

Crossbreeding: The Forgotten Tool



JIM GOSEY

UNIVERSITY OF NEBRASKA

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**A Google search on the web for
“Beef Cattle Crossbreeding”**

**takes less than 1 second.....
produces 56,400 articles !**

**If, after reading the 56,400
crossbreeding articles.....**

**You still want to
straightbreed.....**

Call me !

**I have a 12 step program for
you**

Step 1. Admission

Hi, my name is Bob,
I'm an Angusoholic

**PROBLEM: Three generations
of Angus bulls used on F1
Angus cows results in:**

3/4 Angus

7/8 Angus

15/16 Angus

and a loss of 87% of Hybrid Vigor !

CROSSBREEDING IMPACT

HETEROSIS
(Hybrid Vigor)

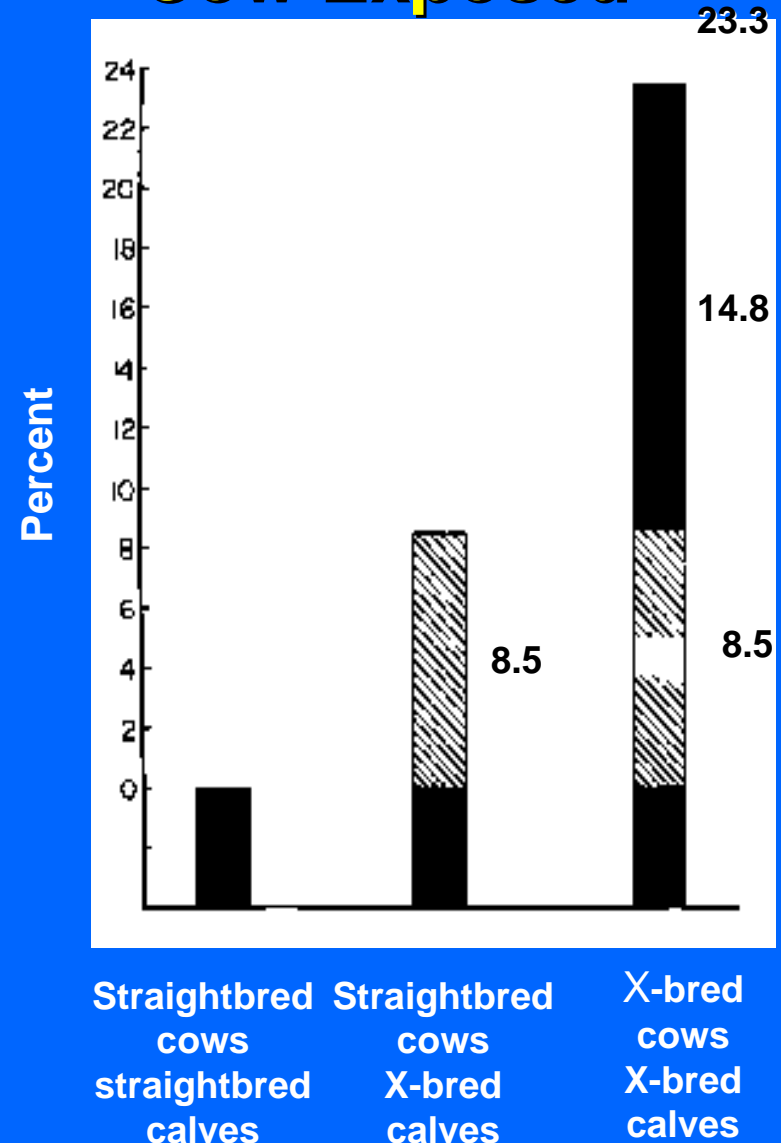
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BREED DIFFERENCES
(Complementarity)

Heterosis

- Heterosis increases production per cow 20 to 25%.
- More than half of this effect is dependent on use of crossbred cows.

Weight of Calf Weaned Per Cow Exposed



HETEROSIS

- **GREATEST IN LOWLY HERITABLE TRAITS**
- **DUE TO DOMINANCE GENE EFFECTS**
- **ACCOUNTED FOR BY RECOVERY OF ACCUMULATED INBREEDING DEPRESSION IN BREEDS**

