CROSSBREEDING IN COMMERCIAL BEEF HERDS

Range Beef Cow Symposium
Mitchell, Nebraska
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Overview

- Introduction
- Reasons for crossbreeding
- Crossbreeding systems
- Impact of crossbreeding

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Audience Input and Attitudes

(BIF, 2007)

The ideal beef cow will be crossbred.	
Response	**%**
1. Yes	72
2. No	6
3. Maybe	22

The ideal market steer for feedlot profitability will be crossbred.	
Response	**%**
1. Yes	76
2. No	6
3. Maybe	18

The ideal market steer for overall carcass value will be crossbred.	
Response	**%**
1. Yes	70
2. No	10
3. Maybe	20

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Breed Makeup: 2007 Calf Crop

(USDA-NAHMS, 2009)

	Percent of Operations				
	Number of Cows				
Breed	**1-49**	**50-99**	**100-199**	**>200**	**All**
Purebred	13.7	20.3	16.0	20.8	15.3
Composite	12.9	12.0	7.4	7.7	12.0
Crossbred (2 breeds)	42.2	42.9	49.7	50.8	43.4
Crossbred (3 breeds)	31.2	24.8	26.9	20.7	29.3

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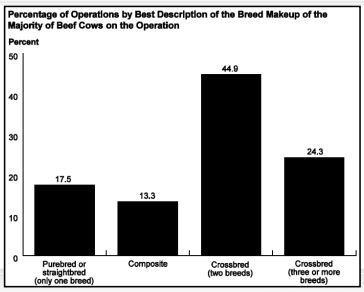
Breed Makeup: Majority of Beef Cows

(USDA-NAHMS, 2009)



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Breed Makeup of the Cowherd

(BEEF, 2014)

Breed Makeup	**% of Cowherd**	
	2010	**2014**
High % purebred British (AN, HH)	47.4	51.3
High % purebred Continental	4.1	3.2
Mostly British crossbred	20.5	17.1
Mostly Continental crossbred	2.8	3.3
Mostly British x Continental crossbred	11.7	7.9

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Reasons to Crossbreed

- **Heterosis**
  - Performance advantage of crossbreds compared to the average of the straightbred parents
  - Improvement in performance available from crosses of breeds, not within breeds

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Reasons to Crossbreed

- **Heterosis**
  - Types: individual, maternal, paternal
  - Level of heterosis determined by the degree of genetic difference between the parent breeds

$$\% \ Heterosis = \left[\frac{Crossbred\ average - Purebred\ average}{Purebred\ average} \right] x\ 100$$

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Level of Individual Heterosis

Advantage of a Crossbred Calf		
Trait (Unit)	**Improvement**	**% Heterosis**
Calving rate (%)	3.2	4.4
Survival to weaning (%)	1.4	1.9
Birth weight (lbs.)	1.7	2.4
Weaning weight (lbs.)	16.3	3.9
Average daily gain (lbs./day)	.08	2.6
Yearling weight (lbs.)	29.1	3.8

(Cundiff and Gregory, 1999)

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Level of Individual Heterosis

Advantage of a Crossbred Calf	
Trait	**% Heterosis**
Dressing percent	0.0
Ribeye area (REA)	3.0
Fat thickness	5.0
Quality grade	1.0
Cutability	1.0

(Long, 1980)

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Level of Maternal Heterosis

Advantage of a Crossbred Dam		
Trait (Unit)	**Improvement**	**% Heterosis**
Calving rate (%)	3.6	3.7
Survival to weaning (%)	0.8	1.5
Birth weight (lbs.)	1.6	1.8
Weaning weight (lbs.)	18.0	3.9
Longevity (yr.)	1.36	16.2
Cow Lifetime Production		
Number of calves (#)	0.97	17.0
Cumulative weaning weight (lbs.)	600	25.3

(Cundiff and Gregory, 1999)

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Impact of Heterosis

Traits	Heritability*	Heterosis
Reproduction	Low	High
Growth	Moderate	High
Carcass Merit	High	Low

***Heritability measures the amount of variation in a trait that is due to genetics.**

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Reasons to Crossbreed

- **Complementarity**
  - Combination of breeds that excel in different characteristics
  - No one breed is best at everything
  - Breed complementarity: ["Serving to fill out or complete, mutually supplying each others lack" (Webster) - Cartwright, 1970]

