Introduction to CLARIFIDE® and Female Selection

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Genomics

• DNA markers matched to genetic information learned through traditional methods
• Grounded in Familiar Things
  – 1895 – USDA collects milk and fat records
  – 1936 – First national sire evaluation
  – Many years of DHI & breed data... genetic evaluations
  – Millions of Records
• 2009 – Genomic evaluations official
• Aug 2010 – Evaluations using 3K markers

Genomics Impact

Improve Efficiency and Profitability by Accelerating Genetic Progress

\[ \text{Genetic Progress} = \text{Accuracy} \times \text{Selection Intensity} \times \text{Genetic Variation} \times \text{Generation Interval} \]

Primary Gains via female population compared to pre-genomics time.

Primary Gains via male population compared to pre-genomics time.

Average # of Animals Genotyped Per Month

Average # of Animals Genotyped Per Month

Genetically, we have a LONG way to go

A “SuperCow” constructed from the best haplotypes in the Holstein population would have an EBV(NM$) of $6745

Paul VanRaden
2014

Advancing Dairy Cattle Genetics: Genomics and Beyond, Phoenix, AZ Feb 19, 2014.

How many possible unique individuals could arise from the same parents?

1,152,921,504,606,850,000

(>1 quintillion)

Which individual is created is unpredictable… the Mendelian Sampling phenomena.

We don’t know which genes the offspring got from their parents until they are genomic tested.

Genomic NM$ relationship to the % of Cows Still Alive 3.5 yrs later (genomic tested early 1st Lactation; n=240)

Herd Owners Have Decisions

Which has the LEAST CHANCE of being profitable? Which has the BEST CHANCE?

CLARIFIDE – Comprehensive Info… One Test

Parentage & Inbreeding Info

Parentage (Sire & Dam), Maternal Grand Sire, Individual genomic inbreeding %, Future inbreeding %.

Parentage Correction is a big benefit

Parentage Correction is a big benefit

National Average approx. 15%

This also benefits Genetic Evaluation System

Source: Subsample of WI-tested herds
How would you RANK these heifers?

Options to Rank Dairy Heifers

What’s a SNP genotype worth?

For daughter pregnancy rate ($h^2$=0.04), SNP genotype = 131 daughters

What’s a SNP genotype worth?

Pedigree is equivalent to information on about 7 daughters

For protein yield ($h^2$=0.20), the SNP genotype provides information equivalent to an additional 34 daughters

Increase in Reliability

Impact of Reliability on Milk Rank

• This is what those heifers “look” like with information that has low reliability (parent avg.).

PARENT AVG. data was used to determine DOT color.
This is what those heifers "look" like with information that has higher reliability (genomic data).

Impact of Reliability on Milk Rank

- Superior Merit (Top 20%)
- Average Merit (Middle 60%)
- Inferior Merit (Bottom 20%)

Direct genomic values for Milk were used to determine DOT color.

Source: Midwest Dairy herd data (same as prior herd)

21 day pregnancy risk. All tested animals.

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21 day pregnancy risk. DPR<0 (Negatives)

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21 day pregnancy risk. DPR>0 (Positives)

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2214 lb. milk difference between best and worst 10%

22000 lb. milk difference between best and worst 10%

23980 lb. milk difference between best and worst 10%

24853 lb. milk difference between best and worst 10%

26313 lb. milk difference between best and worst 10%

30480 lb. milk difference between best and worst 10%

33663 lb. milk difference between best and worst 10%

36087 lb. milk difference between best and worst 10%

39378 lb. milk difference between best and worst 10%

42453 lb. milk difference between best and worst 10%

45687 lb. milk difference between best and worst 10%

48921 lb. milk difference between best and worst 10%

52153 lb. milk difference between best and worst 10%

55387 lb. milk difference between best and worst 10%

58621 lb. milk difference between best and worst 10%

61855 lb. milk difference between best and worst 10%

65089 lb. milk difference between best and worst 10%

68323 lb. milk difference between best and worst 10%

71557 lb. milk difference between best and worst 10%

74791 lb. milk difference between best and worst 10%

78025 lb. milk difference between best and worst 10%

81259 lb. milk difference between best and worst 10%

84493 lb. milk difference between best and worst 10%

87727 lb. milk difference between best and worst 10%

Milk Genetics vs Phenotype: Contrast of Results (n=328)

GPTA Daughter Stillbirth (DSB) vs. % Stillbirths 1st Calving

GPTA Daughter Stillbirth (DSB) [Integer] (# Calvings Observed)
What would you DO with these heifers, knowing their Genomic NM$ Rankings?

And How Often Could you Use their Genomic Data for Decision-Making?

