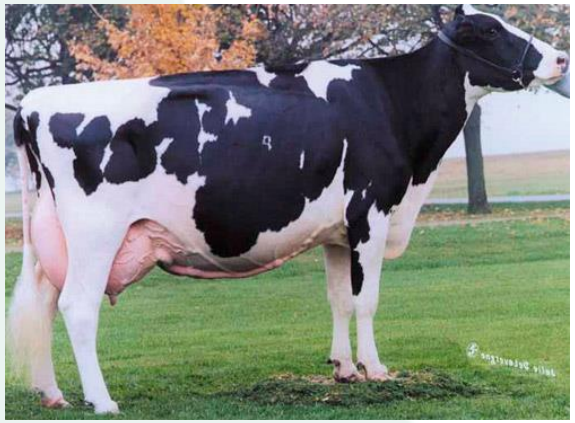
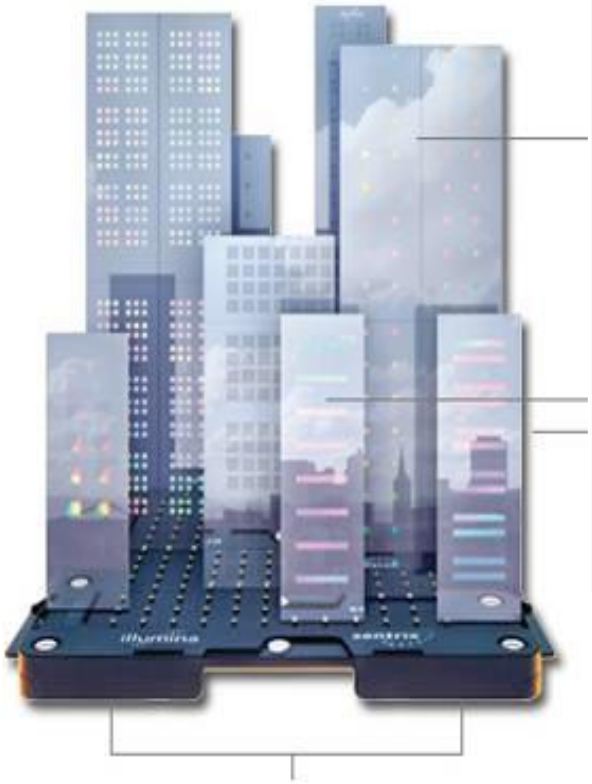
Applications of Genomics on Brazilian Dairy Farms





Marcos Vinicius Silva
Senior Scientist,
Genomics and Bioinformatics
Embrapa Dairy Cattle
São Roque, Sep 12th 2022

Background

Brazil

- The Brazilian dairy industry is based mainly on pasture-oriented production systems;

- Dual purpose systems in the tropical part, utilizing ***B. taurus x B. indicus* hybrid animals**, mostly Holstein/Gir (Girolando breed=> 5/8H 3/8G);

- 80% of the milk produced => Girolando cows;

Background

Brazil

- Cows are milked with restricted suckling of calves;
- Average herd size: 80 cows;
- About 18.0 million dairy cows (around 1.3 million farms);

How importante is the dairy sector in Brazil?

- Milk is produced in every county in Brazil;
- 34,8bn litres/year with an annual growth close to 3% (2021);
- 4 million jobs (directly and indirectly);
- Gross sale: US$ 7.5 billion;
- Turnover: US$ 18 billion;
- Around 1 percent of the country's Gross Domestic Product (GDP);

Brazilian Animal Breeding Programs in *Bos indicus* and Girolando

1983:
National Breeding Program of Dairy Gyr breed

1997:
National Breeding Program of Girolando breed

- The Girolando and Gir Breeding Programs are based on a progeny testing ;

- In these field-based progeny testing the semen of highly selected bulls are distributed in a large area to many farmers in different environments;

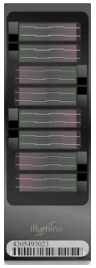
- These actions require huge resources both financial and infrastructural - a large AI network, robust and dynamic data collection and analysis system;

- In Brazil, usually, the breed association and Embrapa develop the progeny testing together;

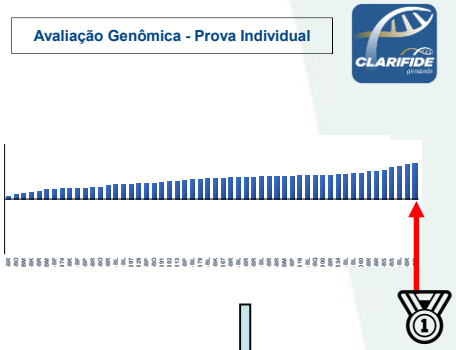
Genomic Selection in Brazilian Dairy Cattle

