Integrated Program for Reducing Bovine Respiratory Disease in Beef and Dairy Cattle

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US Bovine Respiratory Disease Coordinated Agricultural Project
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Bovine Respiratory Disease Complex Coordinated Agriculture Project

USDA United States Department of Agriculture National Institute of Food and Agriculture

The "Integrated Program for Reducing Bovine Respiratory Disease Complex (BRDC) in Beef and Dairy Cattle" Coordinated Agricultural Project is supported by Agriculture and Food Research Initiative Competitive Grant no. 2011-68004-30367 from the USDA National Institute of Food and Agriculture.

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Overview

- What is BRD
- Need for novel approaches for BRD
- What is the BRD Coordinated Agricultural Project
- What is needed to develop accurate genomic/DNA tests
- Work of BRD CAP to address these needs
- Extension objectives of the BRD CAP
- Interest in

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Background and Rationale

"Year in and year out, diseases of the respiratory system are a major cause of illness and death in cattle from 6 weeks to two years of age. Sadly, this is as true today as it was 30 years ago despite development of new and improved vaccines, new broad spectrum antibiotics, and increased fundamental knowledge as to the cause of disease"

- Bovine Respiratory Disease (BRD) has been extensively studied since the 1800s, and yet it remains prevalent
- More effective vaccines have not decreased the morbidity or mortality of BRD
- Mortality has increased as vaccine efficiency has increased
- 1.4% of all US feedlot cattle perish before reaching harvest weight
- **Need to develop new approaches to tackle BRD**

Montgomery, D. 2009. Bovine Respiratory Disease & Diagnostic Veterinary Medicine. Proceedings, The Range Beef Cow Symposium XXI. December 1, 2 and 3 2009, Casper, WY. Pages 1-6.

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BRD Coordinated Agricultural Project

Long-term goal is to reduce the incidence of BRD in beef and dairy cattle by capitalizing on recent advances in genomics to enable novel genetic approaches to select for cattle that are less susceptible to disease

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Potential benefits of genomics are greatest for economically-important traits that:

- Are difficult or expensive to measure
- Cannot be measured until late in life or after the animal is dead
- Are not currently selected for because they are not routinely measured
- Have low heritability

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Issues in the development of genetic approaches to select against susceptiblity to BRD

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- Disease resistance heritabilities tend to be low, especially under field conditions
  - suboptimal diagnosis (e.g. not all sick animals are identified and healthy animals may be incorrectly diagnosed as ill),
  - some susceptible animals will appear resistant to a disease when in fact they have not been exposed to the disease agent.

Bishop, S. C., and J. A. Woolliams. 2010. On the genetic interpretation of disease data. Plos One 5: e8940.

- In feedlot calves, heritability estimates were low and ranged from 0.04 to 0.08 (Snowder et al., 2006). When the observed heritability estimate was transformed to an underlying continuous scale, the estimate increased to 0.18

Snowder, G. D., L. D. Van Vleck, L. V. Cundiff, and G. L. Bennett. 2006. Bovine respiratory disease in feedlot cattle: environmental, genetic, and economic factors. J Anim Sci 84: 1999-2008.

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Disease resistance is a very attractive target trait for genetic improvement

- The presence of genetic variation in resistance to disease, coupled with the increased consumer pressure against the use of drugs, is making genetic solutions to animal health problems increasingly attractive.
- The non-permanent effectiveness of chemical agent (due to development of resistance by the pathogen) further contributes to this interest.

Newman, S. and Ponzoni, R.W. 1994. Experience with economic weights. Proc. 5th World Congress on Genetics Applied to Livestock Production. 18:217-223.

