Genetic Improvement of Feed Intake and Utilization

Evaluation Experience and Implementation Challenges

D. H. "Denny" Crews, Jr.
Center for Genetic Evaluation of Livestock (CGEL)
Department of Animal Sciences
Colorado State University

Feed Intake & Utilization

- Feed intake is clearly a cost-side ERT
  - Feed and supplementation account for > 65% of non-fixed production cost (Basarab et al., 2004: NR = R – C)
- Intake has complex inter-correlations with other ERT
  - Growth rate, mature size, and body composition are related to intake
  - Must be considered within the context of multiple trait selection
  - Phenotypic expression of efficiency remains contentious
- Traditional NCE for feed utilization has progressed slowly
  - High data collection cost (~ $150 hd^{-1})
  - Indicators explain 65-70% of individual intake variance: DMI = $\mathbf{X}_i\boldsymbol{\beta} + \boldsymbol{\epsilon}$
    - There is value in the 30-35% not predicted by production level
  - Polygenic architecture is reasonably well known, but NCE are prototypical

Recommended Intake Test Timeline

Crews et al. (2008), BIF Intake Guidelines Subcommittee

wk	1	2	3	4	5	6	7	8	9	10	11	12	13	14
d	0	7	14	21	28	35	42	49	56	63	70	77	84	91
LWT[a]	?			■		■		■		■		■		■
RTU[b]				■					?					■
Test d				0	7	14	21	28	35	42	49	56	63	70
PRE[c]	■	■	■											
DMI[d]				■	■	■	■	■	■	■	■	■	■	■

[a] Live weights are often recorded every 2 weeks, but could be less frequent with longer tests (minimum of 5-6 for computation of ADG). 2 on/2 off is less desirable.
[b] Ultrasound could be collected at beginning and end of test, serially, or if only once, at the end of test.
[c] Pre-conditioning or warm-up period of 21 d for facility and diet acclimation.
[d] Dry matter intake data collection for 70-d ensures a minimum of ~50 usable days. Archer et al. (1997) and Wang et al. (2005) generally showed an absolute minimum of 35-45 d required for DMI. 70-d is required for ADG.

Cluster and Meta-Analysis of Genetic Parameters for Feed Intake Traits

- Feed intake and utilization data from 62 studies (1961-2011);
- Main objective and main concern : Provide meta genetic parameters
  - ✓ Country
  - ✓ Sex
  - ✓ Amount of data evaluated

	Results				
	RFI	MBW	DMI	ADG	FCR
RFI	0.31(0.02)	0.25(0.09)	0.67(0.12)	0.04(0.08)	0.65(0.10)
MBW		0.31(0.03)	0.36(0.04)	0.33(0.06)	0.24(0.04)
DMI			0.39(0.03)	0.38(0.11)	0.34(0.13)
ADG				0.32(0.04)	-0.15(0.12)
FCR					0.26(0.03)

Genetic evaluation of feed utilization traits

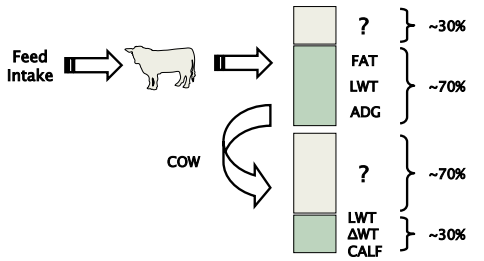
Gelbvieh/Balancer Prototype

- 1,594 Gelbvieh and Balancer bulls born between 2007 to 2011
- Traits evaluated: ADG, RFI, MBW, DMI
- Pedigree – 18,427 animals
- Prototype: Typical direct genetic evaluation model with CG

	ADG	MBW	RFI	DMI
Sires with own record	0.61	0.70	0.59	0.56
Sires without own record	0.32	0.36	0.32	0.33
Total	0.34	0.38	0.34	0.35

	Mean	Minimum	Maximum
ADG lb/d	0.10(0.17)	-0.70(0.20)	0.87(0.55)
DMI lb/d	-0.10(0.24)	-5.20(0.05)	4.58(0.70)
MBW lb	17.44(0.20)	-24.24(0.12)	35.50(0.60)
RFI lb	0.09(0.27)	-0.70(0.12)	0.80(0.70)

Conceptual Intake: Steer vs. Cow



"Efficiency" in Cows

- In Australia, RFI in heifers had a 0.95 genetic correlation with RFI measured again when they were nearly mature (open) dams
  - Both tests were drylot-based
  - Effectively shows repeatability within animal
- The main issue with a measure of efficiency in cows is as a correlated trait
  - Most selection on replacements and sires
  - Designs are to detect antagonisms
- Few studies have reported or predicted the effects of intake or efficiency selection on the total system
  - Archer et al., 1999
  - Crews, 2005
- Basarab et al., 2007 reported on a retrospective study
  - Their basic question was what could be said about the mothers of low RFI versus high RFI calves

Retrospective Study: Cow Traits

		Progeny RFI group			
Traits	Overall	Low (Efficient)	Medium (Average)	High (Inefficient)	*P*
Cows (1996-06)	136	33	62	41	
Pregnancy rate	95.61	95.61	95.27	96.03	0.900
Twinning rate	1.43	0.00	0.35	3.77	<0.001
Dystocia	1.29	2.87	0.71	0.84	0.103
Calving rate	84.76	84.88	83.43	86.28	0.619
Weaning rate	81.22	81.46	80.18	82.31	0.793
Cow backfat, mm		9.1	7.8	7.2	0.004
Δ fat, Clv → Brd		−0.67	−0.79	−0.79	0.042
Julian calving day	90	92	87	88	0.008
Cow intake	11.72	10.80	11.30	12.22	0.003
Cow RFI		−0.05	0.44	1.88	0.018

Adapted from Tables 5-7, Basarab et al., 2007

Dams of High-, Med- and Low-RFI calves

- Dams of the low-RFI calves
  - Higher 10-yr average condition score
  - Lost less backfat from calving to breeding
  - Lower intake on forage
  - Calved ~5 d later in the calving season, but maintained similar interval
- Dams of high-RFI calves
  - Higher calf death loss
  - Higher twinning rate
- No differences noted among dams for other cow productivity traits
  - Pregnancy rate, calving rate and weaning rates similar
  - Calf weaning weights similar
  - Various production and biological "efficiency" indexes were similar

Summary Thoughts

- Intake and efficiency development will benefit from both phenotypic and genomic approaches
- Standard guidelines for intake recording will be available to improve consistency in data collection
- Reporting of genetic values for intake and its components will likely be determined by breed groups
- The primary limitation of national evaluation of intake and related inputs has been and will be data density
- Selection and improvement of efficiency must be considered within the multiple trait context

Thanks.

Denny.Crews@ColoState.edu
970.491.7550