Comparison of ProCROSS® Crossbred and Holstein Cows for Dry Matter Intake, Production, Feed Efficiency, and Income Over Feed Cost

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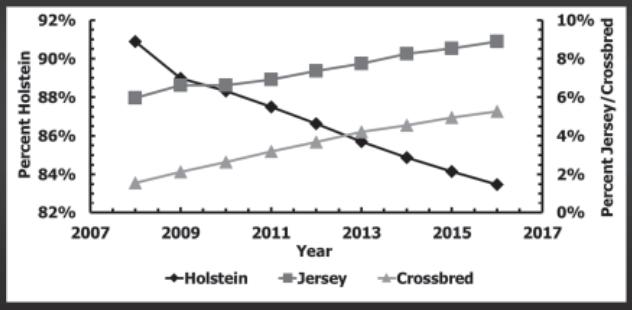
Breed composition of U.S. cows



Norman et al., 2017

Why the interest in crossbreeding?

- Calving difficulty continues to hinder first-calf heifers
- Fertility of Holsteins has declined in most environments
- Health problems of Holsteins are more frequent
- More Holsteins are dying on farms (> 8% in USA)
- Cows are calving fewer times during their lives

Feed intake and efficiency

- High cost of feed intake for individual cows because of specialized labor and equipment
- Feed efficiency is the ability of animal to convert feed to product
- Multiple measures of feed efficiency
  - Ratio measures of feed efficiency
  - Income over feed cost
  - Residual feed intake

Inbreeding of the HO breed

Birth years of cows	Average pedigree inbreeding (%)	Average annual increase in inbreeding (%)
2010	5.66	+0.11
2011	5.76	+0.10
2012	5.89	+0.13
2013	6.11	+0.22
2014	6.35	+0.24
2015	6.60	+0.25
2016	6.85	+0.25
2017	7.22	+0.37
2018	7.60	(very early births)

Council on Dairy Cattle Breeding, 2019

Feed efficiency and crossbreeding

- Jersey × Holstein versus Holstein cows
  - Jersey × Holstein more efficient than Holstein
    (Schwager-Suter et al., 2001; Prendiville et al., 2009)
  - No difference between breed groups
    (Heins et al., 2008; Olson et al., 2010)
- Montbeliarde × Holstein versus Holstein cows
  - No difference between breed groups
    (Buckley et al., 2007)

Comparison of ProCROSS and Holstein cows for dry matter intake, body weight, cow height, body condition score, production, feed efficiency, income over feed cost, and residual feed intake

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Data

- Holstein versus ProCROSS (Holstein, Montbeliarde, Viking Red) cows
- Data collection from 4 to 150 days in milk for the first 3 lactations of cows
- Cows calved for the first time from September 2014 to April 2017
- Cows that left the herd before 150 days in milk were deleted (8.6% of cows that began the project)

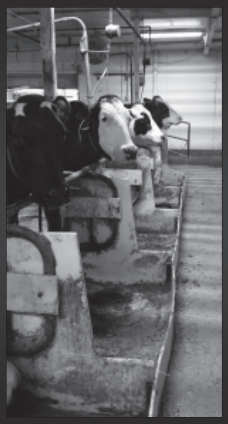
Objectives

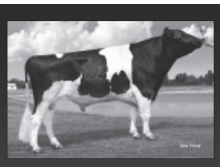
Compare ProCROSS and Holstein cows for

- Dry matter intake (DMI)
- Production
- Body weight (BW)
- Cow height
- Body condition score (BCS)

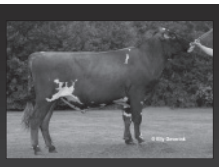
Recording of individual feed intakes

- Cows were fed the same TMR on a daily basis
  - Delivered twice daily
  - Feed refusals were weighed once daily
- Feed samples were taken twice weekly
  - Pooled weekly samples analyzed for dry matter content
  - Pooled monthly samples analyzed for nutrient composition





