

Crossbreeding Strategies: Terminal and Maternal Crossing

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One Bull to Do It All...

Antagonisms
Retained Heterosis



Breed Complementarity
Selection tools/trait focus



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Separate Maternal and Terminal Mating Decisions



More Flexibility



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You get what you sow...

- If you use terminal trait EPD or terminal indexes in selection, what do you get?
You get response in terminal traits!
- If maternal traits are important to you, put pressure on maternal traits
 - Think 'optimization'
 - Traits: CE, CEM, DOC, HP, Stay (rebreeding), MW, ME, replacement indexes
- Align traits used in selection with marketing endpoint/breeding objective



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Having Your Cake and Eating it Too

- Commercial cattlemen **SHOULD** care about BOTH additive and non-additive effects.
 - Selection index/EPDs
 - Hybrid vigor or heterosis
- Seedstock producers **SHOULD** focus on additive genetic merit, and putting it in a package that helps clientele exploit non-additive effects.



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Sire Selection in Two Steps

1. Pick the right breed(s)
 - PLANNED** Crossbreeding
 - Breeding objectives
 - Considerations
2. Chose right individual in that breed
 - EPDs
 - Genetic risk management
 - Selection indexes



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The Power of Crossbreeding

- Heterosis
 - Superiority of a crossbred animal as compared to the **average** of its straightbred parents
 - Especially maternal heterosis
- Breed Complementarity
 - Selection of breeds for core traits that fill the other breed(s) shortcomings
 - Maternal crossbreds-appropriate cow size/lactation for environmental fitness
 - Terminal crossbreds-add value to calves in market place



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Heritability and Heterosis: Inversely Related

Trait	Heritability	Heterosis
Reproduction (fertility)	Low	High
Production (growth)	Moderate	Moderate
Product (carcass)	High	Low

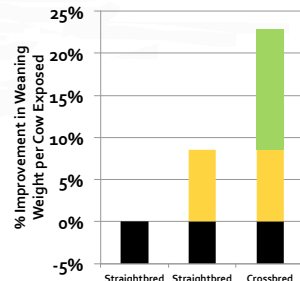


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Benefits of Heterosis

- Heterosis increases production 20 to 25% per cow in *Bos taurus* x *Bos taurus* crosses; 50% in *Bos indicus* x *Bos taurus* crosses in subtropical regions
- More than half of this effect is dependent on use of crossbred cows

Jenkins, MARC



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Retained Heterosis

System	% Max Heterosis	% Increase in Calf Wt./ Cow Exposed
Pure breeds	0	0
2 breed rotation	67	16
3 breed rotation	86	20
2 breed composite	50	12
4 breed composite	75	17
Rotating F1 AB AD	67	16
Rotating F1 AB CD	83	19
Term. Sire/purch. F1 ♀	100	23-28



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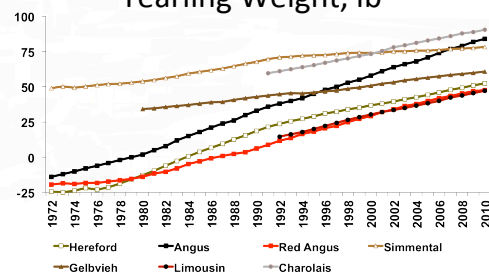
Breeds Have Changed
Overtime, Does
Heterosis Still Exist?

What About
Complementarity?



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Genetic Trends for Yearling Weight, lb



Adapted from Spring 2012 Genetic Trends from Breed Associations and 2012 AB-EPD factors (Kuehn et al., 2012)



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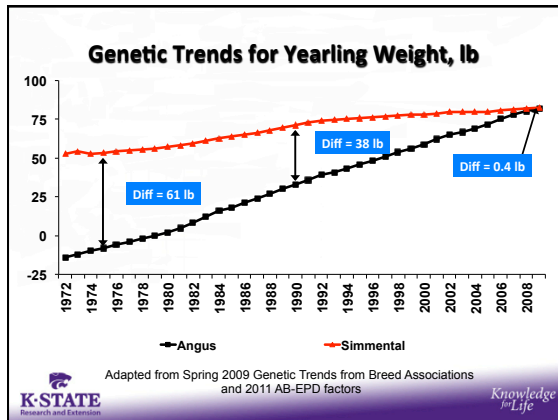


