73
Calf RFI, kg/day	-0.78[a]	-0.09[b]	0.64[c]
No. of cows tested	26	40	45
Cow DM intake, kg/day	10.8[a]	11.3[a]	12.2[b]

[a,b,c]Means differ at $P < 0.05$.

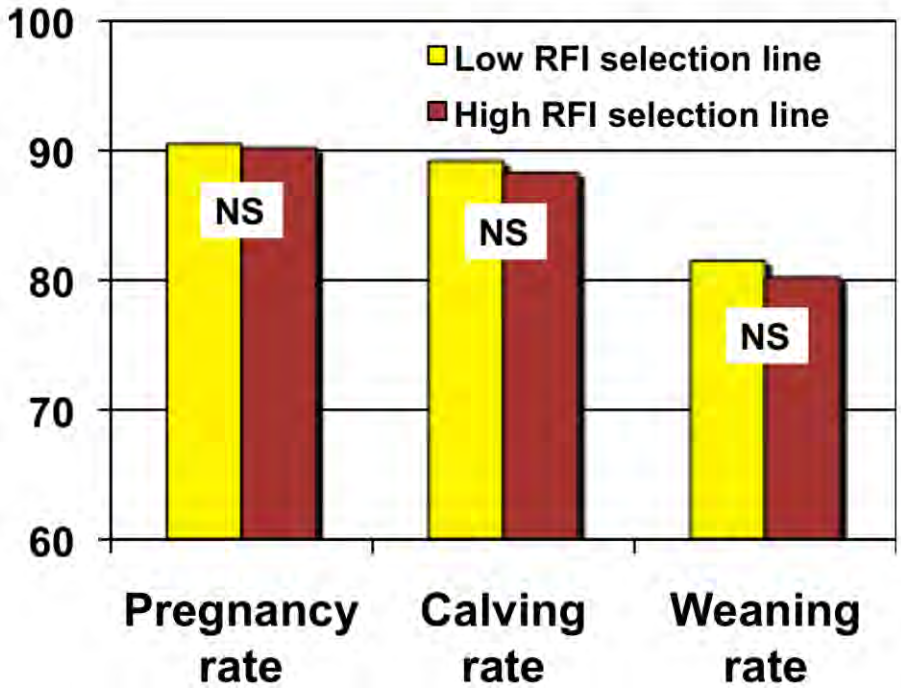
Basarab et al., 2007

Associations between postweaning RFI and efficiency of grazing cattle

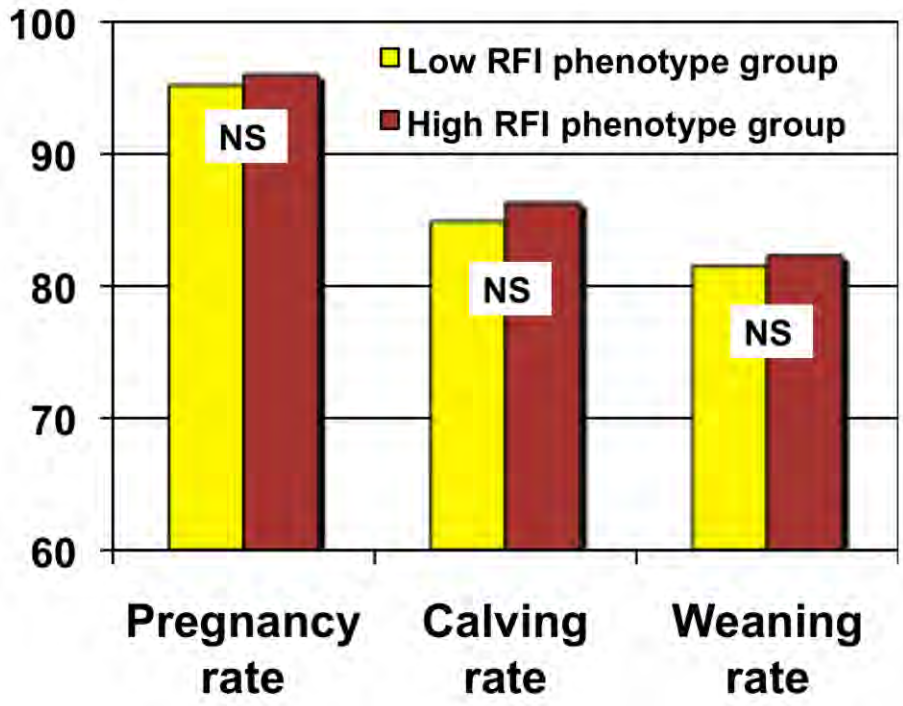
Trait	RFI selection line[1]			RFI phenotype group[2]		
	Low	High	P-value	Low	High	P-value
No. of calves	22	31	--	9	9	--
ADG, kg/d	0.50	0.42	0.10	1.07	0.95	0.10
DMI, kg/d	9.2	9.8	NS	6.9	7.4	NS
Forage: gain ratio	**10.8**	**12.2**	0.10	**6.6**	**8.2**	0.05