One or More Strategies can be Adopted

Next Generation Genetic Strategies (any Age)
- Non-Select
- Select - Conventional Semen
- Select - Sexed Semen
- ET or NF Amplification

Precision Inventory Management

Recovering Heifer Raising Costs

- A cow must produce over 31,000 lbs of milk before she has covered her raising costs and her ongoing cost of production and is adding to the profitability of the operation
  - Typically 2nd lactation cow

Integrating Results (Conceptual results with Decision-Making on $275 GNM group)

Donor Dam Sexed semen
Recip getting embryo from 526 NM

Avg Genetics passed on to each offspring:
- $345 vs $275 (+$70 increase)
- Lifetime Profitability $120 - $140/ld kept

Lifetime Profitability (x2): +$140/ld kept

Avg Genetics passed on to each offspring:
- $451 vs $275 (+$176 increase)

Animal genomics from UW Madison Integrated Dairy

Herd Facts

- 4th Generation farm family for over 90 years
- 11 family members
- 62 employees total
- 2400 milking cows, 90 lbs/cow/day
- 5000 acres cropland
- Cross ventilated and conventional free stall barns
- Double-20 and Double-22 BouMatic milking parlors
- Special needs areas
- Five nursery barns
- Calf barn for 2 to 5-month-old calves
Evolution of Decision to Genomic Test
• Herd Owner had prior experience using genomics on high genetic cow families
• Early Aug 2011 – Sent in first samples after deciding to initially test heifers that were out of dams purchased through the dairy’s expansion
• Wanted first hand experience using the data as a tool

Evolution of CLARIFIDE Testing
• Sept 2011 - Reviewed first results with Zoetis
  – Gain in Reliability from 21 Rel to 60 Rel
  – 50% of animals changed more than $100 NMS; 10% changed more than $200 NMS
  • Thus animals re-ranked a fair amount
• Feb 2012 – Reviewed results again with larger management team
  – 670 heifers
  – Net Merit $ Reliability gain was from 21 to 62 on avg
  – Sire mis-ID identified through genomic testing (8.2%)
  – Recessives – 13.2% of heifers were carriers of one or more genetic condition

Early Decisions Made
• CLARIFIDE test all heifers born after December 25, 2011
• Continue to sell excess low-end ranking youngstock at 4 months using spreadsheet for projected calvings by month
• Developed a Customized Selection Index based on NMS, CMS with added emphasis on Udders and Feet & Legs
• Used information in A.I. mating program.
• Planned to review results again once cows started calving to validate information.

Parentage Errors
Total Sire Mis-ID or not found = 7.8% (n=1178)
• 1% (18) from bull breedings
• 0.6% (12) appear to be switched at birth
• Remaining likely are mistakes around insemination

Additional Notes:
• Third best NMS animal was sire mis-identified [flush?]
• National average is about 15% sire mis-identification

Avg GNM$ by Birth and Dam Purchase Status
Source: Zoetis Data on File, September 2013, n=671
Example of Re-Ranking in Commercial Herd (AFTER parentage corrected, n = 3398)

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Overall, 49% were within range (2 greens), but 18% were very different (red/orange).

47% wrong if used PA for IDing bottom 20%.

Source: Zoetis Data on File - Aug. 2014; n=3398

Herd Milk (n=709)

Milk Decile vs Avg 305ME Milk

Jan. 2014

28629 milk difference between best and worst 10%

Milk Decile vs Avg 305ME Milk

Jan. 2014

5333 milk difference between best and worst 10%

Source: Zoetis Data on File - Aug. 2014; n=886

Lower heritability traits, like SCS, also can gain progress faster with CLARIFIDE

Lower occurrence of Mastitis

Source: Zoetis Data on File - Aug. 2014; n=886

Reproduction – Current GDPR vs Preg Rates (Feb. 2014)

• Voluntary Waiting Period: 78 days for 1st Lactation

• All genomic animals averaged 19% PR
  – If GDPR < 0, then PR was 16%
  – If GDPR = 0.1 to 1.4, then PR was 21%
    • $97/cow more profit than low group each lactation!
  – If GDPR >=1.5, then PR was 26%
    • $169/cow more profit each lactation

1 Estimate based on UW Extension Repro Money economics. – Dr. Victor Cabrera.

Source: Zoetis Data on File - Feb. 2014
Genomic Heifer Conception Rate vs Times Bred as Heifer

Decisions From March 2013 and Thereafter

- Revised Customized Ranking Index few times
- Worked out the amount of sexed semen to use in upper ranking heifers, at a ratio to be able to breed other lower ranking animals (cows) in the herd to beef.
- Jan. 2014 wanted to relook at economics of testing all animals vs another dairy’s partial testing & use of ADG
  - Full analysis using own data and strategies showed benefit over other alternatives
- Plan forward is to continue strategy of last 6 months…

Strategies Utilizing

Enlight Shows Herd’s Genetic Progress

Genetic Progress

Next Generation Genetic Strategies

- Precision Inventory Management
- Lower Value Cows: Beef
- Top 50% Heifers: Sexed Semen
- 5-30% Sell
- 1% ET

Partial genomic testing
Tested all calves

Relationship between DPR and Milk

Scatterplot of Animal Traits

Milk versus DPR - All Accounts for All Years

- 178 Males
- 1637 Females

Relationship between DPR and Milk

Started making big shift in DPR emphasis

Source: Enlight Herd Data Example - Nov. 2014
Conclusions and Summary

• CLARIFIDE Testing offers the ability to PROACTIVELY and more ACCURATELY predict an animal's future profit potential.
• Higher levels of reliability are achieved through genomic testing, especially for lower heritable traits.
• Young animals can be ranked with confidence and can be prioritized for breeding and management decisions.
• Progress can be made for traits important to each herd whether production, type or fitness traits.
• Data can be easily managed and utilized.
• Real herds are utilizing this data to improve efficiency and profits – now it’s YOUR turn.