Table 2. Estimates of biological type heterosis (SE) (British x British, British x Continental and Continental x Continental) for birth, weaning and yearling weight (Model 1)

Covariate ¹	BWT ² , kg	WT205D ² , kg	WT365D ² , kg
B × B	0.47 (0.37)	6.43 (1.80)**	17.59 (3.06)**
B × C	0.75 (0.32)*	8.65 (1.54)**	13.88 (2.63)**
C × C	0.73 (0.54)	5.86 (2.57) *	9.12 (4.34) *
Maternal heterosis	0.41 (0.31)	0.34 (1.84)	3.44 (2.66)

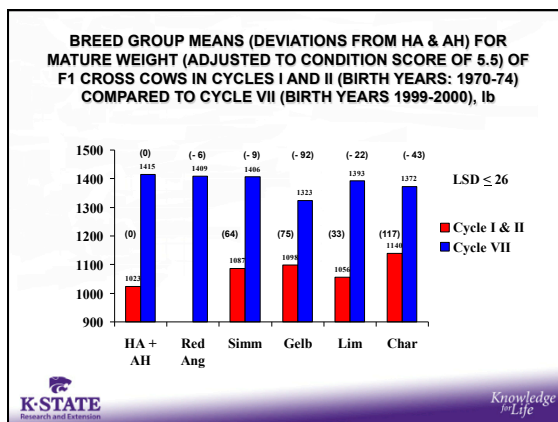
¹B = British, C = Continental.

²BWT = adjusted birth weight, WT205D = adjusted weaning weight, WT365D = adjusted yearling weight.

*P < 0.05.

**P < 0.01.

Schiermister et al., 2015 JAS

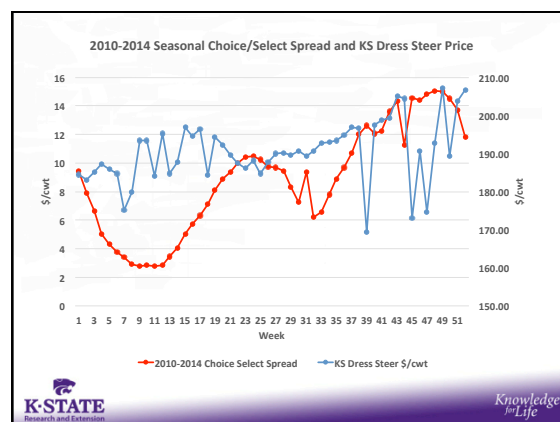


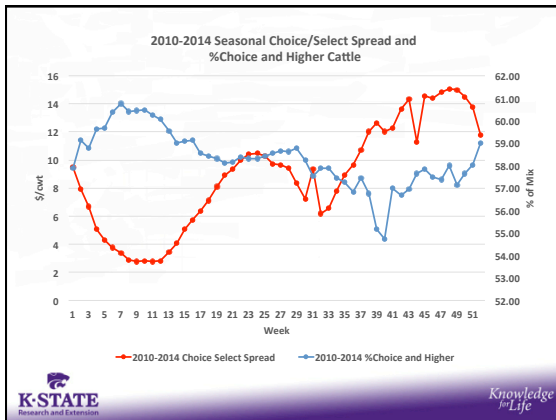
Breed Complementarity

- Harvest the core strengths of breeds
 - Additive Traits (EBV)
 - Type or conformation/phenotype
 - Adaptation/Fitness Traits
- Crossing breeds to combine direct and maternal heterosis and breed effects to optimize performance levels
- Match cows to environment, calves to market....