Holstein



Viking Red

ProCROSS

Montbeliarde

Mean DMI and production from 4 to 150 DIM for primiparous cows

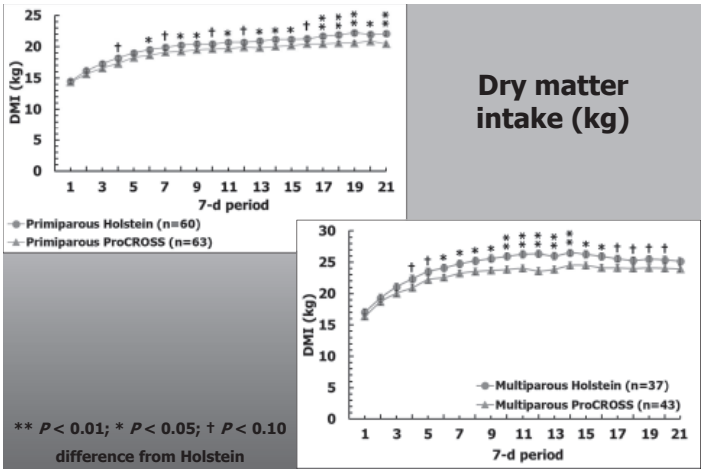
	Breed of cow		
Trait	Holstein (n = 60)	ProCROSS (n = 63)	Difference from Holstein
Dry matter intake (lb)	6,499	6,188	–311 (–4.8%) **
Milk volume (lb)	10,516	10,061	–455 (–4.3%) **
Fat + protein (lb)	725	730	+5 (+0.5%)

** $P < 0.01$ difference from Holstein

Mean DMI and production from 4 to 150 DIM for multiparous cows

Trait	Breed of cow: Holstein (n = 37)	Breed of cow: ProCROSS (n = 43)	Difference from Holstein
Dry matter intake (lb)	7,919	7,408	–514 (–6.5%) *
Milk volume (lb)	14,630	13,810	–820 (–5.6%) *
Fat + protein (lb)	972	981	+9 (+0.9%)

* $P < 0.05$ difference from Holstein

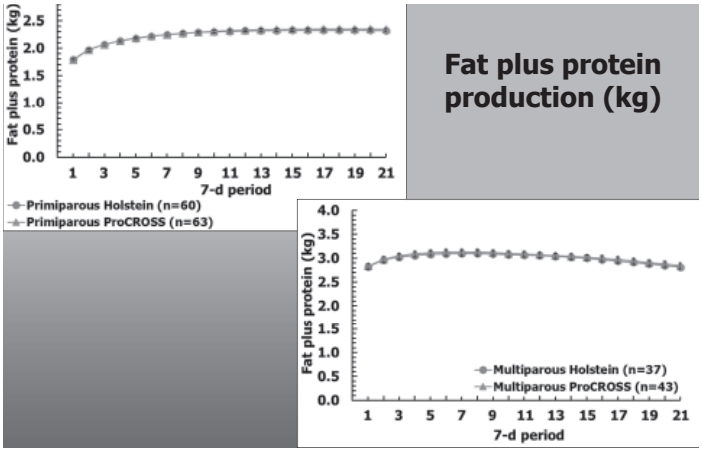


Dry matter intake (kg)

Means for body traits from 4 to 150 DIM for primiparous cows

Trait	Breed of cow: Holstein (n = 60)	Breed of cow: ProCROSS (n = 63)	Difference from Holstein
Body weight (lb)	1,226	1,239	+13
Wither height (cm)	139.4	135.4	–4.0 **
Hip height (cm)	144.3	142.3	–2.0 **
Body condition score	3.20	3.46	+0.26 **

** $P < 0.01$ difference from Holstein

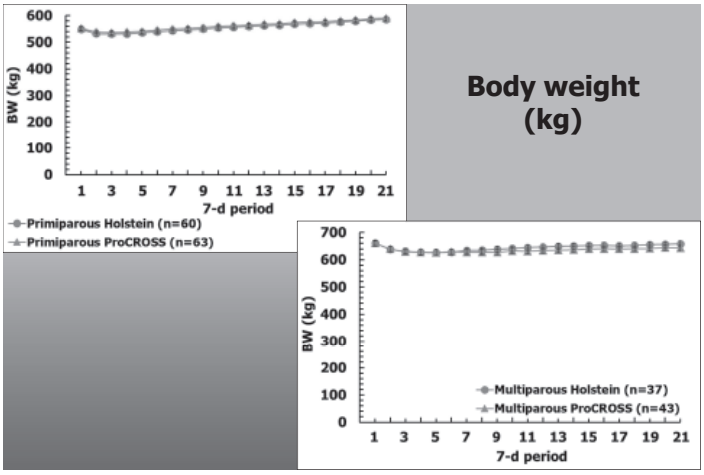


Fat plus protein production (kg)

