Challenges in Reproduction

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Dairy Reproduction 2013
Ever-Green-View My 1326-ET
Waldo, Wisconsin USA February 2010

32,805 kg of milk*
1,267 kg fat
974 kg protein
365 d lactation

*3-times average US cow in 2010
Ever-Green-View My 1326-ET
Waldo, Wisconsin USA February 2010

32,805 kg of milk per year
134,000 cups of milk
Nutritionally equal to (calories):
• 22,000 dozen eggs
• 5000 roasting chickens
• 250 whole hogs
• 100 sides of beef

ONE COW
Innovations of the past decade

• Highly Effective Synch Programs for Cows
  – Presynch Ovsynch
  – G6G
  – 5 day Cosynch 72
  – Double Ovsynch

• Highly effective Resynch Programs for COWS
Innovations of the past decade: Gender selected semen
Innovations of the past decade: Improved systems for automated estrus detection
Innovations of the past decade:
Better and more portable ultrasounds
Innovations of the past decade:

Blood pregnancy tests
Milk Pregnancy Test Now Available

Is she pregnant? Is she still pregnant? These are some of the most important questions asked on the dairy farm. Managing the reproductive cycle on your farm—from timely breeding to pregnancy confirmation to successful calving—is a critical component on today’s dairy farms.

Traditionally, producers have had limited options for pregnancy detection. The most common and most effective in early detection is palpation or ultrasonography by a veterinarian to identify the presence of a fetus. More recently, blood testing has been used to confirm pregnancy. Today, NorthStar Cooperative is making available a new tool for producers in the management of the reproduction cycle. Working with IDEXX Laboratories, AntelBio now offers a pregnancy test for milk that is based on ELISA technology, a rapid and trusted diagnostic method. The test detects the presence of Pregnancy Associated Glycoproteins (PAGs) in the milk sample. These proteins are released by the placenta during pregnancy and are specific to pregnancy, unlike some other chemical indicators of pregnancy such as progesterone. PAGs can be detected in milk from 35 days post-breeding and testing can be implemented anytime after traditional voluntary waiting periods.

on the farm is reproductive status. Being able to gather that type of information noninvasively, without additional labor or stress on the cow is a win for both the producer and the animal.

How it works

The new Milk Pregnancy Test is based on ELISA technology, a rapid and trusted diagnostic method. The test detects the presence of Pregnancy Associated Glycoproteins (PAGs) in the milk sample. These proteins are released by the placenta during pregnancy and are specific to pregnancy, unlike some other chemical indicators of pregnancy such as progesterone. PAGs can be detected in milk from 35 days post-breeding and testing can be implemented anytime after traditional voluntary waiting periods.

Stockowner notices

Stockowner meetings are fast approaching and all stockowners are encouraged to attend to cast a vote for the election of directors and resolutions and advisory committee members. To be eligible to vote at the 2013 stockowner meetings you must be sign-up as a common stockowner by December 31, 2012.

For more information on how to become a NorthStar stockowner, talk to your area NorthStar Specialist.

Pre-pay and earn 3%

Earn an extra 3 percent on your money when you make a pre-payment towards your 2013 purchases at NorthStar Cooperative. To take advantage of this opportunity, visit one of your local NorthStar Cooperative locations to make your pre-payment by November 15, 2012.
Innovations of the past decade: Automated Milk Progesterone Testing

Förster Technik: FT Multilyser

DeLaval: Herd Navigator
Milk progesterone around TAI

C1 Cows with normal luteolysis

PGF2α, GnRH

AI

TAI

CR=67%

Escalante and Lucy (unpublished)
Milk progesterone around TAI

C1 Cows without luteolysis

PGF2α and GnRH

TAI

AI

CR=0%

Escalante and Lucy (unpublished)
Cow 426 – Reproductive Graph

Graphs: Heat Heat Graph

Range: User Defined

Date


Legend:
- HN Heat Alarm
- Calving Event
- Insemination Event
- High Activity Event
- HN Heat Alarm Level
- Progesterone Rnx
- Progesterone Smoothed
Innovations of the past decade: Introduction of Daughter Pregnancy Rate
75th Annual Hoard’s Dairyman
Cow Judging Contest

1st Contest 1931 Winner
First Holstein Winner

25th Contest 1956 Winner
Inka Pietje Veeman, EX

50th Contest 1981 Winner
Jan Com Fond Matt Matilda, EX 97 5E
Pinehurst Farm, Sheboygan Falls, Wis.

