

IMPACT OF *BOS INDICUS* ON THE BEEF INDUSTRY

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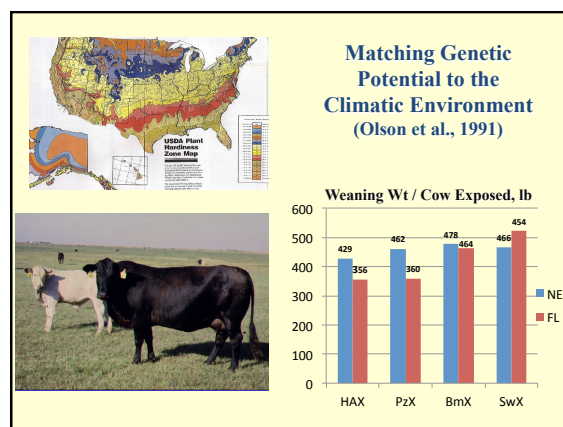
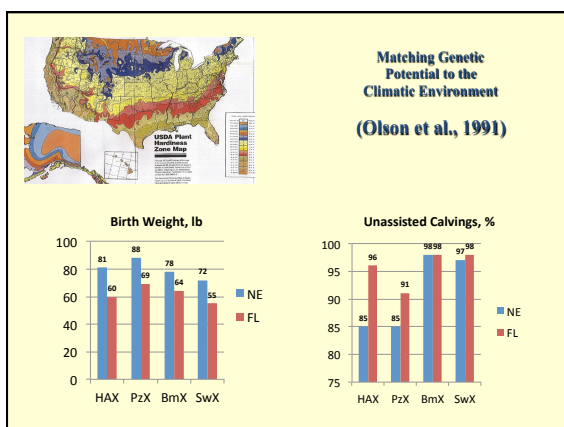
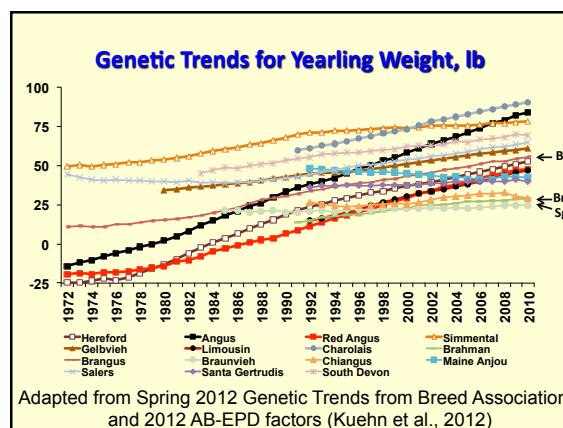
SIRE BREEDS USED TO PRODUCE F₁ CROSSES WITH ANGUS AND HEREFORD DAMS IN THE GERMLASM EVALUATION PROGRAM AT MARC^a

Cycle I 70-72	Cycle II 73-74	Cycle III 75-76	Cycle IV 86-90	Cycle V 92-94	Cycle VI 97-98	Cycle VII 99-00	Cycle VIII 01-02
Hereford Angus Jersey S. Devon Limousin Simmental Charolais	Hereford Angus Red Poll Braunvieh Gelbvieh Maine Anj. Chianina	Hereford Angus Brahman Sahiwal Pinzgauer Tarentaise	Hereford Angus Longhorn Salers Galloway Nellore Shorthorn Piedmontese Charolais Gelbvieh Pinzgauer	Hereford Angus Tuli Boran Belg. Blue Brahman Piedmontese	Hereford Angus Wagyu Norweg. Red Sw. Red&Wh. Friesian	Hereford Angus Red Angus Limousin Charolais Simmental Gelbvieh	Hereford Angus Beefmaster Brangus Bonsmara Romosinuano

Sire breeds mated to Angus and Hereford females, Composite MARC III (1/4 Angus, Hereford, Red Poll and Pinzgauer) cows were also included in Cycles V, VI, and VII.