Breed combinations that make \$ense

- Market weaned calf or retain ownership of cattle that sell live or on a 'balance' grid
 - 50% British:50% Continental
 - 75% British:50% Continental
- Retain ownership and sell in beef on grid that significantly rewards Quality Grade
 - British crossbreds
 - 75% British:25% Continental





How Do I Choose a Breeding Program

- Are you profit or premium focused?
 - Why not both?
- Herd size
 - Efficient bull utilization/manage variation in marketing groups
- How do I generate replacement heifers?
- How do I market calves?
- Constraints
 - Environment
 - Management

Mating System Goals

1. Optimize the utilization of calf and maternal heterosis.
2. Utilize breed complementarity to match cows to their environment and their progeny to market targets.
3. Minimize variation in progeny phenotypes by stabilizing breed inputs.
4. Use Adv. Repro tech to help structure mating system (i.e. AI, gender sort semen)

Breeding Programs

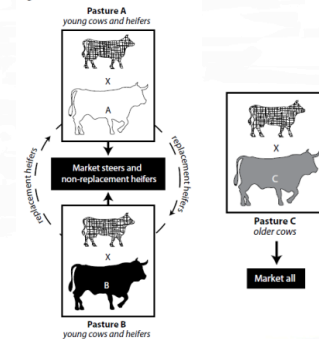
- Terminal
- F1, Hybrid, or Composite Seedstock
- Rotational 2, 3, 4 breeds
 - if your operation is (very) large enough
- ♦ Retained Heterosis
- ♦ Stabilization of Breed Percentages

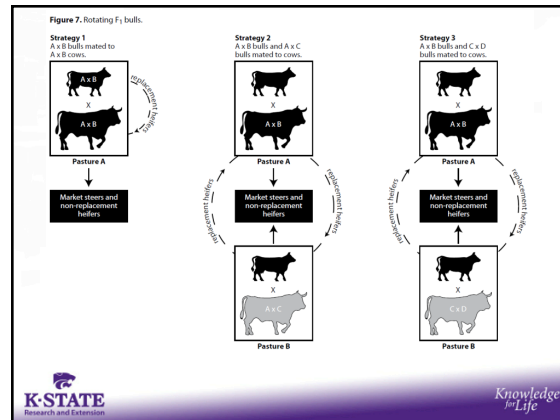
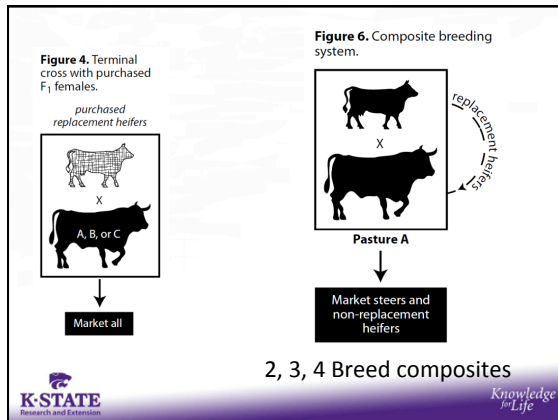
Systems, Benefits, Constraints

Table 7. Summary of crossbreeding systems by amount of advantage and other factors.^a

Type of System	% of Cow Herd	% of Marketed Calves	Advantage (%) ^b	Retained Heterosis (%) ^c	Minimum No. of Breeding Pastures	Minimum Herd Size	No. of Breeds	
2-Breed Rotation	A*B Rotation	100	100	16	67	2	50	2
3-Breed Rotation	A*B*C Rotation	100	100	20	86	3	75	3
2-Breed Rotational/ Terminal Sire	A*B Rotational T x (A*B)	50 100	33 100	0 21	2 90	2 3		
Terminal Cross with Straightbred Females ^d	T x A (A)	100	100	8.5	0 ^e	1	Any	2
Terminal Cross with Purchased F ₁ Females	T x (A*B)	100	100	24	100	1	Any	3
Rotate Bull every 4 years	A*B Rotation	100	100	12-16	50-67 ^f	1	Any	2
Composite Breeds	A*B*C Rotation	100	100	16-20	67-83 ^f	1	Any	3
	2-breed	100	100	12	50	1	Any	2
	3-breed	100	100	15	67	1	Any	3
	4-breed	100	100	17	75	1	Any	4
Rotating Unrelated F ₁ Bulls	A*B x A*B A*B x A*C A*B x C*D	100 100 100	100 100 100	12 16 19	50 67 83	1 1 2	Any Any Any	2 3 4

Figure 3. Two-breed rotational/terminal sire.





Crossbreeding Done RIGHT!

- Build a plan – set attainable goals
- Considerations
 - Marketing end points
 - Replacement females (cows must have heterosis)
 - Environment
 - Management
- Stick to it!

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Thank You!
Questions