Answering Practical Questions
For Michigan Cattle Producers

Bovine Infectious Disease Research
Importance of the Cattle Industry

Michigan Commodity Ranking: 2007
By Value of Sales

2007 Value of Sales $5.7 billion

- Grains, oilseeds, dry beans: 29.7%
- Milk, other dairy products: 22.3%
- Nursery, greenhouse, floriculture, sod: 10.8%
- Cattle and calves: 7.8%
- Fruit and berries: 6.8%
- Hogs and pigs: 6.2%
- Vegetables, melons, potatoes: 6.0%
- Poultry and eggs: 4.5%
- Hay and other crops: 3.9%
- Other animals and products: 0.6%
- Horses, ponies, mules: 0.4%
- Sheep, goats and their products: 0.2%
- Aquaculture: 0.1%

Percent of Total Sales
Applied Research

- Transmission of *Mycobacterium bovis* (bTB)
  - Survival of *Mycobacterium bovis* ensiled feeds

- Michigan Johne’s Disease Control Demonstration Project
  - Research ✦ Teaching ✦ Outreach
Survival of *Mycobacterium bovis* during forage ensiling
Background

- *Mycobacterium bovis* is the bacteria which causes bovine TB
- Bovine TB continues to be a problem in NE MI
  - White tail deer are likely the primary reservoir
  - Transmission of *M. bovis* from deer to cattle believed to be indirectly thru contaminated feed, water, environment
  - Still learning about transmission risks
Potential bTB Transmission Reservoirs?
Background

- Under experimental conditions, *M. bovis* can survive on common feeds used to bait deer and feed cattle

Background

- We do know that some pathogenic bacteria can survive the ensiling process:
  - **Listeria** Pauley and Tham, Acta vet. Scand. 2003; 44: 73-86
  - **Streptococcus** Petersson-Wolfe *et al.*, J. Dairy Sci, 2011;94 :5027–5032
- Others do not:
  - **STEC E. coli** Byrne *et al.*, J. Food Protection, 2002;65:1854–1860
  - **Salmonella** Cook *et al.*, J. Applied Microbiology, 2013 ;115:334-45
Background

- **Mycobacterium avium subsp. paratuberculosis (MAP)**
  - MAP detected by PCR in mixed grass/alfalfa ensiled for 150 days *Cook et al.*, J. Applied Microbiology, 2013 ;115:334-45

- MAP detected by PCR in grass hay baleage ensiled for 107 days *Khol et al.*, Veterinarni Medicina, 55, 2010 (5): 225–232

- In both cases, MAP culture was attempted, but unsuccessful

- Nothing on *M. bovis*
**Objective**

- Determine the survivability of *M. bovis* in feedstuffs that are commonly harvested, ensiled and then fed to cattle in NE MI

**Specific Aims**

1. Determine if *M. bovis* can survive ensiling.
2. Determine if survival of *M. bovis* in ensiled forages decreases over time.
3. Determine if there are differences between forage ensiled.
Forages Used

- Forages commonly ensiled in NE Michigan
  - **Alfalfa**
    - 35% DM
  - **Mixed grass**
    - 60% DM
    - 40% DM
  - **Corn**
    - 32% DM
Alfalfa
Mixed Grass
Corn
Design

250 gms of forage

Negative Control

$M. \text{bovis}$

$M. \text{bovis}$

Forage Analysis

Day 0, 1, 2, 6, 9, 13, 15, 28, 56, 112

$M. \text{bovis}$ Culture $t=0$

$x 2/bag$ (n=4)

$M. \text{bovis}$ Culture $t=24$

$x 2/bag$ (n=4)

$M. \text{bovis}$ PCR $t=0$

$x 2/bag$ (n=4)

$M. \text{bovis}$ PCR $t=24$

$x 2/bag$ (n=4)

Dairy One Forage Analysis

Day 112 - Negative Control Temperature Recorder
Liquid Culture
BACTEC

Conventional Solid Agar Culture

Acid Fast Stain

Real Time PCR
Alfalfa - Acid Concentration

Day Post Ensiling

Lactic Acid%

Aceitic Acid %
Alfalfa Profile

Your results vs. typical & goal values

Black = Test Sample    White = Goal    Grey = Typical
# Culture Results

## Alfalfa

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<th>Culture Result</th>
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## Grass (60% dry matter)

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## Corn

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# Alfalfa PCR Results

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Summary to Date

- Model for making silage in laboratory system
- We can successfully inoculate and recover *M. bovis* from forages
- Culturable *M. bovis* recoverable at least 2 weeks.
  - Low risk
- Detectable *M. bovis* DNA for length of study
  - Dormant?
  - Infectious?
  - Risk?

