Extension demonstration project outcomes: Industry adoption and translation of project deliverables

Matt Spangler
University of Nebraska-Lincoln

Fundamentals of Beef Production Profit

Profit = Revenue – Costs

Revenue – easy to measure
Costs – hard to measure

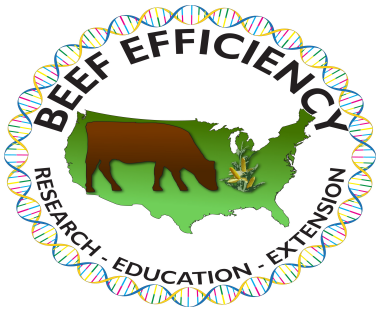
Increased Accuracy-Benefits

- Mitigation of risk
- Faster genetic progress

$$_{BV}/t = \frac{r_{BV,EBV}\, i_{BV}}{L}$$

What Role Does Genetics Play?

	ADG	DMI	RFI	G:F
ADG	0.26	0.56	-0.15	0.31
DMI		0.40	0.66	-0.60
RFI			0.52	-0.92
G:F				0.27



www.BeefEfficiency.org

Weight Trait Project

The WTP is an organized effort to facilitate DNA technology transfer and while at the same time providing a national focus for integration of molecular information into beef genetic evaluation and selection.

National Beef Cattle Evaluation Consortium

Building Better Beef...

Location of producer collaborators

EPDs for FE and component traits and "test drive" the technology

Comparison of feed efficiency terms

Method	More Desirable	Less Desirable	Difference
Raw F:G – Raw Feed Conversion: usually on dry matter basis (lbs feed/ lb of gain)	Lower values Example: 4.5 lbs	Higher values Example 7.5 lbs	Example: 3.0 lbs of feed
Adj. F:G – Adjusted Feed Conversion: usually on dry matter basis (lbs feed/lb of gain)	Lower values Example: 4.5 lbs	Higher values Example: 6.5 lbs	Example: 2 lbs of dry matter
RFI – Residual Feed Intake: usually on dry matter basis	Negative values Example: -1.7	Positive values Example: +1.5	Example: 3.2 lbs of feed
R-ADG – Residual Average Daily Gain: usually on lbs gained per day	Positive values Example: +0.86	Negative values Example: --.63	Example: 1.49 lbs of average daily gain
Adj. DMI – Adjusted Dry Matter Intake: should be on dry matter basis	Negative values Example: -0.9	Positive values Example: +0.8	Example: 1.7 lbs of feed

Dahlke et al (www.iowabeefcenter.org/Docs_cows/IBC41.pdf)

Economically Relevant Traits

- Traits that are directly associated with a revenue stream or a cost
- Examples
  - BWT vs CE
  - REA vs YG
  - YWT vs CWT
  - MWT vs DMI
  - RFI vs FI

Indicator Traits

- Traits that are genetically correlated to an ERT
- Why use indicator traits?
  - Measured earlier in life
  - Cheaper/easier to measure
  - Measured on both sexes

What Is a Selection Index?

- Selection on 'aggregate merit' (Hazel, 1943)
- List of traits that influence "satisfaction"
- Relative Economic Value (REV) of each trait
  - Increase in satisfaction with one unit change in a trait, all others held constant
- List of characteristics to be measured on animal
- Relationships between characteristics (phenotypes) and traits (genotypes)

$$H_i = a_1 BV_{i1} + a_2 BV_{i2} + \mathrm{K} + a_n BV_{in}$$

Why Do We Need Selection Indexes?

"There is no easily accessible, objective way for breeders, particularly breeders in the beef and sheep industries where ownership is diverse and production environments vary a great deal, to use these predictions intelligently."

-- R. M. Bourdon, 1998

Index Based Selection Rolfe et al. (2011)

Predicted responses per generation in dry matter intake for 140 days (DMI) and total body weight gain for 140 days (GAIN) following various selection criteria.

		Response : units of intensity · kg	
Selection Criterion[1]	Direction	DMI	GAIN
DMI	Down	-56.7	-5.4
GAIN	Up	+26.3	+7.5
G:F	Up	-27.5	+2.4
I_1	Down	-44.6	+1.9
I_2	Down	-38.5	0
I_3	Down	-12.4	+5.4
I_4	Down	0	+7.7

Most Desirable Index?