Means for body traits from 4 to 150 DIM for multiparous cows

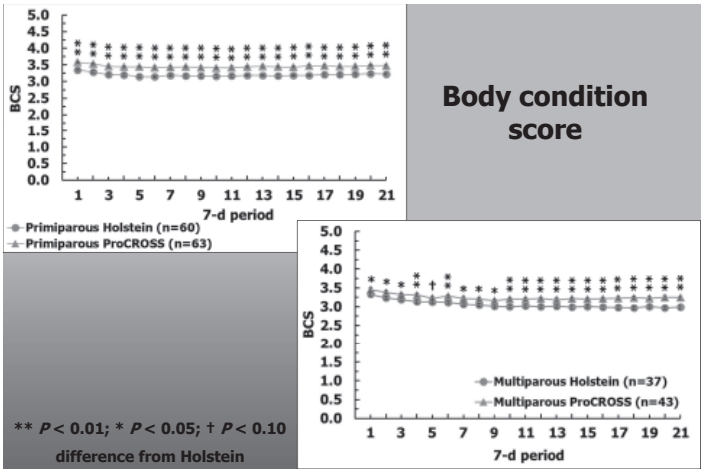
Trait	Breed of cow: Holstein (n = 37)	Breed of cow: ProCROSS (n = 43)	Difference from Holstein
Body weight (lb)	1,420	1,402	–18
Wither height (cm)	143.7	140.2	–3.5 **
Hip height (cm)	146.4	145.2	–1.2
Body condition score	3.06	3.25	+0.19 **

** $P < 0.01$ difference from Holstein



Body weight (kg)

Body condition score



** $P < 0.01$; * $P < 0.05$; † $P < 0.10$ difference from Holstein

Mean income over feed cost

Trait	Breed of cow: Holstein	Breed of cow: ProCROSS	Difference from Holstein	
Primiparous	n = 60	n = 63		
IOFC ($)	825	875	+$50	+6% **
Daily IOFC ($)	5.61	5.95	+$0.34	
Multiparous	n = 37	n = 43		
IOFC ($)	1,208	1,296	+$88	+7% *
Daily IOFC ($)	8.22	8.82	+$0.60	

* $P < 0.05$, ** $P < 0.01$ difference from Holstein

Fat plus protein production (kg) divided by DMI (kg)

Parity	Breed of cow: Holstein	Breed of cow: ProCROSS	Difference from Holstein
Primiparous	0.113 (n=60)	0.119 (n=63)	+6% **
Multiparous	0.124 (n=37)	0.134 (n=43)	+8% **

** $P < 0.01$ difference from Holstein

Residual feed intake

- Difference of actual and predicted feed intake
- Estimated by error from regression of DMI on energy sinks
  - Production (milk energy output)
  - Body maintenance (metabolic body weight; $BW^{0.75}$)
  - Change in body energy (change in body weight and BCS)
- Lower number (negative) is more desirable
  - Because a cow actually consumed less than predicted

Energy corrected milk (kg) divided by DMI (kg)

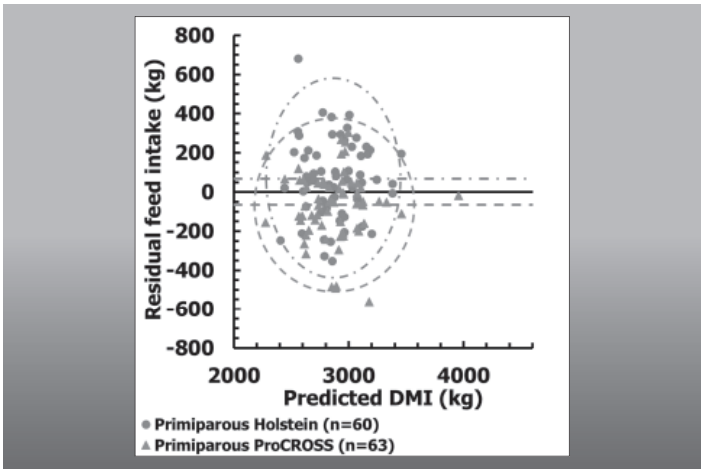
Parity	Breed of cow: Holstein	Breed of cow: ProCROSS	Difference from Holstein
Primiparous	1.70 (n=60)	1.77 (n=63)	+4% *
Multiparous	1.89 (n=37)	2.01 (n=43)	+6% *

* $P < 0.05$ difference from Holstein

Mean residual feed intake (kg) from 4 to 150 days in milk

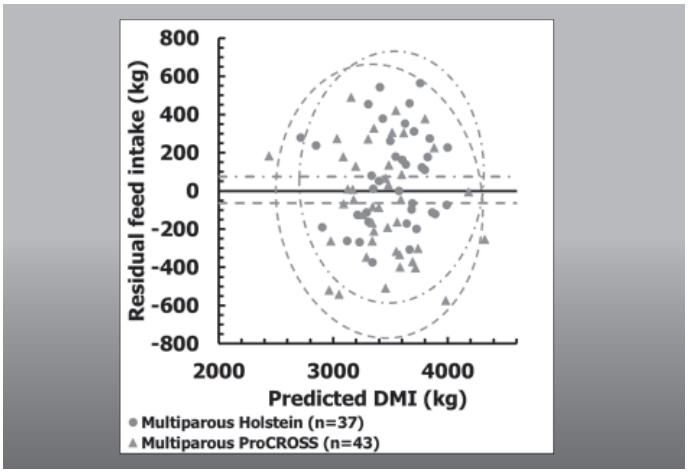
Parity	Breed of cow: Holstein	Breed of cow: ProCROSS	Difference from Holstein
Primiparous	+68.8 (n=60)	−65.5 (n=63)	−134.3 **
Multiparous	+75.0 (n=37)	−64.5 (n=43)	−139.5 *

