Efforts in Developing Decision Support Software for the Beef Industry

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Situation

- The global Animal Breeding and Genetics community has done a tremendous job at increasing scientific knowledge, developing selection tools, and delivering these tools to the US Beef Industry.
- Despite these advancements, technology adoption is embarrassingly poor.
  - < 30% of producers use EPD (Weaber et al., 2014)

Thesis

- Poor technology adoption is related to the sum of many underlying issues:
  - Genetic prediction seems opaque
  - Consultancy is often from sources other than what might be preferred
  - Commercial producers do not have the needed time to excel in all areas, and focus on day-to-day animal and financial management
  - Combining all partial solutions is a very cumbersome task
    - Breeding objective
    - Breeding system
    - Breed choice
    - Trait emphasis
    - Sire selection
    - And all need to contemplate that which is economical and possible given environmental constraints

Critical Need

- A web-based tool to aid in the amalgamation of all sources of information towards economically driven sire selection decisions
- Assistance in determining the value proposition of increased information content
  - Collection of phenotypic records for "novel" traits
  - Economic value of genotyping
  - All predicated on the economic value of accuracy

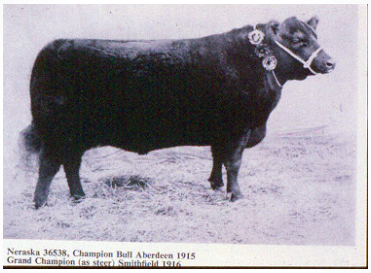
Current Partial Solutions

- Global heterosis estimates
  - Can be refined using biological type estimates
  - In the future refined with breed x breed estimates
- Plethora of EPD
  - 20+ and not all are Economically Relevant
- Projects centered on genomic discovery for "novel" traits
  - Feed Efficiency, disease susceptibility, fertility, etc.
- Bio-economic indices
  - Focus on additive merit
  - Robust relative to changes in costs/returns
  - One size fits all

Current Status=Confusion

	CE	BW	WW	YW	MCE	MM	MWW
Adj.		90	700	1320			
Ratio		101	107				
EPD	9	-1.0	25	49	3	11	23
Acc	.29	.37	.30	.27	.18	.19	.23

	YG	Marb	BF	REA
Adj.		4.65%	.23	12.5
Ratio		106	100	95
EPD	.21	.44	.05	-.39
Acc	.32	.31	.33	.34



Past Attempts

- Decision support software is not all together new.
  - For Example: Decision Evaluator for the Cattle Industry; **DECI**; Williams and Jenkins, 1998; Colorado Beef Cow Production Model; **CBCPM**; Shafer *et al.*, 2005
- Adoption of previous tools suffered due to:
  - The depth of information required to parameterize the model.
    - Unit cost of production metrics are generally unknown at the firm-level
  - A general lack of funding to support the initiation and continuation of these efforts.

Goal

- To develop a web-based decision support tool that combines all partial solutions towards providing sire selection recommendations based on relative economic value to a firm (producer).
- Furthermore, this tool would provide guidance in an economic framework relative to the value of added information.
  - Commercial phenotypes
  - Genomics

Overview

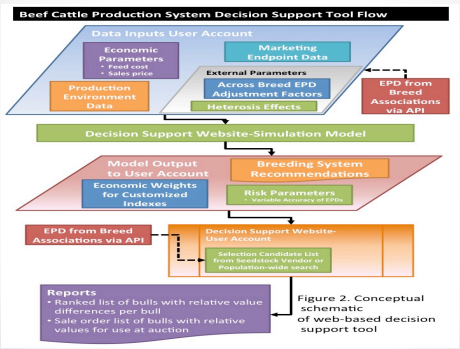


Figure 2. Conceptual schematic of web-based decision support tool

Knowledge Gaps

- Across-Breed EPD
  - Currently focused on growth and carcass merit
  - Need to expand to include traits such as calving ease, heifer pregnancy, and stayability
- Heterosis
  - These estimates, including breed effects, cannot be reliably estimated from field data
  - Global estimates and biological type estimates exist
  - Expanding to breed x breed estimates would refine decisions

Ease of Use

- A tiered level of information required by the user would likely aid in wide-spread use.
  - As simple as geographic region, general cow-herd breed composition, and market endpoint
  - Needs to be scalable to allow for more detailed herd level data