HETEROSIS

HAS GREATEST EFFECT ON

- REPRODUCTION
- CALF SURVIVAL
- LONGEVITY
- MILK PRODUCTION
- EARLY GROWTH

Additive Gene Action

BREEDING

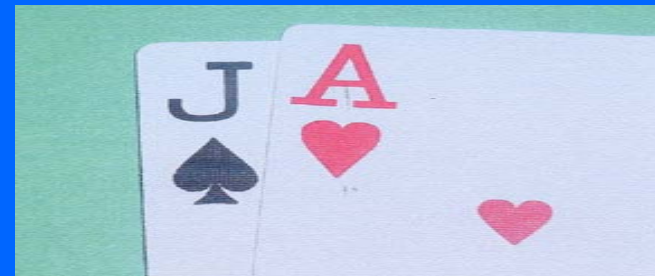
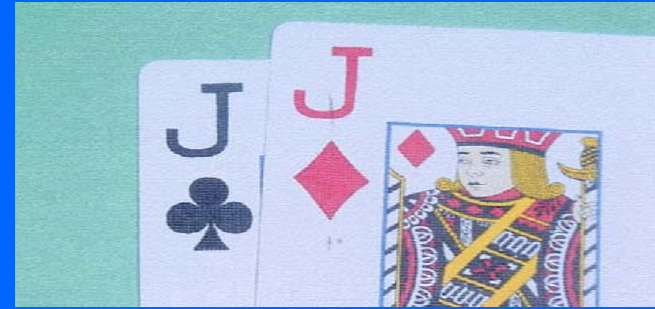
GENES **WEIGHT**

aa **400**

Aa **450**

AA **500**

POKER



Dominance Gene Action

BREEDING

BLACK JACK

GENES

WEIGHT

aa

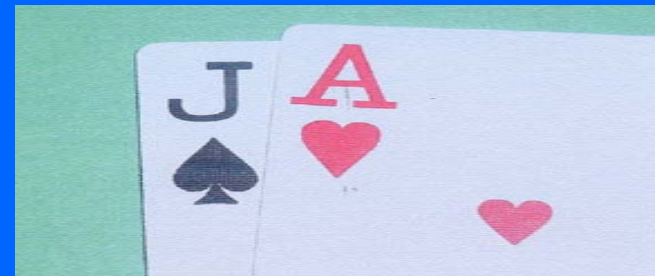
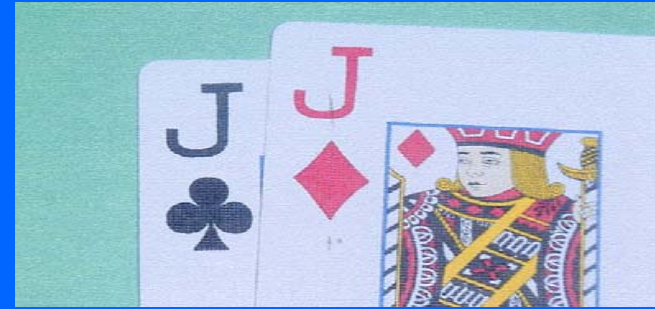
400

Aa

500+

AA

500



Recovery of Inbreeding Depression

- ALL BREEDS ARE INBRED
- MOST BREEDS 8 TO 14% INBRED
- RATE OF INBREEDING IS .5 - .6 % PER GENERATION
- DEPENDS ON STARTING POINT, POPULATION SIZE, MATING PLAN, USE OF AI.

**“There is tremendous
opportunity for heterosis within
the Angus breed”**

Purebred Angus breeder

Beef Magazine, Page 40, Jan. 2005

LINECROSS HETEROSIS WITHIN BREED ?

- **NOLINES WITHIN BREEDS LACK SUFFICIENT SEPARATION TO PRODUCE MEASURABLE HETEROSIS.**

**(EXCEPT WHERE OUTSIDE GENES
HAVE BEEN INTRODUCED !!!)**

Using Breed Differences (Complementarity)

**No single breed excels in
all the traits important to
beef production.**

**“ You can’t beat the straight
Angus cow for ease of
maintenance, longevity and
mothering ability”**

Commercial beef breeder

BEEF Magazine, page 40, Jan. 05

LIFETIME PRODUCTION OF HEREFORD (H) and ANGUS (A) COWS and RECIPROCAL CROSSES

Trait	Breed group				Heterosis
	H	A	HA	AH	
Longevity, yrs.	8.4	9.4	11.0	10.6	1.9*
Lifetime production					
No. calves	5.9	6.6	7.6	7.6	1.3*
Wt of calves wean, lb.	2405	2837	3254	3514	766*

*P < .05

Between & Within Breed Differences do Exist for:

- **Birth Weight and Mature Size**
- **Composition of Gain**
- **Efficiency to Certain Endpoints**
- **Calving Ease**
- **Milk Production**
- **Age of Puberty**

British vs. Continental Breeds (30 years later), MARC

- 1. No diff. in wt., height or growth rate**
- 2. No diff. in efficiency to wt. endpoint**
- 3. British more efficient to fatness endpoint**
- 4. Continentals more efficient to retail product endpoint**

British vs. Continental Breeds (30 years later), MARC

- 5. British marbling & quality grade advantage is 64% of 30 yr. earlier**
- 6. Continental retail product yield advantage is 71% of 30 yr. earlier**
- 7. Calving ease increased significantly in Continentals**
- 8. No diff. In repro. rate & survival**

QUESTION:

Why isn't crossbreeding
more widely used ?