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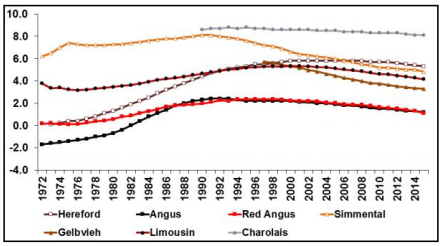
Breed Differences – BWT

(7 Most Highly Used Breeds)



(Kuehn and Thallman, 2017)

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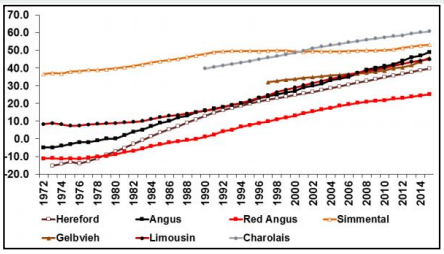
Breed Differences – WWT

(7 Most Highly Used Breeds)



(Kuehn and Thallman, 2017)

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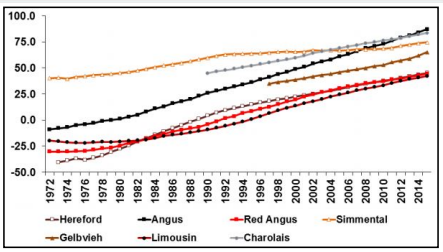
Breed Differences – YWT

(7 Most Highly Used Breeds)



(Kuehn and Thallman, 2017)

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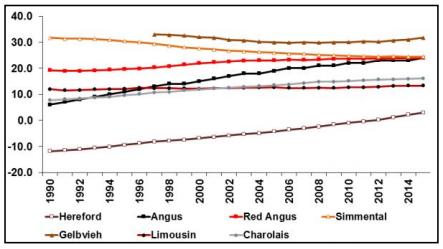
Breed Differences – MILK

(7 Most Highly Used Breeds)



(Kuehn and Thallman, 2017)

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Breed Complementarity

- **Identify proper breeds:**
  - Production and marketing objectives (goals)
    - Desired level of performance
    - Source of replacements
    - Markets for calves
  - Production environment
    - Resources (feed, labor, management, etc.)
  - Dam (maternal) lines and sire (paternal) lines
    - Match cows to environment; fit calves to market

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Crossbreeding Considerations

Coefficients of variation for purebred versus composite steers.		
Traits	**Purebreds**	**Composites**
Birth weight	0.12	0.13
Weaning weight	0.10	0.11
Carcass weight	0.08	0.09
Retail product %	0.04	0.06
Marbling	0.27	0.29
Warner-Bratzler shear force	0.22	0.21

Adapted from Gregory et al., 1999

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Summary of crossbreeding systems by amount of advantage and other factors.								
Type of System		% of Cow Herd	% Marketed Calves	% Advantage	% Retained Heterosis	Minimum # of Pastures	Minimum Herd Size	# 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 Rotation/ Terminal Sire	A*B Rotation	50	33			2		
	T x (A*B)	50	67			1		
	Overall	100	100	21	90	3	100	3
Terminal Cross with SB Females	T x (A)	100	100	8.5	0	1	Any	2
Terminal Cross with 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	1	Any	2
	A*B*C Rotation	100	100	16 – 20	67 – 83	1	Any	3
Composite Breeds	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	100	100	12	50	1	Any	2
	A*B x A*C	100	100	16	67	1	Any	3
	A*B x C*D	100	100	19	83	2	Any	4

(Ritchie et al., 1999)

Impact of Crossbreeding
(Daley and Earley, 2010)

- Evaluate the impacts of crossbreeding in a vertically integrated beef system
- Conducted as a field trial under real-world conditions
- Evaluated economic differences at the ranch, feedlot, and packing plant

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Impact of Crossbreeding
(Daley and Earley, 2010)

- Angus-based cows randomly mated to Hereford and Angus bulls
  - Year 1: 400 cows; 10 bulls each breed
  - Years 2 & 3: 600 cows; 15 bulls each breed
  - DNA collected on all calves; only the cattle traced to single sire were used in analysis