- Phenotypic RFI
- Genetic RFI
- Economic index of DMI and GAIN
- Economic index of RFI and Gain

Simulation Framework

- Stochastic Model
  - Allows for random variation in multiple traits
  - Variation based on fluctuation in historical data
- Simulate base herd then perturb traits one at a time
- **P** is a *n* x *n* matrix of the phenotypic (co)variances among the *n* traits measured and available as selection criteria, **G** is a *n* x *m* matrix of the genetic (co)variances among the *n* selection criteria and *m* objective traits, and **v** is an *m* x 1 vector of economic values for all objective traits

$$b=P^{-1}Gv$$

Terminal or Maternal?

Terminal

- $B, $F, $G (Angus)
- TI (Simmental)
- CHB$ (Hereford)
- MTI (Limousin)
- EPI and FPI (Gelbvieh)
- Charolais
- GridMaster (Red Angus)

Maternal

- $W, $EN (Angus)
- API (Simmental)
- BMI$, BII$, CEZ$ (Hereford)
- HerdBuilder (Red Angus)
- $Cow (Gelbvieh)

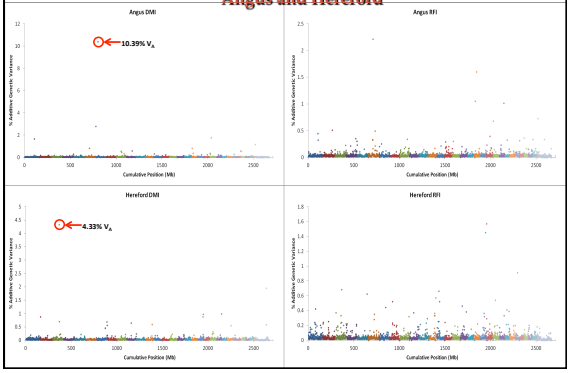
How much impact does DMI have?

- HCW = 59.5%
- DMI=19.3%
- MS=11.1%
- REA=5.5%
- FAT=4.6%
  - Ocshner et al. (2016)

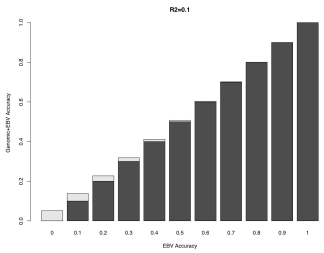
Heritabilities

	DMI (lb)			MMWT ($lb^{0.75}$)			ADG (lb/d)			RFI (lb/d)		
Breed	VA	VE	h^2	VA	VE	h^2	VA	VE	h^2	VA	VE	h^2
Hereford	3.2	4.6	0.41	79	78	0.50	0.09	0.23	0.27	1.60	1.90	0.45
USMARC	1.9	3.4	0.35	84	97	0.47	0.07	0.16	0.30	0.91	0.94	0.49
Simmental x Angus	1.4	3.7	0.27	28	36	0.48	0.04	0.13	0.23	0.96	2.02	0.32
Angus	4.1	7.5	0.35	125	130	0.49	0.06	0.24	0.19	1.30	4.80	0.21

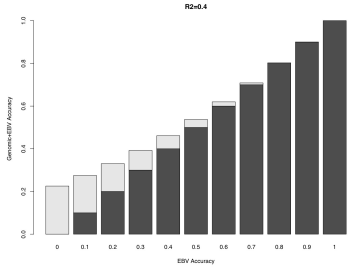
GWAS of DMI and RFI in Angus and Hereford



Impact on Accuracy--%GV=10%



Impact on Accuracy--%GV=40%



Field Demonstration

AI Sires

AI and Herd Bulls from 24 WTP Producers

AI to commercial cattle
Rex Ranch (2011) & USMARC (2011 and 2012)

FE (2013)

FE (2013 & 2014)

SUMMARY OF DEMONSTRATION CATTLE

Sire Breed	Heifer	Steer	Total
AR	14	53	67
COM	0	54	54
HH	12	11	23
AN	72	132	204
GV	69	80	149
CH	32	32	64
LM	34	39	73
SM	17	98	115

Genomic Prediction Equations

- Starting point
  - Requires continuous phenotyping and genotyping
    - In a strategic fashion
- Current methods have limitations
  - Across-breed is still problematic
  - Multi-trait models will be needed to account for sequential culling bias

Next steps

- Sequenced all sires
- Re-genotyping with GGPF250
  - Also genotyping ~2,500 purebreds

Helpful Resources

- http://beef.unl.edu
- www.nbcec.org
- www.beefefficiency.org
- www.eBEEF.org