74th Contest 2004 Winner
VanDyk-K Charles Pandora-ET, EX 91 2E
VanDyk-K Holsteins, Lynden, Wash.

Ever-Green-View
My 1326-ET
Lactose
(milk sugar)

Two molecules of glucose are used in the production of one molecule of lactose.
How much glucose per day?

72 g of glucose to produce 1 kg milk
100 kg milk per day
7.2 kg glucose per day
Glucose supply and demand: Prepartum and early lactation

[Bar chart showing glucose supply and demand over days relative to calving]
Bovine embryonic and fetal development depends on glucose

Photo courtesy of The Drost Project (University of Florida)
Early postpartum glucose and pregnancy later postpartum

![Graph showing plasma glucose levels and probability of pregnancy.](image)

Blood glucose and serum insulin

Glucose - top lines
Insulin (all cows, bottom, right axis ng/mL, ELISA assay)

Ismeans
n=3 Guernsey
n=5 Holstein

Day, P < 0.001; superscripts are for Duncan’s multiple range test
Serum BHBA

Is means
n=3 Guernsey
n=5 Holstein

Hour of trial
Day, P < 0.001; superscripts are for Duncan's multiple range test
Serum IGF1 (Keisler lab)

IGF1 - top lines
Insulin (all cows, bottom, right axis ng/mL, ELISA assay)

Ismeans
n=3 Guernsey
n=5 Holstein

Serum IGF1, ng/mL

Day, P < 0.001; superscripts are for Duncan's multiple range test
Luminal Epithelium of the bovine uterus at 25 dpp

Lucy and Waldron (unpublished)
Day 35 bovine fetuses

- Lactating; Pregnant at 2\textsuperscript{nd} AI
- Not lactating; Pregnant at 1\textsuperscript{st} AI

SEQUENCES, SEQUENCES, AND SEQUENCES

Frederick Sanger

Retired from Medical Research Council Laboratory of Molecular Biology, Hills Road, Cambridge, CB2 2QH, England

Table 1  The progress in sequencing

<table>
<thead>
<tr>
<th>Year</th>
<th>Protein</th>
<th>RNA</th>
<th>DNA</th>
<th>Number of residues</th>
<th>Ref.</th>
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<td>1935</td>
<td>Insulin</td>
<td></td>
<td></td>
<td>1</td>
<td>4</td>
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<tr>
<td>1945</td>
<td>Insulin</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
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<tr>
<td>1947</td>
<td>Gramicidin S</td>
<td>5</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1949</td>
<td>Insulin</td>
<td>9</td>
<td>12</td>
<td></td>
<td></td>
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<tr>
<td>1955</td>
<td>Insulin</td>
<td>51</td>
<td>22</td>
<td></td>
<td></td>
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<tr>
<td>1960</td>
<td>Ribonuclease</td>
<td>120</td>
<td>25</td>
<td></td>
<td></td>
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<tr>
<td>1965</td>
<td>tRNA&lt;sub&gt;Ala&lt;/sub&gt;</td>
<td>75</td>
<td>32</td>
<td></td>
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<tr>
<td>1967</td>
<td>5S RNA</td>
<td>120</td>
<td>35</td>
<td></td>
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<tr>
<td>1968</td>
<td>Bacteriophage λ</td>
<td>12</td>
<td>45</td>
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<td>1978</td>
<td>Bacteriophage φX 174</td>
<td>5,386</td>
<td>61</td>
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<td>1981</td>
<td>Mitochondria</td>
<td>16,569</td>
<td>58</td>
<td></td>
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<td>1982</td>
<td>Bacteriophage λ</td>
<td>48,502</td>
<td>54</td>
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<tr>
<td>1984</td>
<td>Epstein-Barr virus</td>
<td>172,282</td>
<td>64</td>
<td></td>
<td></td>
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</tbody>
</table>
Human Genome Project
10th anniversary – 2011

- 3 billion base pairs
- 10 years draft sequence
- 13 years completed sequence
- $2.7 billion
Innovations of the past decade: Sequencing of the bovine genome

An agriculturally important animal for beef and milk production.