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Animal industries have successfully implemented selection against other diseases

- In dairy cattle, selection programs have been developed to take advantage of genetic variability in mastitis resistance, despite the fact that the heritability of clinical mastitis is low and mastitis resistance has an adverse correlation with production traits
- Likewise chicken breeders have long used breeding to improve resistance to avian lymphoid leucosis complex and Marek's disease

Stear, M. J., S. C. Bishop, B. A. Mallard, and H. Raadsma. 2001. The sustainability, feasibility and desirability of breeding livestock for disease resistance. Res Vet Sci 71: 1-7

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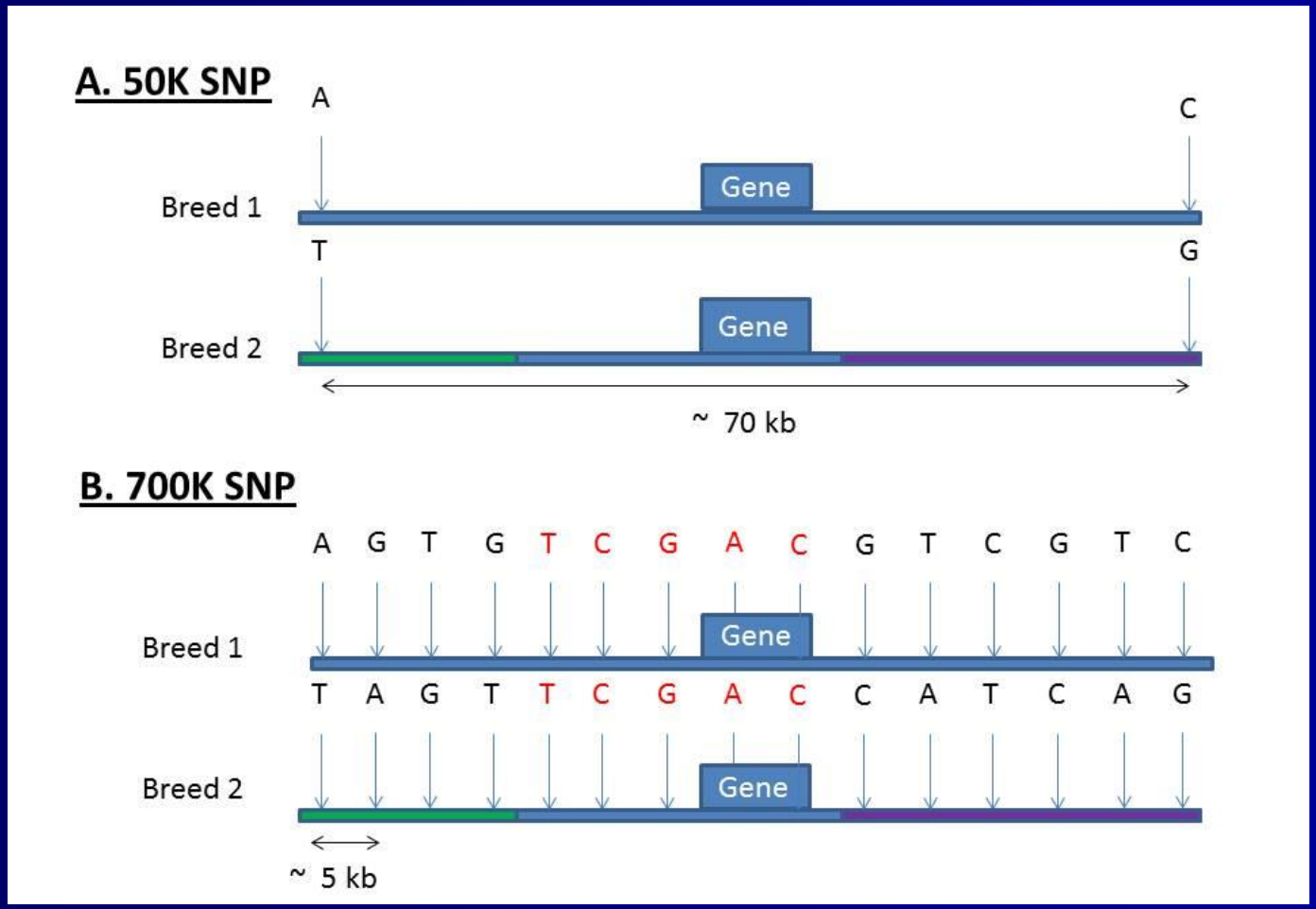
What is needed to develop DNA-tests for BRD susceptibility?