SIRE BREED MEANS FOR WEIGHTS, FEED CONVERSION AND CARCASS TRAITS OF F₁ STEERS (447 d)

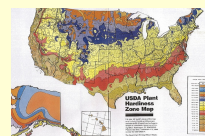
Bree Group	Birth wt lb	200 d wn lb	Final wt lb	Mcal per lb gain	Retail product %	Marb. sc	7-d Shear lb
HA and AH	78.0	448	1030	9.58	65.8	430	9.8
Brahman-X	89.5	474	1044	9.95	68.9	468	8.6
Sahiwal-X	83.1	450	972	10.15	68.6	431	9.3
Pinzgauer-X	85.8	456	1034	9.59	68.9	445	11.5
Tarentaise-X	82.0	461	1026	9.93	69.3	454	11.1
LSD _{0.05}	0.6	12	32	.25	1.0	18	.3



OUTPUT/INPUT DIFFERENCES AMONG BOS INDICUS X BOS TAURUS AND BOS TAURUS X BOS TAURUS F₂ COWS (GREEN ET AL., 1991)

Item	Overall mean	Breed group ^a (ratio)			
		HAX	PzX	BmX	SWX
Progeny (126 days)					
Weight gain, lb	284	91	98	109	102
Energy consumed, Mcal ME	596	112	102	91	93
Dams (126 days)					
Milk production, lb/day	14.6	93	113	99	94
Cow weight, lb	1,229	98	100	105	96
Fat probe, in	.46	89	92	104	115
Energy consumed, Mcal ME	3,305	94	105	104	97
Efficiency (138.5 days)					
Progeny gain, lb/Mcal ME calf + dam	.073	94	95	105	97

^aHAX = Hereford-Angus, PzX = Pinzgauer, BmX = Brahman, and SwX = Sahiwal crosses



Matching Genetic Potential to the Climatic Environment

What is the optimum proportion *Bos indicus* inheritance the temperate region of Nebraska?

Mated HAX, PzX, BmX, and SwX cows to raise reciprocal backcross and F₂ calves to study alternative *Bos indicus*:*Bos taurus* ratios of inheritance

100:0 HA & AH cows mated to H, A, HA & AH bulls
PzH & PzA cows mated to H, A, Pz, PzH and PzA bulls

25:75 BmH & SwH cows mated to H bulls
BmA & SwA cows mated to A bulls

50:50 BmH cows mated to BmH bulls
BmA cows mated to BmA bulls
SwH cows mated to SwH bulls
SwA cows mated to SwA

75:25 BmH & BmA cows mated to Bm bulls
SwH & SwA cows mated to Sw bulls

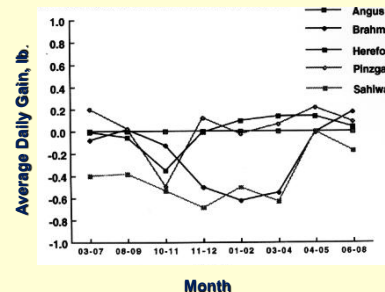


MORTALITY IN CALVES WITH DIFFERENT RATIOS OF BOS INDICUS TO BOS TAURUS INHERITANCE

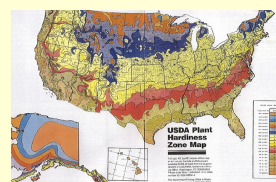
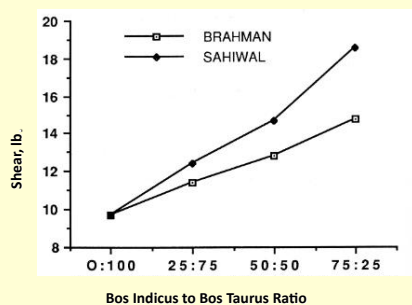
Temp (F°)	Bos indicus to Bos taurus ratio				Mean
	0:100	25:75	50:50	75:25	
>52	2	0	4	1	2
46 to <52	2	5	0	4	2
41 to <46	5	0	4	36	11
36 to <41	2	4	4	41	13
30 to <36	1	2	22	37	16
<30	3	8	12	9	8