[1]Steers from single generation of divergent selection for RFI (Herd et al., 2002)
[2]Steers previously ranked by RFI phenotype (0.5 SD); Forbes (unpublished)

Impact on cow reproductive traits



Data from 3 mating seasons for Angus cows divergently selected for RFI (Arthur et al., 2005)



Data from 10 mating seasons for crossbred cows that produced calves with divergent RFI (Basarab et al., 2007)

Impact on reproductive traits in Brangus heifers

Trait	Low RFI	Medium RFI	High RFI	P-value
No. of heifers	112	138	98	n = 348
RFI, kg/day	**-0.77[a]**	**0.00[b]**	**0.88[c]**	**0.01**
Age at puberty, days	279	273	271	**Not different**
No. exposed to breeding	94	119	82	n = 295
Overall pregnancy rates, %	89.4	85.7	79.3	**Not different**

Lancaster et al. (2008)

Relationships between RFI and other economically relevant traits

Cow and bull reproductive traits:

- ✓ Pregnancy rates—similar in cows with divergent RFI
- ✓ Postpartum return to estrus—shorter in Brahman cows selected for low RFI
- ✓ Age at puberty—similar in Brangus heifers with divergent RFI
- ✓ Age at puberty—inconsistent results in Brahman bulls with divergent RFI

Current challenges to adoption of feed efficiency technologies

- ✓ Measuring intake still expensive even with GrowSafe technology
- ✓ More test facilities to measure feed efficiency are needed
- ✓ Uniform guidelines (BIF) for measuring intake are needed
- ✓ Accurate EPDs for RFI are needed
- ✓ Multi-trait selection indexes that incorporate RFI are needed