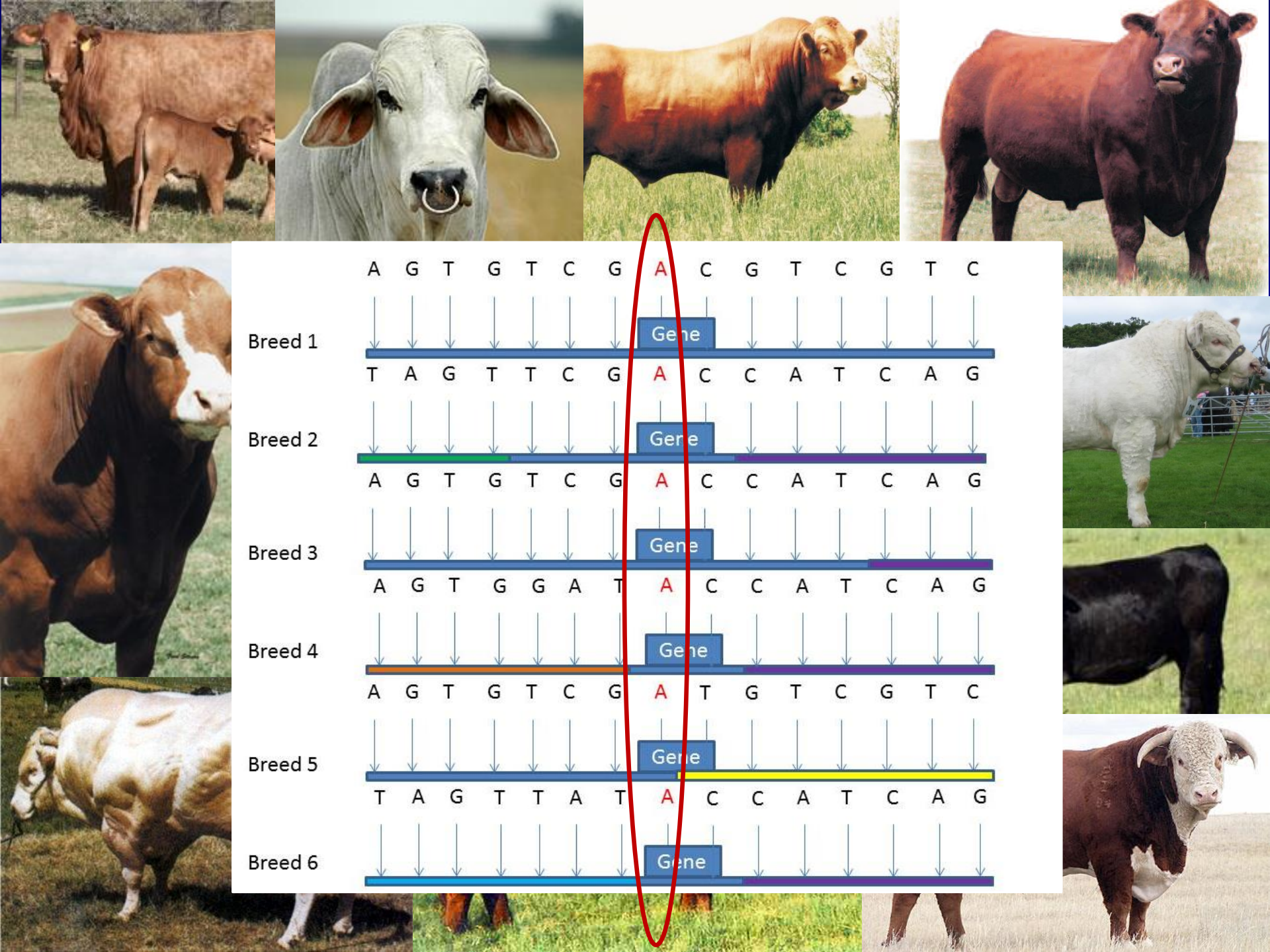
Large training/discovery populations with BRD observations and high density 700K SNP genotypes = used to estimate the value of every chromosome fragment contributing variation to BRD susceptibility.

