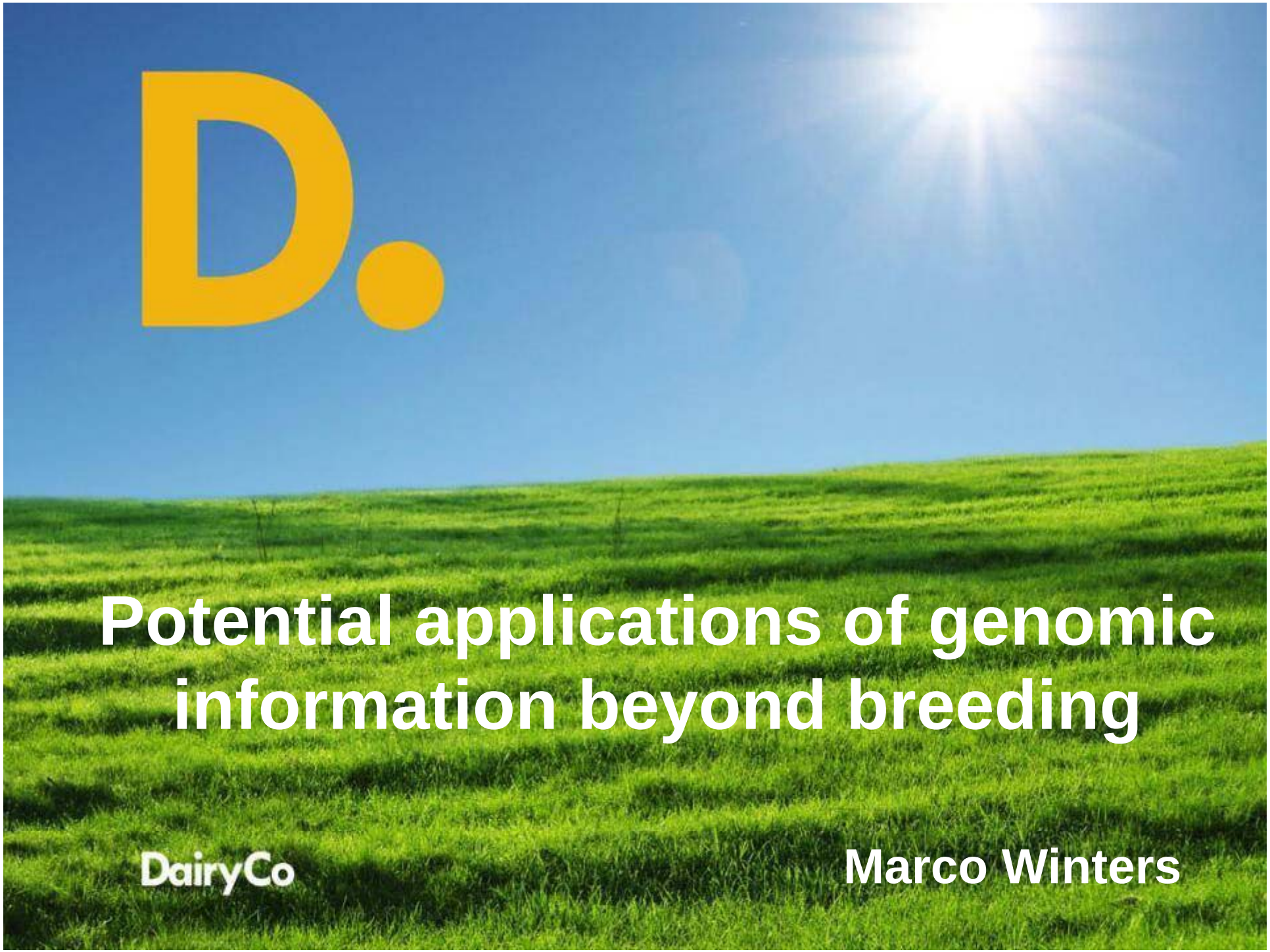

D.
Potential applications of genomic information beyond breeding
DairyCo
Marco Winters

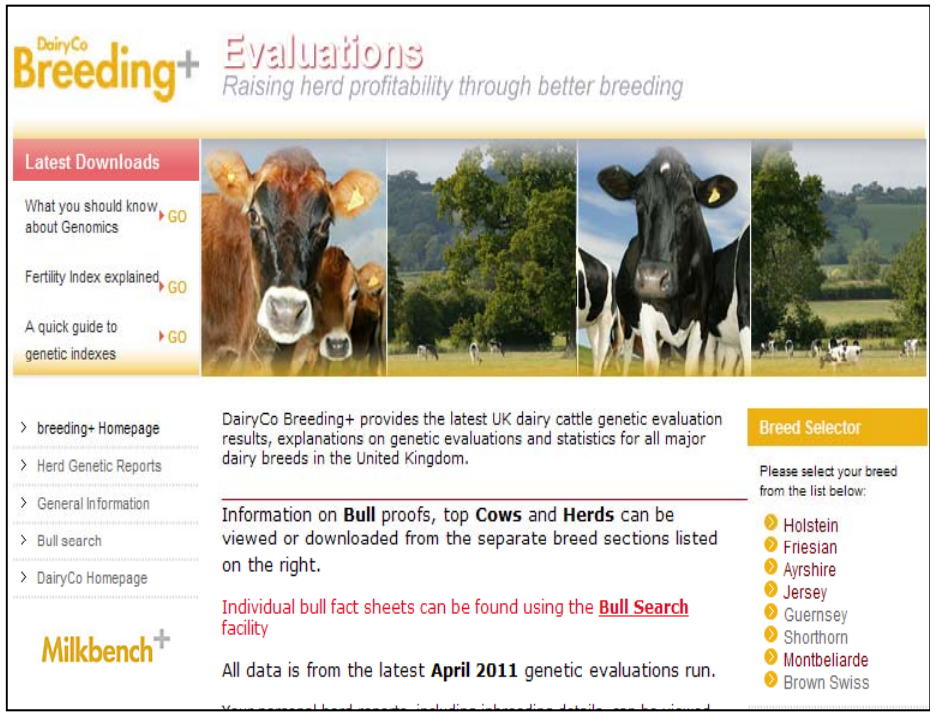
Agenda

- 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



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 vacination

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