Bovine Respiratory Disease Complex
Coordinated Agricultural Project

Phenotypic Data Collection for Bovine Respiratory Disease

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Bovine Respiratory Disease—Overview

- BRD and Profitability
- Genetics of BRD
- Guideline Development for BIF

Economics of BRD

- Leading cause of mortalities in the beef industry
- In 1997, Dr. Griffin estimated losses to the industry as $750 million per year
- In a 1996 report, loss of production and carcass value resulting from BRD averaged over $92/head (McNeill et al.)

- Clearly BRD incidence has economic value to our industry
- But is there a genetic component?

Two perspectives for evidence of a genetic component

- Quantitative
- Molecular

Genetics of BRD

- Heritability
  - What we observe in disease incidence—how much is due to additive genetic differences in the population?
  - To be an opportunity for genetic improvement must have some degree of heritability
    - $h^2 > 0$

Summary of heritability estimates

Heritability	Incidence	Endpoint	Source Comments	Source
.04 to .08 .18(underlying)	4% to 44%	Feedlot	N>18,000 (MARC)	Snowder et al., 2006
.11 .07	11.4% 9.6%	Weaning Feedlot	ISU Steer test	Schneider et al., 2011
.17	9 to 48%	Feedlot	CSU	Brigham et al., 2012

Provides quantitative evidence, but what about molecular?

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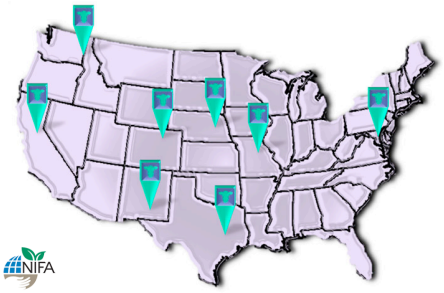

USDA NIFA

United States Department of Agriculture
National Institute of Food and Agriculture

BRDcomplex.org

Genomic Evidence: BRD CAP Project

- 2000 feedlot samples of 5 breeds from Colorado and Washington (case-control)
- Subset genotypic relationship in a case-control heritability was 37%
- Further evidence:
  - 100+ genomic regions associated with BRD (Holsteins; Neibergs et al., 2014)
  - Analysis of Holstein data indicates a large-effect gene on chromosome 27 (Dr. Jerry Taylor)

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Conclusion

- There is a genetic component to susceptibility to BRD
- Therefore; there is the potential for genetic improvement in this trait.

Delivery of Tools for Selection

- EPD for susceptibility
- What will go into this tool?
  - Phenotypic data
  - Genomic data
    - Several projects completed/underway to develop these
      - USDA-NIFA BRD CAP Grant
      - USDA Foundational Grant (CSU and USDA-MARC)
      - Privately funded efforts (Zoetis project)

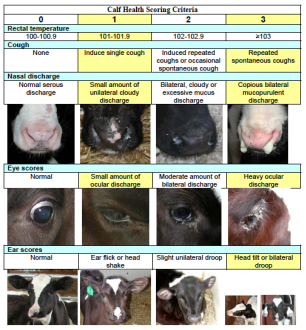
Using an EPD for susceptibility in a genetic improvement program

- Incidence of BRD ~7 times more important in a terminal sire index than WW, PWG or feed intake
- 2-3 times more important than marbling score and yield grade.
- Van Eenennaam and MacNeil (2011)

Complex trait presents challenges

- Number of different ways to record disease incidence information
  - Binary – treated or not

S. McGuirk's Diagnostic Criteria



Need some standardization of data

- Enable production of EPD
  - Add accuracy to selection
- Allow validation of newly developed genomic panels
  - Currently this is problematic—who has data for testing?

BRD Guidelines Committee

- Dr. Dee Griffin, University of Nebraska
- Larry Kuehn, USDA MARC
- Dr. Jim Lowe, University of Illinois
- Holly Neibergs, Washington State University
- Chris Seabury, TAMU
- Alison Van Eenennaam, UC Davis
- R. Mark Enns, Colorado State University

What are feedlots recording now?

- Drs. Lowe and Griffin
- Two widely-used feedlot software programs
  - Animal Health International
  - Micro Technologies (Micro Beef Technologies)
- Production Animal Consultation provided summaries of reporting rates

Data reporting rates for two feedlot recording systems:

- Lot info
  - In date (100%)
  - Out date (100% if closed)
  - Sex (100%)
  - Owner (74%)
  - Buyer (41%)
  - Origin (71%)
  - Starting average weight (100%)
  - Ending average weight (100% if closed)
  - Starting head (100%)
  - Ending head (100% if closed)
  - Risk (1%)
  - Breed (0%)

Treatment information recording rates

- Date (100%)
- Weight (99%)
- Temperature (74%)
- Severity score (41%)
- Products applied (100%)
- Cost of products applied (69%)
- Pen rider (6%)
- Doctor (4%)
- Diagnosis (100% – doesn't mean it isn't unknown or other occasionally)

Phenotypic data

- The data is being recorded at the feedlot level
- How can we use/leverage this for genetic improvement?

Guidelines

- Recommendations for "performance" recording
- Recommendations for use of data in genetic evaluation
- First attempt at BIF Guidelines for a disease trait

Guidelines for BRD recording

- Suggesting a tiered approach to recording
  - Different levels of data "comfort"
- Enables flexibility in use of data for genetic evaluation
  - Will enable more detailed genomic research should DNA samples be available
- Envision use of both phenotypic and genomic data in the genetic evaluation

Tier 1

- Animal ID (need IDs of all animals in lot)
- Lot information: In and out dates, sex, owner/origin
- Treatment information (tied to animal)
  - Date pulled, temperature (if available, 74% recording rate), diagnosis
  - Animal info: date died/railed
- Used to create a "binary" observation
  - Treated→ yes/no

Tier 2 level: Classifications

- Presumed BRD (pBRD):
  - Increased respiratory rate and/or effort, depression, lack of gut fill (reduced feed intake)
- Active BRD (aBRD):
  - pBRD plus temperature over 104—active inflammatory response
- Chronic BRD (cBRD):
  - pBRD plus temperature below 104—lack of active inflammatory response
- Confirmed BRD (oBRD):
  - aBRD or cBRD pluse evidence of lung pathology consistent with pneumonia
    - Thoracic ultrasound
    - >1 score on Whisper automated auscultation system
- Not levels of severity, but levels of specificity—may be a different trait analysis
- Other contemporary group information

Contemporary group dilemma

- Pen will likely be important environmental factor
  - Most likely vectors for shedding and transmission will be pen mates
  - Historically, add pen to contemporary group definition
    - Birth weight CG + weaning CG + arrival date + origin + pen
- Concern: overspecifying/subdivising CG so that little variability exists.

Contemporary group approaches

- Fit pen(lot) as separate main effect outside of contemporary group structure
- Fit pen(lot) as a random rather than fixed effect
  - Pen effects will be regressed relative to the information content
  - Epidemiology is not completely understood
    - This approach would allow correlations to be fit based on pen proximity (if that data were available)
    - Larry Kuehn

Summary

- There is opportunity for genetic improvement in susceptibility to bovine respiratory disease.
- Considerable data is currently being recorded in the feedlot
- Guidelines committee will submit final recommendations to the board for approval
- Goal: An EPD for selection of animals with reduced susceptibility to BRD