Prediction equation = the results of training can then be used to predict the genetic merit of new animals, not contained in the training data set

Genetically select for reduced BRD susceptibility

Marker location relative to the gene (e.g. BRD susceptibility when using the (A) 50K SNP chip assay (markers spaced at ~ 70 kb intervals), or (B) the high density 770 K SNP chip assay (markers spaced at ~ 5 kb intervals)




A G T G T C G A C G T C G T C
Breed 1
Gene
T A G T T C G A C C A T C A G
Breed 2
Gene
A G T G T C G A C C A T C A G
Breed 3
Gene
A G T G G A T A C C A T C A G
Breed 4
Gene
A G T G T C G A T G T C G T C
Breed 5
Gene
T A G T T A T A C C A T C A G
Breed 6
Gene

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Need for large discovery populations

- The ready availability of dense single nucleotide polymorphism arrays (i.e. 700 K SNP chips) has given rise to hitherto unforeseen opportunities to dissect host variation and identify possible genes contributing to this variation using genome wide association studies
- To have the power to meaningfully quantify genetic variation or perform a genome scan using a dense SNP chip it is necessary to have datasets comprising observations **on several thousands of individuals**.

Bishop, S. C., and J. A. Woolliams. 2010. On the genetic interpretation of disease data. Plos One 5: e8940.

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Need for careful "case" definition

- For studies of infectious diseases this usually necessitates utilizing field data because challenge experiments of a sufficient scale will not be possible.
- However, such field data is very 'noisy'
  - diagnosis of infection or disease may be imprecise; it can be difficult to determine when infection of an individual occurred
  - it is often unclear whether or not apparently healthy individuals have been exposed to the infection
- These factors add environmental noise to the epidemiological data.

Bishop, S. C., and J. A. Woolliams. 2010. On the genetic interpretation of disease data. Plos One 5: e8940.

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Accurate diagnosis (i.e. case definition) of BRD is critical for success of studies

- Traditional methods for detecting morbid cattle include visual appraisal once or twice daily.
- Animals displaying nose or eye discharge, depression, lethargy, emaciated body condition, labored breathing or a combination of these, should be further examined
- Symptomatic animals with a rectal temperature ≥ 103°F are usually considered morbid and given treatment.
- All of these diagnostic systems are **subjective in nature**.
- Confounding factors include the diligence and astuteness of those checking the animals, the variability and severity of the symptoms the animals experience with chronic and acute BRD, and the disposition of the animals

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BRD CAP: BRD field datasets

Case:control field datasets are being developed for bovine respiratory disease

- 6000 animals – case:control design
  - 2000 dairy calves diagnosed on a collaborating dairy calf rearing ranch (CA)
  - 2000 feedlot cattle diagnosed on a collaborating feedlot (TX)
  - 1000 dairy (NM) and 1000 beef (NV) case:control animals will be used to validate loci associated with BRD in the discovery populations
- All will be genotyped on 700K high density SNP chip

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Year 1: CA Dairy Calf Ranch: 70,000 head capacity

Jessica Davis, DVM
Intern at Veterinary Medicine Teaching and Research Center, University of California, Davis; Tulare
Terry Lehenbauer, DVM
Sharif Aly, DVM
Pat Blanchard, DVM
California Animal Health and Food Safety Laboratory System