Combining Partial Solutions

- Stochastic approaches
  - Modeling of genetic merit (additive and non-additive)
  - The SEP of EPD
  - Variability in the accuracy of genomic predictors
  - Economic variability
- Evaluating alternate planning horizons
  - Current production levels in a given environment (input by the user)
  - Evaluate alternate marketing options (e.g. sale at weaning, retained ownership and marketing on grid or live basis)

Value Discovery of Added Information

- Many ERTs are not currently evaluated nor collected routinely in the seedstock sector
- However, they drive value downstream
  - Reproduction phenotypes (longevity)
  - Disease (pulls, treatments, mortality)
  - "Routine" carcass data
  - Plant value—primal yield, dark cutters, blood splash, etc.

Tradeoffs

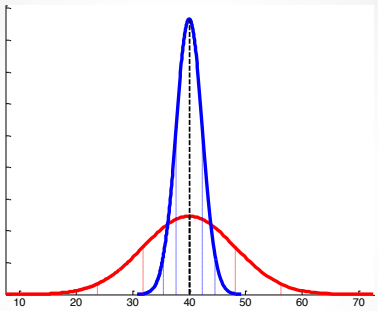
- These phenotypes are not free
- The value is related to the value of improved accuracy (either EPD or sensitivity of indices)
- Quantifying this value is required before these relationships can be brought to fruition

Accuracy Example

Weaning Wt. EPD = 40
ACC. = 0.60

Possible change +/- 4.60

68% confident his true EPD is between 35.4 and 44.6



Difference in EPD Accuracy

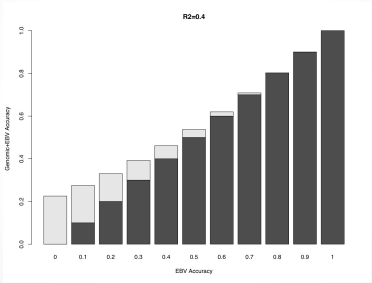
Acc = 0.30, Possible Change = 8.1
Acc = 0.8, Possible Change = 2.3

Accuracy

Table 1. Approximate number of progeny needed to reach accuracy levels (true (r) and the BIF standard) for three heritabilities (h^2).

Accuracy		Heritability Levels		
r	BIF	h^2 (0.1)	h^2 (0.3)	h^2 (0.5)
0.1	0.01	1	1	1
0.2	0.02	2	1	1
0.3	0.05	4	2	1
0.4	0.08	8	3	2
0.5	0.13	13	5	3
0.6	0.2	22	7	4
0.7	0.29	38	12	7
0.8	0.4	70	22	13
0.9	0.56	167	53	30
0.999	0.99	3800	1225	700

Impact on Accuracy-- %GV=40%



Tradeoffs

- Genotyping can increase the accuracy of EPD, but represents an additional cost above phenotyping.
- The accuracy of the decision (bull purchase) changes with additional information.
- The sparse phenotypes mentioned will be needed to fully exploit genomic investment.
- Quantifying this provides a feedback loop and pull through demand between commercial and seedstock assuming the price point is correct.

Trainer the Trainer

- Benefits to commercial producers obvious (hopefully)
- Benefits to the seedstock sector?
  - Help clientele become more profitable
  - Candidate sires ranked based on relative economic value
  - More bulls ranked at the top of someone's list
- Seedstock producers, breed association personnel, and extension personnel targeted for training
  - Use it to advise clientele

Teaching Tool

- Students with background in beef production is declining.
  - Pros and Cons to this
- A web-based decision support tool could be used in undergraduate/graduate courses
  - Beef Production
  - Beef Systems/Capstone
  - Animal Breeding

Partnerships Required

- Breed Association partnerships are key
- The effort described herein will not wait for 100% agreement/partcipation among breed associations

Summary

- Tremendous investments (time and money) have been made
  - Scientific discovery
  - NCE infrastructure
  - Education of producers (extension)
- Despite this investment, technology adoption continues to lag
  - Creates inefficiency
  - The next generation of scientists will not engage in an industry that has not yet adopted 40 year old tools
- Decisions support has always been needed, and past efforts can be used to revisit this critical area
  - Sustainability of this effort would be handed over the seedstock organizations

Would You Use This?

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