Current challenges to adoption of feed efficiency technologies

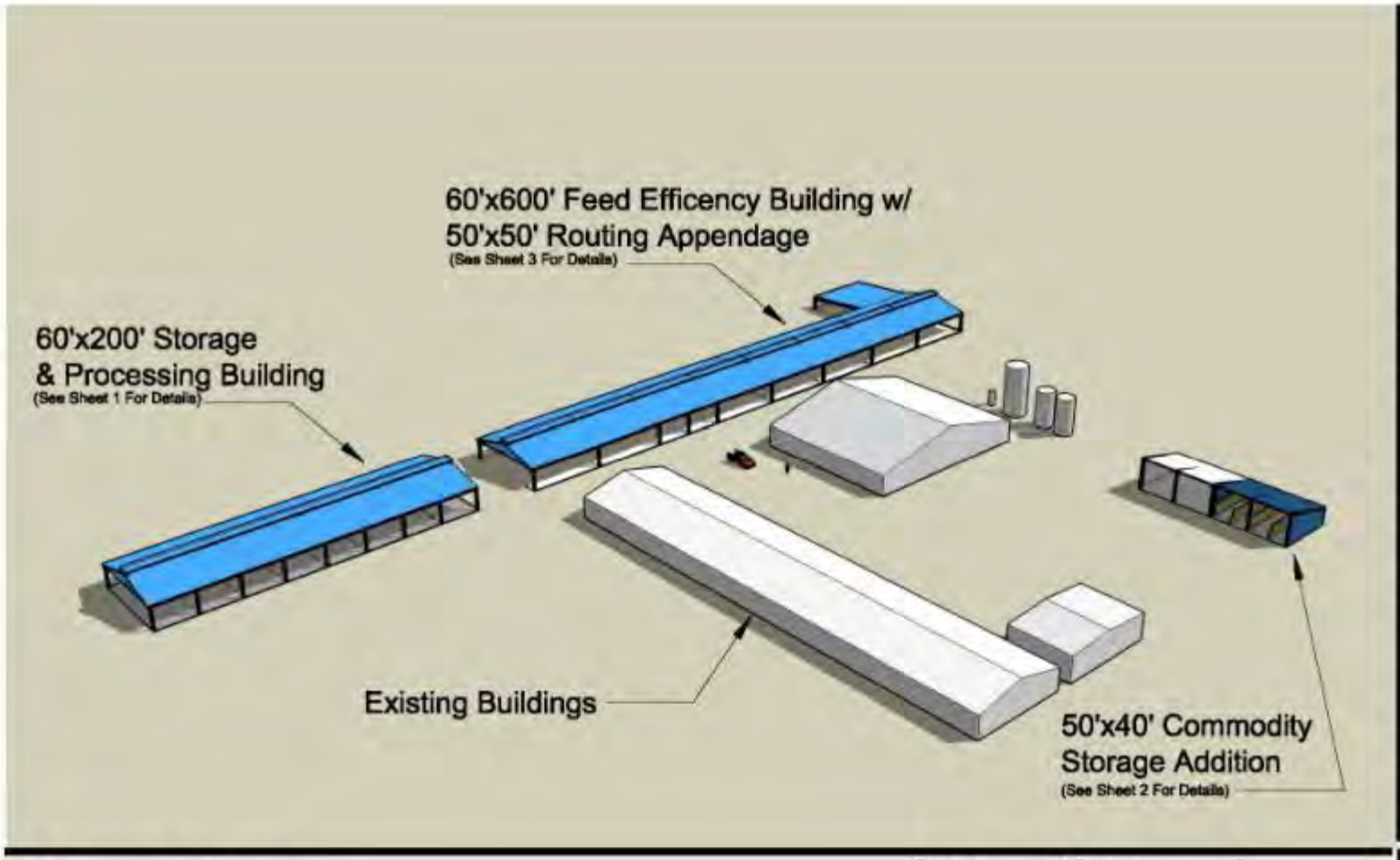
- ✓ Validation of existing and future genetic markers for RFI across multiple breeds and production environments is needed
- ✓ Indicator traits for RFI (e.g., feeding behavior traits) are needed
- ✓ Additional research needed to examine associations between RFI and mature cow efficiency across multiple production environments
- ✓ More research is warranted that examines the associations between RFI and other economically relevant traits

Opportunities to Adoption of feed efficiency technologies

Incorporation of feed efficiency into balanced-trait selection programs:

- ✓ Reduce feed costs in all sectors of the industry
- ✓ Improve profitability of integrated beef production systems
- ✓ Minimal impact on other economically relevant traits
- ✓ Reduce manure N and P excretion
- ✓ Reduce greenhouse gases (carbon offset market?)
- ✓ Reduce stocking pressure on grazing lands

Vision for the Future



UNIVERSITY OF FLORIDA - I.F.A.S.
MARIANNA FEED EFFICIENCY COMPLEX PHASE II

Cover Sheet
Overall Campus Plan

DRAWN BY: MDR
CHECKED BY: JG
DATE: 12.01.06
CAD: UF-PROTOTYPE
REVISIONS:
SHEET 0 of 3

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