SO, YOU HAVE DECIDED TO TEST. WHAT’S THE NEXT STEP?

Who and when do I sample?

» Sample the animals close to when you will use the information, but with enough time to get results and implement.
  - Common sampling times: at birth, weaning, vaccination, pre-breeding process, or far-off heifer pen moves
  - Test results received 3-5 weeks after submission
  - Allow time to implement your plan after receiving results.

Sampling procedures and process

» Visit the Zoetis Genetics website:  
  - www.CLARIFIDE.com
» Take advantage of the ability to do two things at once with an RFID and DNA tissue sampling unit (TSU) combination package
  - Available from Holstein Association USA (HAUSA)
» Also available are Zoetis Genetics customer service, or your Zoetis or HAUSA representative

STRATEGIES TO IMPROVE GENETIC PROGRESS

5 Full Composite Indexes
  - First Merit ($), Second Merit ($), Third Merit ($), Fourth Merit ($), Fifth Merit ($), Six ($)

4 Milk Protein Components
  - Alpha S1 Casein, Beta Lactoglobulin, Kappa Casein I & II, Beta Casein A2*

12 Health & Repro Traits

22 Type Traits & Indexes
  - Linear Conformation Traits, Type Final Score

5 Parentage & Inbreeding Info
  - Parentage (Sire & Dam), Individual genomic inbreeding, % future inbreeding

5 Production Traits
  - Milk Volume, Fat Volume, Protein Volume, Fat %, Protein %

3 Additional Genetic Characteristics
  - Red (or Black), and Dominant Red coat color
Animal ranking is cornerstone for action

- Bring animal rankings down into one number!
- Utilize a selection index or develop your own
- What is a Selection Index?
  - Calculation that ranks animals on a scale that weights multiple traits and places appropriate emphasis on them in accordance with your goals.
- Goal is to improve faster than the industry for your traits selected.
- Most herds utilizing genomic testing and strategy improve at a much faster rate.

Selection Indexes being used today

- Four selection indexes published by the CDCB
  - NM$: Net Merit dollars – frequently used index that balances many traits into a lifetime profit prediction.
  - CM$: Cheese Merit dollars – added emphasis on protein for use in predominantly cheese manufacturing markets.
  - FM$: Fluid Merit dollars – added emphasis placed on milk production, mostly utilized in fluid milk markets.
  - GM$: Grazing Merit dollars – Recently introduced to provide selection index for grazing dairies. Places a large emphasis on reproduction for herds requiring seasonal calving.

Selection Indexes being used today

- Breed association selection indexes are also available in USA:
  - Holsteins: Total Performance Index® (TPI®)
    - Used globally for animal ranking.
    - Many common traits with NM$ therefore relationship is very high.
  - Jersey: Jersey Performance Index™ (JPI)
  - Brown Swiss: Progressive Performance Ranking (PPR)
- Canada: Lifetime Profit Index (LPI) and Pro$

HOW TO USE THE RANKINGS WITH STRATEGIES

Basic Strategy A:
Manage herd replacement inventory

Manage Herd Replacement Inventory

- **Who**: Herds with more expected heifers than needed
- **Goal**: Manage pre-determined herd size while managing heifer replacement costs
- **Strategy**: Remove genetically inferior heifers

Culling heifers makes cents

**Distribution of GPTA NM$ by Birth Year**

- 2012 (Avg=463)
- 2013 (Avg=554)

Zoetis Data on File: 2014
Culling heifers makes cents

Distribution of GPTA NMS by Birth Year

Removing Bottom 15% Increases Average by ~$40
Breed Value for 1 generation only. AddF1 benefit carries multiple generations.

Basic Strategy B:
Generate more from the best

Generate More Replacements from the Genetically Superior Females

Who
All average or above-managed herds; including static & expanding herds

Goal
Choose and make more of the best

Strategy
• Identify replacement numbers needed
• Choose an advanced reproductive technology:
  – Targeted special semen type utilization
  – Aggressive embryo program on best heifer groups

Speed genetic progress

Next Generation Genetic Strategies (any Age)

Precision Inventory Management

Utilize mating programs

» Verified correct parentage!
  – Utilize mating programs to manage inbreeding and deleterious genetic conditions

» More reliable genetic profile of female’s strengths and weaknesses.
  – Mating programs can help us to stack the deck for next generation success

Lifetime implementation of genomic data

KEEP/BUY/CULL
Which animals do I keep or buy and which ones do I sell now?

BREEDING DECISIONS (avg 3 PGs)
• Type of bull?
• Number progeny?
• Making program

LATER LIFE DECISIONS
• If of chances she gets before cull?
• Other mgmt?

An average female could utilize CLARIFIDE results approximately five times in their lifetime!
The more you use CLARIFIDE, the more progress and profit you can make.