(Josey et al., 1993)

Breed Effects as Deviations from Angus (Souza et al., 1993)



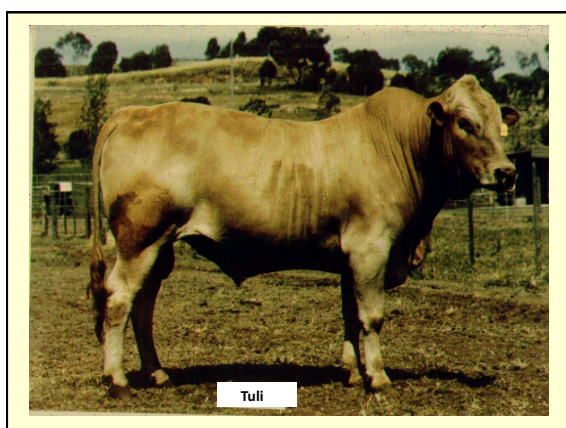
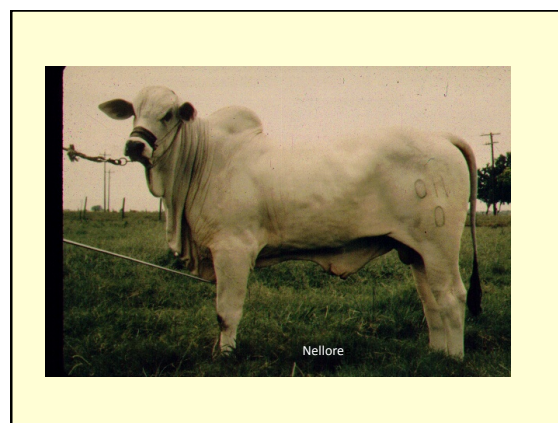
Shear



Matching Genetic Potential to the Climatic Environment

- In hotter more humid climates of the gulf coast cattle with ~50% tropical adapted germplasm are more optimal.
- In more intermediate subtropics, cattle with ~25% tropically adapted germplasm are more optimal.

SIRE BREEDS USED TO PRODUCE F ₁ CROSSES WITH ANGUS AND HEREFORD DAMS IN THE GERMLASM EVALUATION PROGRAM AT MARC ^a							
Cycle I 70-72	Cycle II 73-74	Cycle III 75-76	Cycle IV 86-90	Cycle V 92-94	Cycle VI 97-98	Cycle VII 99-00	Cycle VIII 01-02
Hereford Angus Jersey S. Devon Limousin Simmental Charolais	Hereford Angus Red Poll Braunvieh Gelbvieh Maine Anj. Chianina	Hereford Angus Brahman Sahiwal Pinzgauer Tarentaise	Hereford Angus Longhorn Salers Galloway Nellore Shorthorn Piedmontese Charolais Gelbvieh Pinzgauer	Hereford Angus Tuli Boran Belg. Blue Brahman Piedmontese	Hereford Angus Wagyu Norweg. Red Sw. Red&Wh. Friesian	Hereford Angus Red Angus Limousin Charolais Simmental Gelbvieh	Hereford Angus Beefmaster Brangus Bonsmara Romosinuano
Sire breeds mated to Angus and Hereford females, Composite MARC III (1/4 Angus, Hereford, Red Poll and Pinzgauer) cows were also included in Cycles V, VI, and VII.							