Photo credit: Jessica Davis

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Standardization of BRD Diagnosis

- 1000 case and 1000 control 30-60 day old calves
- Use Dr. Sheila McGuirk's calf respiratory scoring chart
  - Temperature, eyes, ears, nose, +/- cough
  - Additional clinical signs: tachypnea, dyspnea, position of head, appetite
  - Give score and either enroll or not (5 or greater to enroll as case)
- Sample collection
  - Blood for DNA extraction and high density SNP genotyping
  - Nasal swab and deep pharyngeal swab to identify viruses (PCR: IBR, BVD, BRSV, and Corona) and bacteria (*Manheimia haemolytica, Pasteurella multocida*, and *Histophilus somni*, and Mycoplasma spp.) present in the nasopharyngeal and pharyngeal recesses

SCHOOL OF VETERINARY MEDICINE
University of Wisconsin-Madison

http://www.vetmed.wisc.edu/dms/fapm/fapmtools/8calf/calf_health_scoring_chart.pdf

Calf Health Scoring Criteria			
0	**1**	**2**	**3**
Rectal temperature			
100-100.9	101-101.9	102-102.9	≥103
Cough			
None	Induce single cough	Induced repeated coughs or occasional spontaneous cough	Repeated spontaneous coughs
Nasal discharge			
Normal serous discharge	Small amount of unilateral cloudy discharge	Bilateral, cloudy or excessive mucus discharge	Copious bilateral mucopurulent discharge
			
Eye scores			
Normal	Small amount of ocular discharge	Moderate amount of bilateral discharge	Heavy ocular discharge
			
Ear scores			
Normal	Ear flick or head shake	Slight unilateral droop	Head tilt or bilateral droop
			