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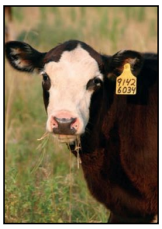
Impact of Crossbreeding
(Daley and Earley, 2010)

Ranch calf performance summary		
Traits	**Angus-sired (n = 304)**	**Hereford-sired (n = 290)**
Weight	498	513
In-value ($1.20)	$597.60	$615.60
Value difference		**$18.00**

- 15-pound difference reflects almost 3% direct heterosis for weaning weight



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Impact of Crossbreeding
(Daley and Earley, 2010)

Feedlot and financial performance summary (1)		
Traits	**Angus-sired (n = 297)**	**Hereford-sired (n = 284)**
Finished	288	275
Weight in	673	674
Weight out	1,232	1,232
Days on feed	155	155
Average daily gain (ADG)	3.45	3.48
Conversion – as fed	7.41	7.05
Conversion – dry matter	5.25	5.25
Cost of gain	$79.77	$75.98

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Impact of Crossbreeding
(Daley and Earley, 2010)

Feedlot and financial performance summary (2)		
Traits	**Angus-sired (n = 297)**	**Hereford-sired (n = 284)**
Death loss percent	1.35%	1.41%
Percent morbidity	10.77%	9.51%
Hospital cost/head treated	$14.52	$12.68
Hospital cost/head placed	$1.91	$1.30
Delivered cost/cwt.	$119.68	$119.68
Total cost of gain/cwt.	$87.05	$82.68
Breakeven/cwt.	$105.18	$102.96
Value difference		**$27.50**

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Impact of Crossbreeding
(Daley and Earley, 2010)

Carcass performance summary		
Traits	**Angus-sired**	**Hereford-sired**
Live weight	1,236	1,232
Hot weight	782	782
Yield percent	63%	63%
Percent Prime	0.82%	0.00%
Percent Choice	65.66%	46.90%
Percent Choice or better	66.40%	46.90%
Select	33.00%	53.00%
Percent total Yield Grade 1 & 2	43.00%	49.00%
Percent Yield Grade 3	51.00%	45.00%
Percent total Yield Grade 4 & 5	6.00%	6.00%
Value difference	**$15.60**	

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Impact of Crossbreeding
(Daley and Earley, 2010)

Economic summary		
Traits	**Angus-sired**	**Hereford-sired**
Ranch		$18.00
Feedlot		$27.50
Carcass	$15.60	
Value difference		**$29.90**

- **In final two years of study, Hereford-sired females had a 7% (93% vs. 86%) advantage in pregnancy rate**

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Impact of Crossbreeding
(University of Idaho)

- **Ranch was given to University of Idaho in early 2000's**
  - **Populated with donated cows from across the state**
  - **Began development of a homogeneous herd for research activities**
  - **In 2008, protocols put in place for Angus x Hereford cowherd**
  - **In 2013, terminal crosses introduced to match calves to market opportunities**

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Impact of Crossbreeding
(University of Idaho)

Comparison of sire breeds from 2013-2018 calf performance for selected traits.

	Performance Traits (# of records)						
Sire Breed	**Birth Weight**	**Birth Weight Adjusted**	**Weaning Weight**	**Weaning Weight Adjusted**	**Hot Carcass Weight**	**Ribeye Area**	**Marbling [a]**
Angus	82.6 (623)	89.8 (641)	567.6 (586)	607.1 (581)	868.1 (227)	13.7 (227)	608 (201)
Hereford	84.9 (360)	90.7 (359)	556.6 (339)	604.3 (339)	872.9 (114)	13.2 (114)	599 (97)
Simmental Influenced	88.9 (768)	93.5 (769)	577.4 (709)	612.0 (709)	882.0 (329)	14.2 (329)	622 (238)

[a] Marbling scores: < 300 = Standard, 300 - 399 = Select, 400 - 699 = Choice, 700 + = Prime

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Summary

- **Crossbreeding is an underutilized tool**
- **Crossbreeding can increase the level of production for various traits in a herd**
  - **Heterosis**
  - **Breed complementarity**
- **Crossbreeding plans can be adapted for most situations**
- **Crossbreeding can be couple with other technologies for optimal implementation**

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THANK YOU!

Questions?

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