SIRE BREED MEANS FOR FINAL WEIGHT AND CARCASS TRAITS OF F ₁ STEERS (447 d)						
Sire breed	No.	Final wt lb	<u>Retail product</u> %	lb	USDA Choice %	14-d Shear lb
Hereford	106	1270	61.9	449	70.3	10.6
Angus	101	1278	62.2	454	84.6	8.9
Brahman						
Early 70's sires	43	1174	64.1	434	29.4	13.4
Mid 80's sires	76	1199	63.8	449	30.4	12.9
Boran	138	1116	62.6	400	47.2	11.3
Tuli	158	1110	63.4	405	63.8	10.1
Nellore	97	1224	65.0	465	51.4	----
LSD ≤ .05		48	1.7	18	22.2	1.3

BREED GROUP MEANS FOR REPRODUCTION AND MATERNAL TRAITS							
Sire breed of female	Age at puberty, No.	Days	2-years of age			3 to 7 years of age	
			Calf crop wnd. %	200-day wt per calf lb	per cow exposed lb	Calf crop wnd. %	200-day wt. per calf lb
Hereford	152	355	74	419	300	89	474
Angus	130	351	74	437	313	86	493
Avg.	282	353	74	428	307	88	483
Brahman							
Early 70's	82	429	54	456	238	86	511
Mid 80's	208	423	70	476	319	83	521
Avg.	244	426	62	466	279	83	516
Boran	206	396	83	444	357	86	488
Tuli	244	371	75	413	296	84	471
Nellore	82	406	75	463	324	92	514
LSD ≤ .05		13	14	18	62	7	14

Genotype X Environment Interaction	
Cycle VIII	
	USMARC
	Males & Females
Hereford	X
Angus	X
Beefmaster	X
Brangus	X
Romoinuano	X
Bonsmara	X

BREED GROUP MEANS FOR PREWEANING TRAITS OF CALVES PRODUCED IN CYCLE VIII OF THE GPE PROGRAM (2001 AND 2002 CALF CROPS)					
Sire breed of calf	No. calves born	Calvings unassist. %	Calv. diff. score	Birth wt. lb.	200-d wt. lb.
Hereford	212	94.4	1.33	91.1	534
Angus	208	97.2	1.19	87.1	541
Avg.	420	95.8	1.26	89.1	538
Brangus	214	96.9	1.19	90.5	549
Beefmaster	222	95.6	1.23	95.5	560
Bonsmara	207	97.7	1.10	90.4	533
Romoinuano	207	99.2	1.05	84.7	507

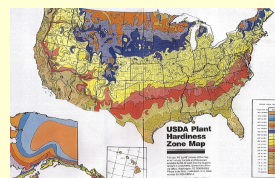
SIRE BREED MEANS FOR FINAL WEIGHT, FEED CONVERSION AND CARCASS TRAITS OF F ₁ STEERS PRODUCED IN CYCLE VIII (426 DAYS)								
Sire Breed	N	Final wt lb	Mcal per lb gain	Retail product %	Marb. score	USDA Choice %	W-B shear lb	
Hereford	102	565	7.65	61.8	465	515	52	8.1
Angus	103	582	7.61	60.0	469	548	71	7.6
Avg.	205	571	7.63	60.9	467	532	62	7.8
Brangus	107	570	7.82	62.1	480	497	42	8.6
Beefmaster	103	588	7.81	61.2	482	483	35	9.0
Bonsmara	104	538	8.17	63.4	464	487	37	8.1
Romoinuano	102	522	7.86	64.4	452	488	37	8.3
LSD < .05	14	.34	1.1	13	24	13	0.5	

BREED GROUP MEANS FOR REPRODUCTION AND MATERNAL TRAITS OF F1 FEMALES CALVING AT 2 YEARS OF AGE IN NEBRASKA AND LOUISIANA (Cundiff and Franke, 2006; Franke and Cundiff, 2006)								
Sire breed of female	Louisiana				Nebraska			
	Age at puberty days	Calf crop weaned %	200-day wt per calf lb	200-day wt per cow exposed lb	Age at puberty days	Calf crop weaned %	200-day wt per calf lb	200-day wt per cow exposed lb
Hereford	---	---	---	---	327	77	461	354
Angus	---	---	---	---	309	68	481	325
Brangus	332	73	398	288	340	83	488	403
Beefmaster	342	69	417	289	344	85	496	421
Bonsmara	336	70	409	288	352	72	461	333
Romosinuano	330	68	377	256	359	79	420	334
LSD < .05	22	17	26	48	22	17	26	48

