

A bright sun in a clear blue sky over a lush green field.

D.

Potential applications of genomic information beyond breeding

DairyCo

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Agenda

- Introduction to DairyCo Breeding+
- Genomics in the UK
- Genomics beyond Breeding
- What does this mean for ICAR members

DairyCo Breeding+

- Responsible for Genetic Evaluation in UK
 - Independent and Paid for by dairy farmers
- All breeds and crosses :
 - Production traits
 - SCC
 - Lifespan
 - Fertility Index
 - Type (excl. B&W)
 - Calving Ease

The screenshot shows the DairyCo Breeding+ Evaluations website. The header includes the logo and the tagline "Raising herd profitability through better breeding". Below the header is a "Latest Downloads" section with three items: "What you should know about Genomics", "Fertility Index explained", and "A quick guide to genetic indexes", each with a "GO" button. To the right of this section are four images of dairy cows in a field. Below the images is a navigation menu with links for "breeding+ Homepage", "Herd Genetic Reports", "General Information", "Bull search", and "DairyCo Homepage". The main content area contains text about genetic evaluation results and a "Breed Selector" section with a list of breeds: Holstein, Friesian, Ayrshire, Jersey, Guernsey, Shorthorn, Montbeliarde, and Brown Swiss. The Milkbench+ logo is visible in the bottom left corner of the screenshot.

Impact of genetics

- Very powerful tool
- Seen in cow performance
 - Production traits
 - Fitness traits
- Ensure we get the balance right
 - Constantly evolving knowledge and needs



Genomics in the UK

- Cooperation of:
 - Milk recording (CIS, NMR, UDF)
 - Herdbooks (HUK)
 - Breeding Companies (Cogent, Genus)
 - SAC
 - DairyCo
- Collaboration with North America
 - April 2011
- R&D on Sequencing and across-breed
- Genomic Evaluations – December 2011



Application - Breeding

- Selection of Elite breeding animals
 - Increased Genetic gains
- Males
 - Pre-selection in Young-bulls
 - Higher use of Younger bulls
 - Increased reliability for Older bulls
- Females
 - Higher accuracy of Genetic ability
 - Adding value for marketing

Application – more widespread

- Different density SNP-Chips
 - 3K, 6K, 50K, High Density,.....
- Able to 'Impute' genotypes to higher density
- Lower cost Chips
 - Achieving similar accuracies to higher density
 - Enables low cost application beyond Elite animals

Application – Beyond breeding

- Genomic testing soon Routine
 - All cows will have genotype
 - Traceability
- What doors does this open?
 - How can we add value to the farmer
- What could this mean for your business?
- In terms of:
 - Data capture
 - Service provision



Application – Beyond breeding

- Parentage Verification
 - Confirm parents
 - Using ~100 SNPs
- Parentage Discovery
 - Identify parents without prior information
 - Using >1000 SNPs
- ICAR working with ISAG (Int. Soc. Animal Genetics)
 - ICAR WG Genetic Analysis (Paolo Ajmone-Marsan)
 - ICAR WG Parentage (Suzanne Harding)

Application – Beyond breeding



- Screening of all Young stock
- Used for pre-selection for Rearing
 - Ability to save cost by Culling poorest heifers
- Used for more targeted breeding approach
 - Breed Best to Elite sexed semen
 - Bottom end to Beef semen

Application – Beyond breeding

- **Mating Programmes**
- Current Mate Selection done on Phenotype
 - Sometimes combined with Genetic (Pedigree) info
 - Complementary mating on Phenotype
- Future Mate Selection incorporates Genomic data
 - Identify ‘weakness’ in Genetic Make-up
 - Complementary mating on Genotypes
- Ability to better estimate and manage Inbreeding
 - Offer opportunity for Genome targeted ‘cross breeding’ ?

Application – Beyond breeding

- Management of genetic abnormalities
 - Screening all animals for known defects
 - Tests included as part of Genotyping
- Discovery of ‘new’ genetic abnormalities
 - Need for recording of abnormalities
 - Need for storage of DNA

Application – Beyond breeding

- Revisit 'old' and Explore 'new' traits
 - Protein fractions (K-casein, Beta-lac.)
 - Fatty acids
 - Disease resistance
 - Feed Efficiency
 - Green House Gas emissions
 -

Application – Beyond breeding

- Nutritional Genomics
 - (Nutrigenomics)
 - Interaction Genes x Diet



- Application examples:
 - Personalised feed advice (using better norms)
 - Response to Concentrate Feeding
 - Which cows are pre-disposed to Milk fever
 - Supplement feeding for individual cows

Application – Beyond breeding

- Personalised Genomic Medicine
 - Determine disease risk (Predisposition)
 - Appropriate therapeutic options
- For example
 - Vaccine response
 - Drug application based on Genomic profile
- This knowledge can also help us to;
 - Improved Vaccine manufacturing
 - Breed better ‘responders’ to vaccination

Opportunities and Threats

- Rapid development of Opportunities beyond breeding
- Large R&D investments needed
 - Start-up costs are high and a barrier for some
- Who has access to R&D results?
 - Patents (ICAR-PSAS)
- Need to ensure that the benefits are able to be used cost effectively by the industry

Requirements

- Accurate data needed (lots of it !)
 - Contract recording herds?
- Accurate animal identification
- Harmonised trait definitions
- Sharing (pooling) of Data
- New tools



What does this mean for ICAR

- What should we be recording?
 - More detailed phenotypes
- What services can we build around this?
 - Sample collection
 - Results interpretation
- Herd management software requirement?
 - Storing, Central pooling and Reporting

What should we consider?

- Think about 'new' applications
- Also consider;
 - Who owns Genotypes
 - Who owns Phenotypes
 - Who owns Calibration equations
- Can we do this (efficiently) on national level?
- Should we store DNA on recorded cows?

Genomics - Summary

- Faster genetic gains
 - Ensure we get right balance of traits
- Data recording critical
 - Harmonisation of Definition and Recording
- Exciting new opportunities beyond breeding
 - Both for Farmers and Support industries