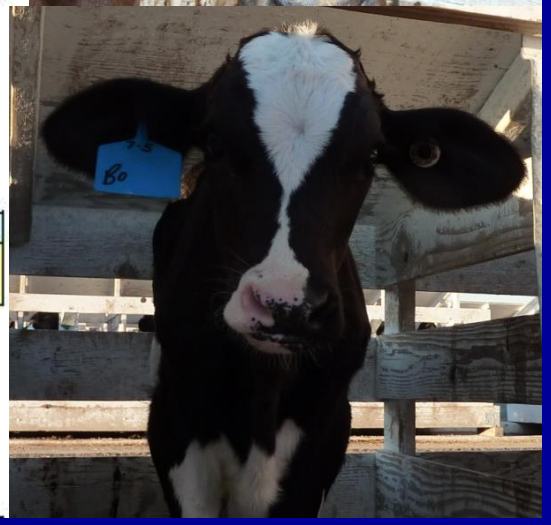
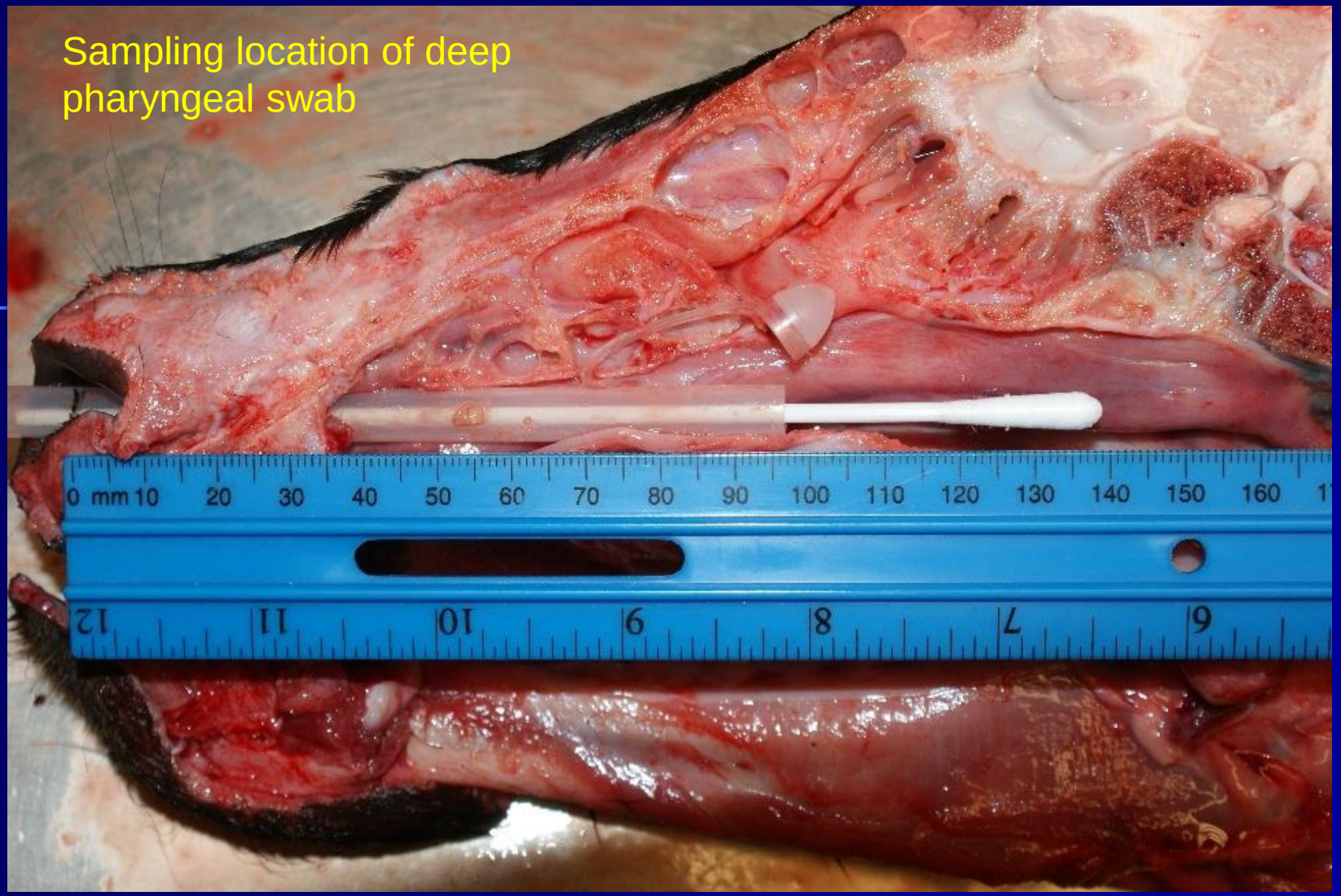


Photo credit: Jessica Davis



To culture organisms associated with BRD, pharyngeal swabs offer a less invasive, less stressful and more rapid alternative to broncheoalveolor lavage.

Photo credit: Jessica Davis

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Controls

- Score control in same way as cases (score of 4 or less)
- Try to select animals in the adjacent hutch, same dairy of origin, and same sex
- Collect samples for control animals in same was as case

Objective: Try to identify cases and controls in a relatively constant environment, subjected to the same exposure and stresses, to decrease the environmental "noise" of these field BRD datasets

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EXTENSION HYPOTHESIS: An integrated multidisciplinary approach to reducing BRD will be more successful than approaches which address only one aspect of the disease or a single sector of the cattle industry.