**Lineage:** Eukaryota, Metazoa, Chordata, Cenazo, Vertebrata, Euteleostomi, Mammalia, Eutheria, Laurasiatheria, Cetartiodactyla, Ruminantia, Pecora, Bovidae, Bovinae, Bos, Bos taurus

![Bos taurus image](image-url)

Photo: courtesy of Terri Hobbs (www.crazyfarcows.com)

- unknown chromosome size

Available maps:

<table>
<thead>
<tr>
<th>Sequence Maps</th>
<th>Genetic maps</th>
<th>RH maps</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 maps</td>
<td>MARC</td>
<td>ILTX</td>
</tr>
</tbody>
</table>

Search Map Viewer for [Enter search term] Find Advanced Search
Innovations of the past decade: Bovine SNP chips and the identification of fertility markers

Fertility markers on chromosome 18
Price et al. (2010)
One Run, Eight Bacterial Genomes: The Potential of the MiSeq® Personal Sequencer

With 10-fold higher output than other small-scale next-generation sequencing platforms, the MiSeq system will enable Tim Stinear, Ph.D. to spend less time generating data and more time analyzing it.

15 trillion bp in a single 48 h run = complete sequence of 500 cows at 10 x coverage
Fits on a 2 sq ft surface; $400 to $750 per run.
Use of haplotypes to estimate Mendelian sampling effects and selection limits

J.B. Cole & P.M. VanRaden

Animal Improvement Programs Laboratory, ARS, USDA, Beltsville, MD, USA

Table 3 Predicted upper and lower bounds of selection limits and largest observed direct genomic values (DGV) for daughter pregnancy rate (DPR), milk yield, lifetime net merit (NM$) and protein yield for US Brown Swiss (BS), Holstein (HO) and Jersey (JE) cattle

<table>
<thead>
<tr>
<th>Trait</th>
<th>Breed</th>
<th>Lower bound</th>
<th>Upper bound</th>
<th>Largest DGV</th>
</tr>
</thead>
<tbody>
<tr>
<td>DPR (%)</td>
<td>BS</td>
<td>20</td>
<td>53</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>HO</td>
<td>40</td>
<td>139</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>JE</td>
<td>19</td>
<td>53</td>
<td>5</td>
</tr>
</tbody>
</table>
Mentally prepare yourself for the first synthetic cow genome.

“We expect that RNA-guided genome targeting will have broad implications for synthetic biology ... and targeted ex vivo and in vivo gene therapy.”
Redefining high fertility
Now is the time to define “high fertility”!

Pregnant after an observed in estrus and AI

Pregnant after a timed AI
Now is the time to define “high fertility”!

- Cycling before breeding period
- Uterus released PGF2α
- Follicle grew; produced adequate estradiol
- Behavioral centers responded to estradiol and cow expressed detectable estrus.
- Pituitary released an LH surge.
- Artificial insemination
- Follicle ovulated, CL formed.
- Pregnancy!
Estrotect Patches

ESTROTECT after single mounting

ESTROTECT after 3-5 mountings

ESTROTECT after more than 5 mountings
Estrotec Patches removed from cattle after the same synch treatment

- Dairy cows
- Dairy heifers
- Beef cows

Scott Pooch and Matt Lucy, University of Missouri
Synchronization programs

14dCIDR_TAI

CIDR

19 days

PGF$_{2\alpha}$ GnRH TAI

56 h 16 h

d -7 d 0 d 14 d 19 d 26 d 28 d 33 d 35 d 36 d 42

Presynch-Ovsynch56

PGF$_{2\alpha}$

PGF$_{2\alpha}$

GnRH

PGF$_{2\alpha}$ GnRH TAI

56 h 16 h

d -7 d 0 d 14 d 19 d 26 d 28 d 33 d 35 d 36 d 42
Resynchronization programs
“The more you tighten your grip, Tarkin, the more star systems will slip through your fingers.”
Now is the time to define “high fertility”!

- Cycling before breeding period
- Uterus released PGF2α
- Follicle grew; produced adequate estradiol
- Behavioral centers responded to estradiol and cow expressed detectable estrus.
- Pituitary released an LH surge.
- Artificial insemination
- Follicle ovulated, CL formed.
- Pregnancy!

Pregnant after a timed AI
Which cow scores better for DPR?

Pregnant after an observed
in estrus and AI

Pregnant after a timed AI
Which cow is the best cow for the future?

Pregnant after an observed in estrus and AI

Pregnant after a timed AI
What about the future?

- Climate change and air pollution
- Water depletion and pollution
- Biodiversity

Food and Agriculture Organization of the United Nations
Thank you!