PRELIMINARY
Plans For This Summer

- Is the DNA detected from live organism?
- If so, what would it take to become infectious and therefore a threat to cattle?
Research Team

Dan Grooms, MSU Department of Large Animal Clinical Sciences
Dan Buskirk, MSU Department of Animal Science
Steve Bolin, MSU Department of Pathobiology
Phil Durst, MSU Extension
John Kaneene, MSU Department of Large Animal Clinical Sciences
Steve Rust, MSU Department of Animal Science
Mike Allen, MSU Department of Animal Science
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James Averill, Michigan Department of Agriculture and Rural Development
Joe Hattey, MSU Diagnostic Center for Population and Animal Health
Jessica Plastow, MSU Diagnostic Center for Population and Animal Health
Corby Werth, MMPA
Michigan Johne's Disease Control Demonstration Project
Johne’s Disease – Chronic Diarrhea and Weight Loss
Johne’s Disease
Infected Dairy Herds In Michigan

- All >200
  - 48%
- >200
  - 100%

Positive Environmental Sample

Blair, 2006
Research Outputs

- Developed and demonstrated a target environmental herd screening tool \( \Rightarrow \) JD Herd Prevalence (Pillars 2009)
- Documented shedding and risk of shedding MAP in young calves in JD infected herds (Bolton 2010)
- Association between farm transmission risk factor and likelihood of being infected with MAP (Pillars 2011)
- Environmental distribution of MAP over time (Pillars 2009)
- Economics of JD control program (Pillars 2009)
- Productivity and longevity of MAP infected cows (Pillars 2011)
- Biosensor developed for detecting MAP antibodies (Okafor 2008)
Extension Outputs

2006 Winter Dairy Meeting

Did you know . . .

Clinical Mastitis - culturing clinical cows can reduce your cost?
Vaccines - what makes good vaccines work while others fail?
Johne’s Disease - you can get rid of this disease?
Bioterrorism - it’s your problem - are you ready?
-Impact-

Testing as Proxy For Control Programs

Number of JD Tests

Year


0 10,000 20,000 30,000 40,000 50,000 60,000

Impact Testing as Proxy For Control Programs
Other Bovine Infectious Disease Work at CVM

- **Shiga Toxin Producing E. coli**
  - Manning (MMG), Bartlett, Grooms, Rust (ANS) Cousins (ANS)

- **Bovine Leukosis Virus**
  - Bartlett, Norby, Erskine, Sordillo, Contreras, Cousins (ANS), Swenson, Grooms

- **Mycobacterial diseases**
  - Grooms, Kaneene, Cousins (ANS), Abramovitch (MMG)

- **Bovine Viral Diarrhea Virus**
  - *UP BVDV Eradication Project*
  - Grooms, Bolin
Summer Food Systems Fellowship Program
Dan Grooms DVM, PhD
Michigan State University
College of Veterinary Medicine
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Michigan Upper Peninsula
Bovine Viral Diarrhea Virus Eradication Project

Partnering In Animal Health - BVDV Eradication Project
Objective

To demonstrate the application of a regional BVDV eradication/control program in the US
BVDV Overview

- Mucosal Disease
- Thrombocytopenia
- Acute Death
- Immunosuppression
- Respiratory Disease
- Acute Diarrhea
- Subclinical Infection
- Congenital Infection
- Abortion
- Normal
- "Weak Calf" Syndrome
- Fetal Infection
- Persistent Infection
- Reservoir of Infection

Acute Infection

Congenital Infection’s

Normal

Congenital Defects
Why Such A Big Deal?

- Significant Animal Health Challenge
  - Morbidity/Mortality/Performance
- Economic Losses
  - All sectors of the cattle industry
- Many countries moving to becoming BVDV free
  - EU
  - New Zealand
Overview of Program Components

- BVDV Education
- Planned Herd BVDV Control Program
  - Eliminate PI BVDV cattle, if present, from herds (biocontainment)
  - Implement plans to keep BVDV from spreading to other herds (biosecurity).
  - Use a comprehensive BVDV vaccination protocol to minimize risk if BVDV exposure occurs
- Surveillance for Presence of BVDV in the UP
BVDV Education
Biosecurity  It's on everyone's mind
Test - Disease Screening
Isolate - 30 Feet for 30 Days
Sanitation - Clean & Disinfect
Vaccinate - Build Immunity
cvm.msu.edu/bvdup

Partnersing in Animal Health
BVDV Eradication Project

COOPERATOR
Upper Peninsula
BVDV Eradication Program

Bovine Viral Diarrhea Virus

Michigan Upper Peninsula BVDV Eradication Project
Summary of Results Over 4 yrs

- Total Cattle Farms in UP = 495
- Total Farms Participating = 294 (59%)
  - Number of Farms w/ BVDV Positive Cattle = 9
- Total Cattle in UP = ~49,000 (NASS 2010)
- Number of Cattle in Program = 26,148 (53%)
  - Number of positive cattle = 24 out of 17,917 samples submitted (0.13%)
Industry Impacts

- Tremendous Excitement
- Industry Cooperation
- BVDV Free Livestock Exhibits
- Marketing of BVDV Free Cattle
- New Appreciation For Biosecurity
- New Focus Comprehensive Disease Control
  - Biocontainment + Biosecurity + Vaccination
Partnerships

- Producers and Cattle Industry
- Michigan State University
  - College of Veterinary Medicine
  - MSU Extension
  - DCPAH
- Pfizer Animal Health
- USDA APHIS VS
- Michigan Department of Agriculture AID