1. Organize an annual Advisory Board face-to-face meeting and BRD research conference
2. Utilize existing extension networks to integrate producers, industry, veterinarians, researchers, graduate and veterinary students into the conducting and interpreting of the research trials.
3. Enhance the eXtension Beef Cattle Community of Practice (CoP) by contributing new content, increasing membership in the CoP, and creating a cross-disciplinary partnership with DAIReXNET in the area of BRD research and outreach
4. Develop community-based programming and work with farm advisors and local veterinarians to identify farms/ranches/managers (beef, dairy, and feedlot) interested in participating in an evaluation of their BRD management practices
5. Determine the economic cost of BRD to dairies and feedlots and develop stochastic bio-economic models for the net cost-benefit of alternative strategies for reducing the prevalence of BRD.
6. Develop and deliver educational programs on best management practices for integrated and economically sustainable animal health management, genomic, and animal breeding approaches to reduce BRD.

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Beta version is online

http://dcbsp.ucdavis.edu/t2/

Currently meeting with producers and veterinarians to go over risk assessment and receive feedback

Plan to go live later on this quarter

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Home

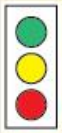
Dairy Respiratory Disease Assessment Survey

Instructions - Answer all questions, and then click the "Evaluate" button at the bottom of this survey to evaluate your management practice in regard to the risks associated with the Bovine Respiratory Disease Complex. By default the Live Feedback is on. Click on the "Live Feedback" button at the top of this survey to turn it off.

For this survey to work, you must enable the JavaScript in your web browser. Click here for instructions on how to enable the JavaScript.

This survey is for your personal use and its results will not be stored on our servers and will not be disclosed to any agency.

Management practices are categorized by color:



- Green = Optimal management practice
- Yellow = Management practice that may increase risk for BRD and other diseases
- Red = Management practice known to increase risk for BRD and other diseases

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Demonstration farms

- Develop BRD risk assessment tool
- Work with local farm advisors and veterinarians to identify facilities having problems with a high incidence of BRD
- Assess ranch/farm/feedlot
- Collaboratively determine Best Management Practices (BMPs)
- In years 3-5 the incidence of BRD will be monitored on the cooperator operations and the impact of the changes to management will be documented

Demonstrate feasibility of implementing best management practices (BMPs). Feedback will be used to modify/develop practical and effective BMPs course curriculum and educational materials.


3341
3340
3340


3339
3339
3338
3338


2484
2484

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- Shiela McGuirk (WI)
- Adroaldo Zanella (Norway)

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Our goal is to integrate research, education, and extension activities to develop cost-effective genomic and management approaches to reduce the incidence of BRD in beef and dairy cattle

The objective of this multi-institutional project is to reduce the incidence of bovine respiratory disease by:

- Capitalizing on recent advances in genomics to enable novel genetic approaches to select for disease-resistant cattle
- Developing improved DNA-based tests for disease diagnosis
- Producing and delivering a variety of educational materials for beef and dairy cattle producers, and feedlot personnel on best management practices to reduce disease incidence
- Providing educational opportunities for undergraduate, graduate and veterinary students to generate a future human resource for the continued reduction in bovine respiratory disease incidence

www.brdcomplex.org

http://www.brdcomplex.org/

About

Bovine Respiratory Disease Complex
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BRD Complex — Facts | Prevention — What you can do | Education — Teaching Materials | Links — Resources | About — Our Research

We are a collaborative group of researchers whose goal is to reduce the prevalence of bovine respiratory disease complex in beef and dairy cattle for the improvement of animal welfare and profitability. The "Integrated Program for Reducing Bovine Respiratory Disease Complex (BRDC) in Beef and Dairy Cattle" Coordinated Agricultural Project is supported by Agriculture and Food Research Initiative Competitive Grant no. 2011-68004-30367 from the USDA National Institute of Food and Agriculture. Our project is led by Dr. James Womack of Texas A&M University and includes scientists and educators from the University of California-Davis, Colorado State University, the University of Missouri, New Mexico State University, Washington State University and USDA's Agricultural Research Service.

USDA NIFA

United States Department of Agriculture
National Institute of Food and Agriculture

Research Plan (PDF 6MB)

Our Researchers

Our Advisory Board

Calendar of Events (PST)

Grant Announcements

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