Progeny Testing of Gir and Girolando Bulls

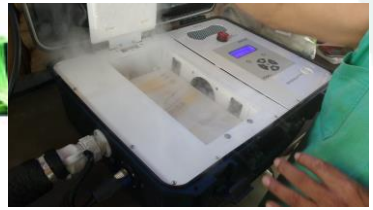
Young Bulls



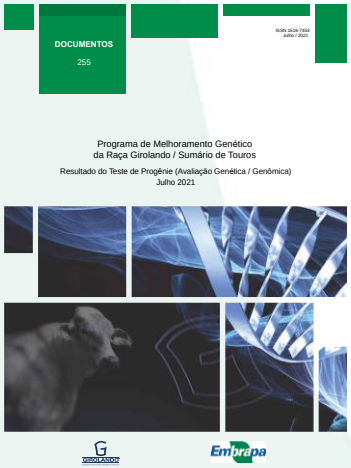
Clarifide
Girolando –
Genomic Selection



Pre-Selection

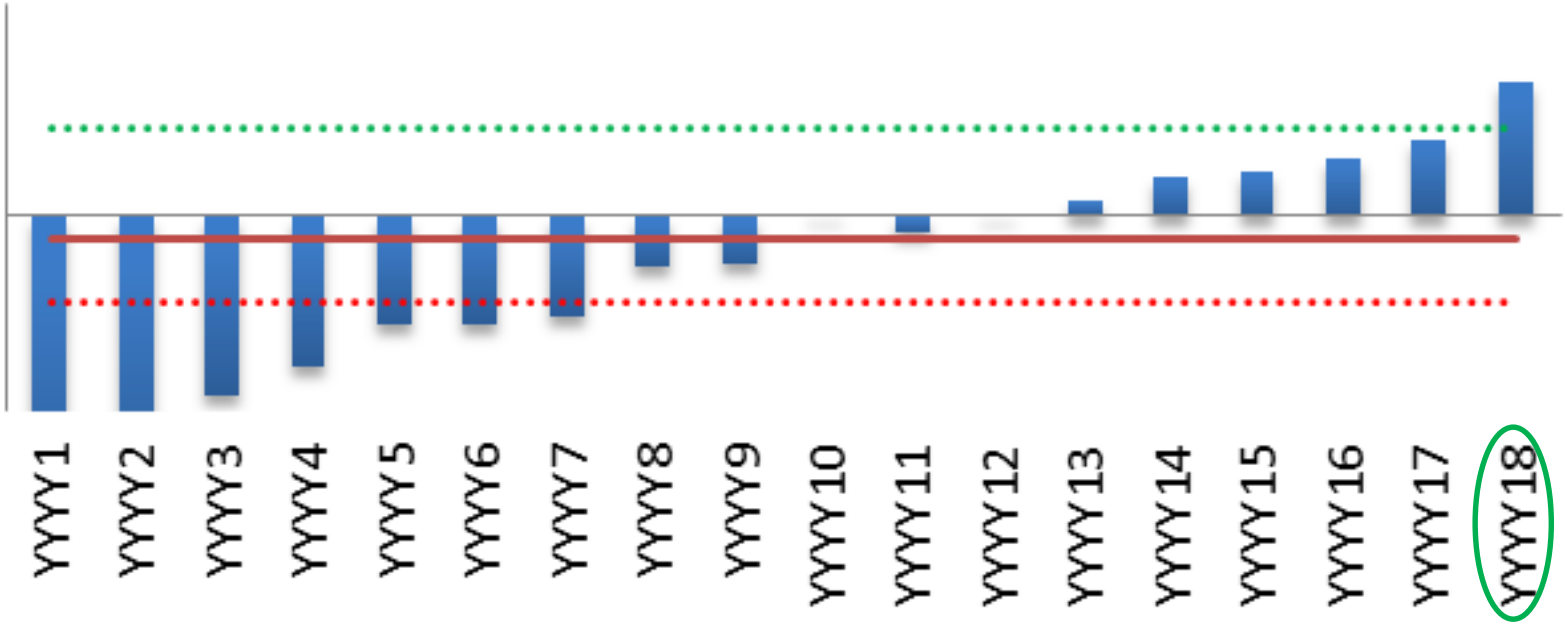


Progeny Testing



Pre-testing at the Farm

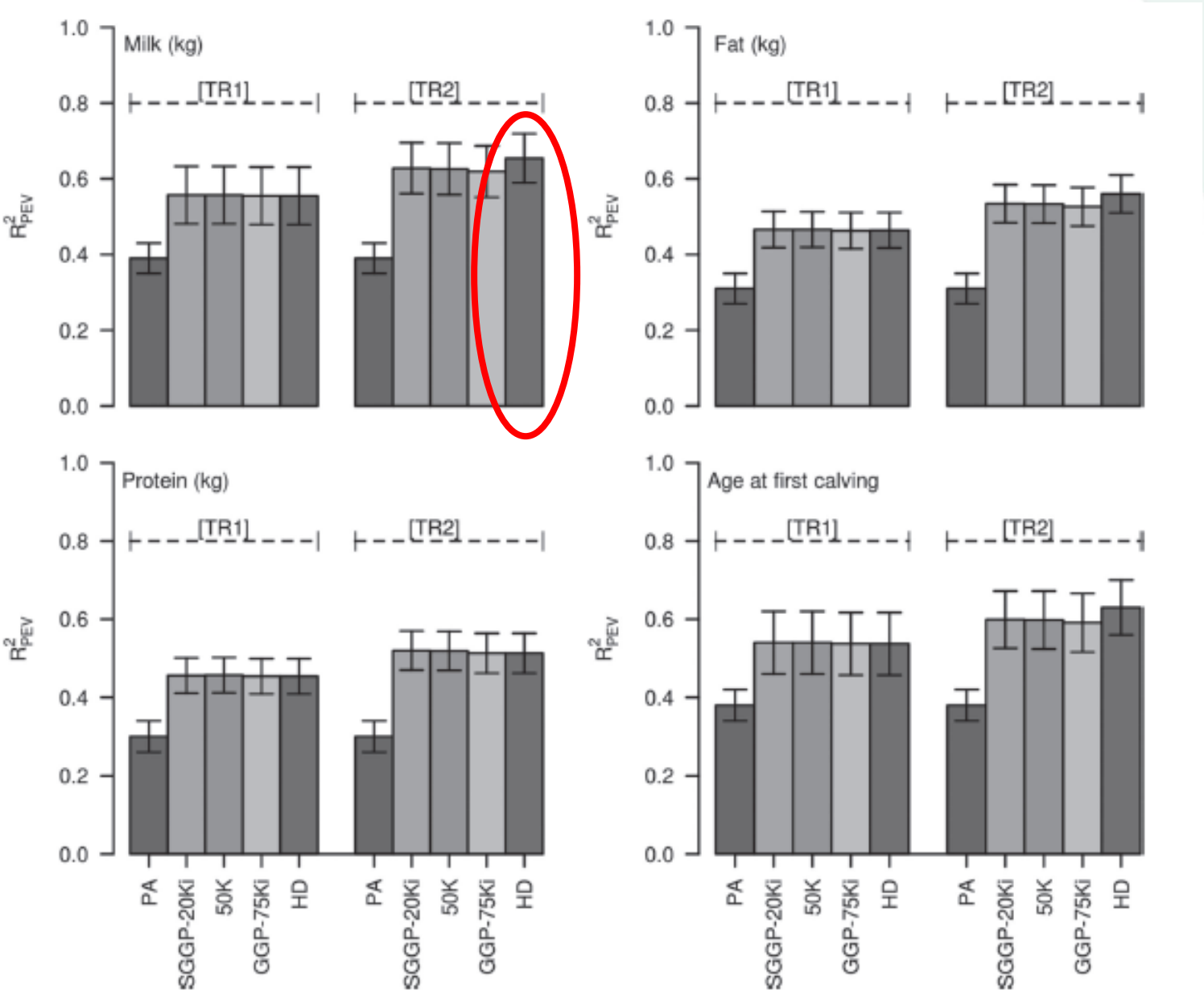
Name of The Farmer



Genomic Selection in Brazilian Dairy Cattle

- ✓ **Dairy Gir Breed:**
  - ✓ Population: 120,000 animals registered
  - ✓ 11,000 animals registerd/year and **8,000 genotyped/year**
  - ✓ **45,000 animals genotyped**
  - ✓ Progeny testing since 1985 (all bulls genotypes)
  - ✓ 567 tested bulls
  - ✓ 280 under evaluation