BREED GROUP MEANS FOR REPRODUCTION AND MATERNAL TRAITS OF F ₁ FEMALES CALVING AT 3 - 7 YEARS OF AGE IN NEBRASKA AND LOUISIANA (Preliminary Analyses, Cundiff and Franke)								
Sire breed of female	Louisiana				Nebraska			
	Number exposed	Calf crop %	200-day wt per calf lb	200-day wt per cow exposed lb	Number exposed	Calf crop %	200-day wt per calf lb	200-day wt per cow exposed lb
Hereford	---	---	---	---	285	87	567	478
Angus	---	---	---	---	289	89	588	511
Brangus	166	83	486	412	147	91	583	508
Beefmaster	186	85	505	434	158	90	592	516
Bonsmara	152	84	500	425	138	93	565	502
Romoinuano	159	89	488	433	155	92	522	472
LSD < .05	8	26	48		8	24	48	

Breeds Grouped into Biological Types for Seven Criteria							
Breed	Growth rate an	Lean to fat ratio	Marbling	Tender-ness	Age at puberty	Milk pro-duction	Tropical adaptation
Angus	XXXXX	XX	XXXX	XXX	XX	XXX	X
Red Angus	XXXXX	XX	XXXX	XXX	XX	XXX	X
Hereford	XXXX	XX	XXX	XXX	XXX	XX	X
Shorthorn	XXXX	XX	XXXX	XXX	XX	XXX	X
Gelbvieh	XXXX	XXXXX	X	XX	XX	XXXX	X
Simmental	XXXXX	XXXX	XX	XX	XXX	XXXX	X
Limousin	XXXX	XXXXX	X	XX	XXXX	X	X
Charolais	XXXXX	XXXXX	XX	XX	XXXX	XX	X
Romoinuano	X	XXX	XX	XX	XXX	XXX	XXX
Tuli	XX	XXX	XXX	XX	XXX	XXX	XXX
Brangus	XXXX	XXX	XXX	XX	XXX	XXX	XXX
Beefmaster	XXXX	XXX	XX	XX	XXX	XXX	XXX
Santa Gertrudis	XXXX	XXX	XX	XXX	XXX	XXX	XXX
Bonsmara	XXX	XXX	XX	XX	XXX	XXX	XXX
Brahman	XXXX	XXXX	XX	X	XXXXX	XXXX	XXXX
Nellore	XXXX	XXXX	XX	X	XXXXX	XXX	XXXX
Boran	XXX	XXX	XX	X	XXX	XXX	XXXX
Sahiwal	XX	XXXX	XX	X	XXXX	XXX	XXXX

Implications



Matching Genetic Potential to the Climatic Environment

- In more intermediate subtropics, cattle with ~25% tropically adapted germplasm may be optimal.
- In hotter more humid subtropical climates of the gulf coast cattle with ~50% tropically adapted germplasm may be optimal.
- In harsher tropical climates between the tropic of cancer and capricorn, 75% tropically adapted germplasm may be more optimal.

Beef Breed Registrations (National Pedigreed Livestock Council Bi-Annual Reports)