TRADITIONAL CROSSBREEDING

<u>SYSTEM</u>	<u>% Max F1 HETEROSIS</u>
• 2-BREED ROTATION	67
• 3-BREED ROTATION	87
• ROTA-TERMINAL	$2X=67+100$ $3X=87+100$

TRADITIONAL CROSSBREEDING

<u>SYSTEM</u>	<u>%ADVANTAGE</u>
• 2-Breed Rotation	16
• 3-Breed Rotation	20
• Rotation Terminal	24

TRADITIONAL CROSSBREEDING SYSTEMS FAIL “MANAGEMENT EASE” TEST

- **Too many breeds / pastures**
- **Difficult in small herds**
- **Sire ID replacements**
- **Swings in breed composition**
- **Hard to market uniform load lots**

**Swings in breed composition
have led to perception of
greater variation in
crossbred cattle.**

BREED COMPOSITION VARIATION

%BREED COMPOSITION

<u>GEN.</u>	<u>SIRE</u>	<u>A</u>	<u>B</u>	<u>C</u>
1	A	50	0	50
2	B	25	50	25
3	C	12	25	62
4	A	56	12	31
5	B	28	56	16
AVERAGE	%	31	29	40

SIMPLIFIED / ONE PASTURE CROSSBREEDING SYSTEMS

ONE PASTURE CROSSBREEDING SYSTEMS

SYSTEM

%ADVANTAGE

- Sire Breed Rotation.....15
- Multiple Sire Breeds.....15-18
- Composite.....15-18

COMPOSITE BREEDS

- **CLOSED COMPOSITE**

Closed at Foundation,

Need 25 Sires Per Generation

to Avoid Inbreeding

OPEN COMPOSITE.....

Open to New Sires,

Reduces Inbreeding in

Small Herds



SEP 15 2004

HETEROISIS RETAINED

- Heterosis in Composites is Equal to $(n-1/n)$, where:

n = Number of Breeds

Example: 4 Breed Composite

$$(4-1) / 4 = 3/4 = 75\%$$

COMPOSITE HETEROSIS BY MATING TYPE

<u>Breeds</u>	<u>Found.</u>	<u>% Heterosis</u>	<u>%Advant.</u>
2	1/2:1/2	50	12
	5/8:3/8	47	11
	3/4:1/4	38	9
3	1/2:1/4:1/4	63	15
	3/8:3/8:1/4	66	15
4	1/4:1/4:1/4:1/4	75	17

MARC RESEARCH ON COMPOSITE BREEDS

- **Heterosis is Retained From F1 to F2, F3 & F4**
- **Variation in Composites was NOT Greater than Parental Purebreds**

COEFFICIENTS OF VARIATION FOR PUREBRED VS. COMPOSITE STEERS

<u>Trait</u>	<u>Purebreds</u>	<u>Composites</u>
Birth Wt.	.12	.13
Wean Wt.	.10	.11
Carc. Wt.	.08	.09
Retail Product %	.04	.06
Marbling	.27	.29
Shear Force	.22	.21



MAR 31 2004

Calves sired by Univ. of Neb. Composite bulls

<u>Date</u>	<u>#</u>	<u>Wt.</u>	<u>Fat</u>	<u>REA</u>	<u>%Y1:2</u>	<u>%Ch</u>
6/05	37	836	.54	13.2	49	97
5/05	45	823	.57	13.8	49	84
5/05	89	795	.51	13.5	62	85
3/05	22	802	.41	14.6	82	91
3/05	24	729	.49	13.0	75	96
12/4	53	809	.40	14.5	89	81
AV.	270	802	.49	13.8	66	87

CONFORMANCE OF BREED TYPES TO CARCASS TARGETS (70% Ch : 70%Y1&2)

BREED TYPE

<u>ITEM</u>	<u>BRITISH</u>	<u>CONT.</u>	<u>M1</u>	<u>M2</u>	<u>M3</u>
% Y 1&2	38	89	83	56	53
<u>% CH +</u>	<u>70</u>	<u>30</u>	<u>43</u>	<u>55</u>	<u>66</u>

MARC RESEARCH ON COMPOSITE BREEDS

- **COMPOSITE BREEDS MAY BE
THE BEST SOLUTION FOR THE
ANTAGONISM BETWEEN
MARBLING AND RETAIL
PRODUCT %**

SUMMARY:

- 1. Crossbreeding Works**
- 2. Breed Differences Important**
- 3. Composites Simplify**
- 4. Crossbreeding helps with trait antagonisms**
- 5. Composites Not More Variable**