Average reliability using GBLUP



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https://doi.org/10.3168/jds.2016-11811
JDS11811

Accuracy of genomic predictions in Gyr (*Bos indicus*) dairy cattle

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Strategies for single nucleotide polymorphism (SNP) genotyping to enhance genotype imputation in Gyr (*Bos indicus*) dairy cattle: Comparison of commercially available SNP chips

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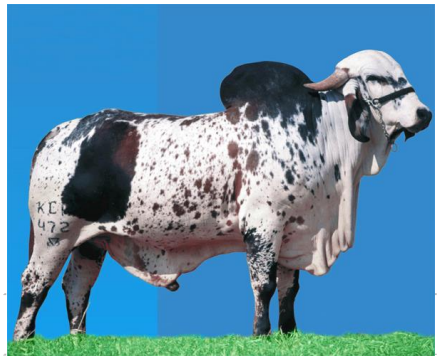
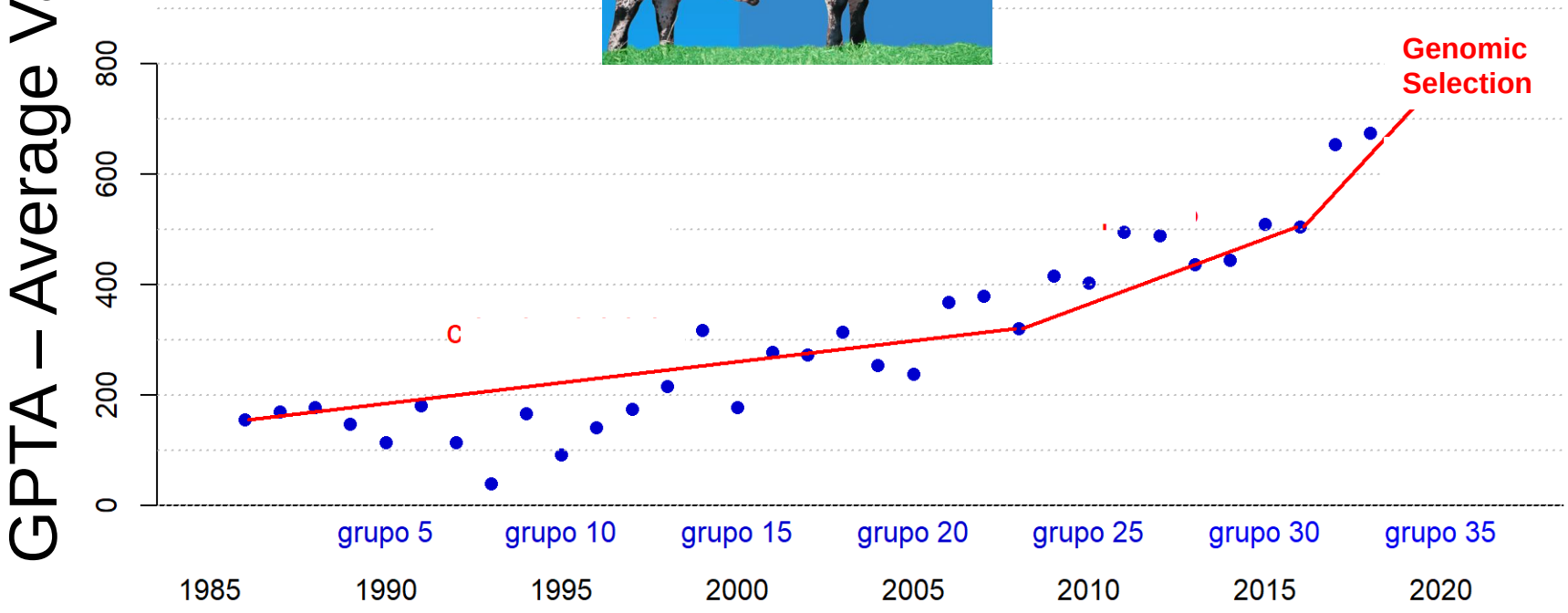
Dairy Gir Breed
GPTA- Average Value By Sire Group (MilkYield)