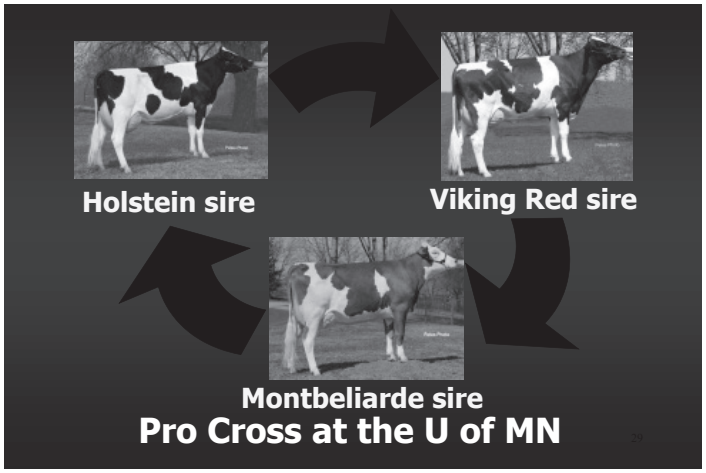
* $P < 0.05$, ** $P < 0.01$ difference from Holstein

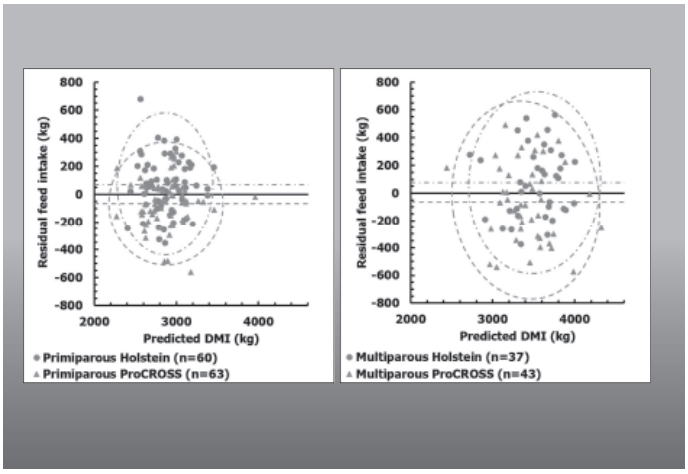


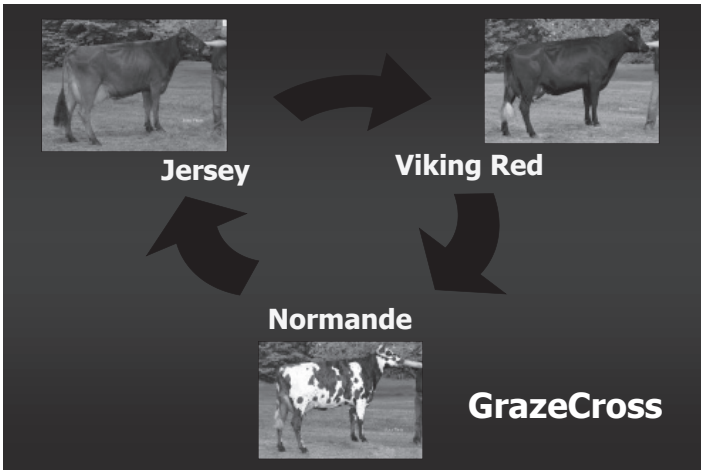
Ideal Dairy Cow

- High fat and protein
- Excellent fertility and ability to produce a calf regularly
- Longevity (~5 to 7 years)
- Low somatic cell count
- Smaller and functional cow
- Efficiently converts feed to milk
- Breed depends on each producer's management system
- AI is a must!









Important points

- Crossbreeding is a mating system that complements genetic improvement of breeds
- Selection of best A.I. bulls within breed results in genetic improvement
- Heterosis from crossbreeding is a "bonus" on top of genetic improvement within breeds
  - 3 (northern Europe breeds) to 10% (Alps breeds) for production
  - Greater than 10% for fertility, health, and survival

Recommendations for crossbreeding

- Crossbreeding systems must use three breeds to optimize heterosis
- Two breeds limits the amount of heterosis
- Four breeds limits the influence of specific breeds
- Therefore, select three breeds for specific needs of herd

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