Year	British					Continental					American					Total 1000s
	A	H	Sh	RA	Total %	C	S	L	G	Total %	Bm	SG	Brg	Bfm	Total %	
1965	34.6	56.0	3.4	0.2	94.3	2.8				2.8	1.4	1.1	0.4		2.9	1,113
1970	40.0	45.0	4.0	0.6	89.9	5.1				5.1	2.1	2.2	0.7		5.0	882
1975	29.2	39.9	2.8	0.8	73.1	7.4	8.0			15.4	2.6	2.1	1.3	1.2	7.3	1,049
1980	28.1	38.5	2.1	1.1	70.2	2.9	7.4	4.3	0.5	15.1	4.0	2.8	2.7	3.3	12.7	917
1985	22.3	26.1	2.4	1.8	52.9	3.9	12.2	6.0	2.3	24.4	4.3	3.8	4.4	4.7	17.1	700
1990	21.5	23.1	2.4	2.1	49.4	6.3	10.6	9.8	3.1	29.8	1.8	2.0	4.3	6.3	14.4	738
1995	28.7	14.8	2.0	3.8	49.7	7.1	9.1	10.1	4.3	30.6	1.9	1.5	3.6	5.6	12.7	784
2000	37.5	12.2	2.7	5.7	58.0	6.1	6.2	7.0	3.8	23.1	2.6	1.5	3.9	4.6	12.7	696
2005	41.7	9.6	2.5	6.0	59.8	10.3	6.1	5.5	3.8	25.7	1.1	1.0	3.2	2.7	8.0	777
2007	44.1	8.8	2.5	6.0	61.3	9.5	6.6	4.8	4.6	25.5	1.1	1.0	3.2	2.3	7.5	789
2009	44.8	8.6	2.1	6.4	61.9	8.8	6.1	3.9	4.7	23.6	1.1	1.0	4.0	2.0	8.1	745

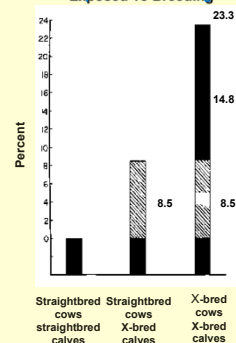
Heterosis favors 50:50 *Bos indicus*:*Bos taurus*

•Heterosis increases production per cow 20 to 25% in *Bos taurus* x *Bos taurus* crosses

•Heterosis increases production per cow at least 50% in *Bos indicus* x *Bos taurus* crosses in subtropical regions.

•More than half of this effect is dependent on use of crossbred cows.

Weight of Calf Weaned Per Cow Exposed To Breeding



TRADEOFFS

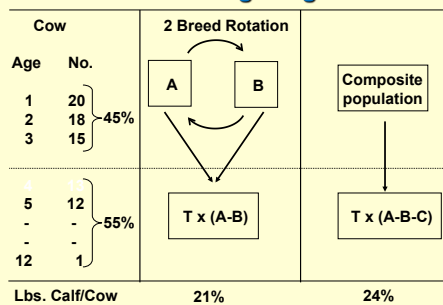
Bos indicus x *Bos taurus* crosses excel in

- Weaning weight per cow exposed
- Cow efficiency

but even in subtropical and tropical regions these advantages are tempered by:

- Older age at puberty
 - Reduced meat tenderness
- and in temperate regions in cold seasons increased calf mortality reduced rate and efficiency of gain

Terminal Sire Crossbreeding Programs





OUTPUT/INPUT DIFFERENCES AMONG BOS TAURUS X BOS TAURUS F ₁ COWS (JENKINS ET AL., 1991)								
Item	Overall mean	Breed group ^a (ratio)						
		HAx	Rx	Bx	Gx	Mx	Cix	
Progeny (138.5 days)								
Weight gain, lb	346	97	99	103	100	103	98	
Energy consumed, Mcal ME	744	106	102	99	96	98	99	
Dams (138.5 days)								
Milk production, lb/day	8.8	85	101	118	111	104	82	
Cow weight, lb	1,138	98	91	97	100	107	107	
Fat probe, in	.25	124	101	91	93	90	101	
Energy consumed, Mcal ME	3,787	91	96	105	105	100	104	
Efficiency (138.5 days)								
Progeny gain, lb/Mcal ME calf + dam	.077	103	103	99	97	103	95	

^aHAx = Hereford or Angus, Rx = Red Poll, Bx = Brown Swiss, Gx = Gelbvieh, Mx = Maine and Cix = Chianina sire F₁ crosses.