Year of Distribution of Semen

Genomic Selection in Brazilian Dairy Cattle

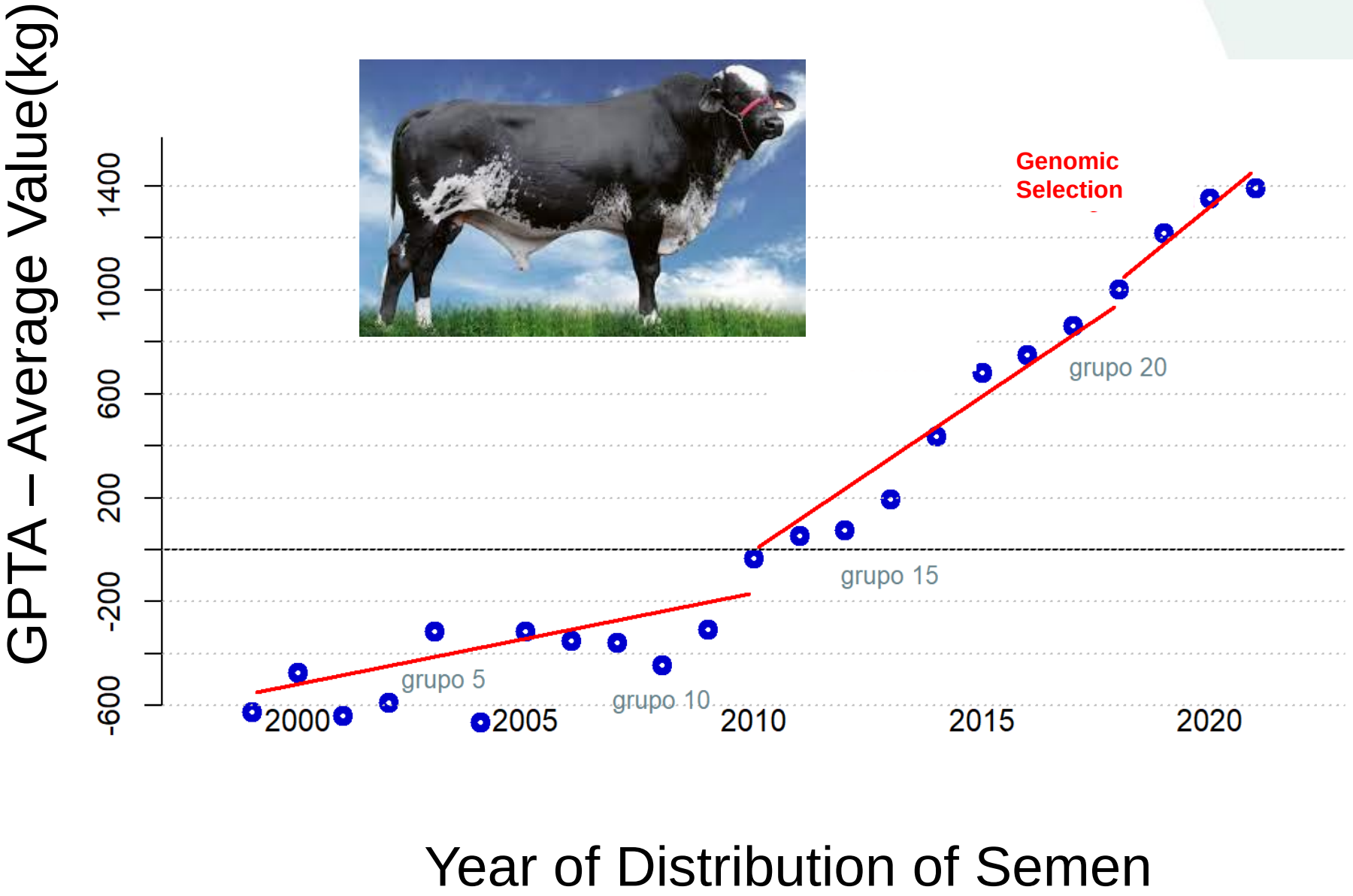
- ✓ **Girolando Breed:**
  - ✓ Population: 15 M animals
  - ✓ 150,000 animals registered/year and 10,000 genotyped/year
  - ✓ 35,000 animals genotyped

Results #1 – Young Animals

EBVs and reliabilities from genomic and traditional evaluation

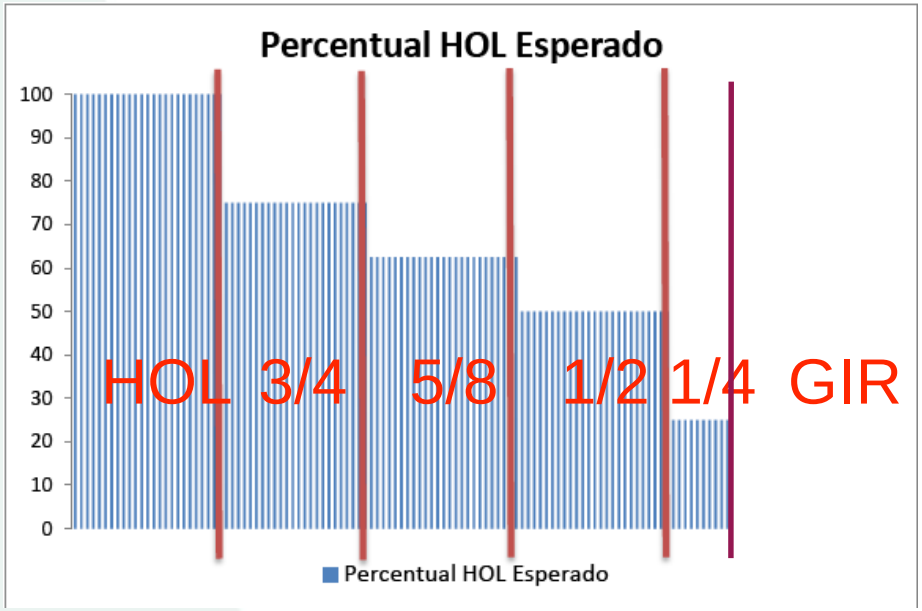
Trait	PA (REL)	gEBV (REL)	Gain
Milk	18%	55%	37%
AFC	18%	56%	38%
CI	8%	32%	24%

Girolando Breed
GPTA- Average Value By Sire Group (MilkYield)

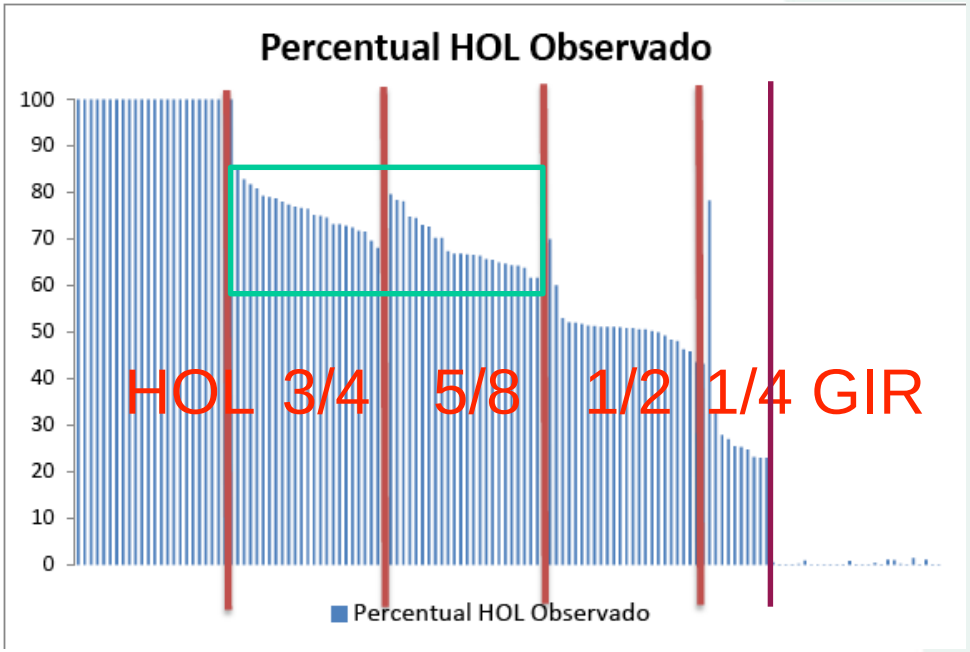


Breed composition – Example

Expected from pedigree



Observed using genomics



Genomic Selection Scheme for Females in the Farms - Dairy Gir and Girolando Breed

- Genotyping the young females

- Top 5 to 10% - donors for ET or IVF
- 20 to 40% - AI with sexed semen
- 20 to 40% - recipients from ET or IVC
- 10 to 15% - beef bulls or for sale

frontiers in Genetics

ORIGINAL RESEARCH
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Genome-Wide Analyses Reveal the Genetic Architecture and Candidate Genes of Indicine, Taurine, Synthetic Crossbreds, and Locally Adapted Cattle in Brazil

OPEN ACCESS

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Genotype imputation in a tropical crossbred dairy cattle population

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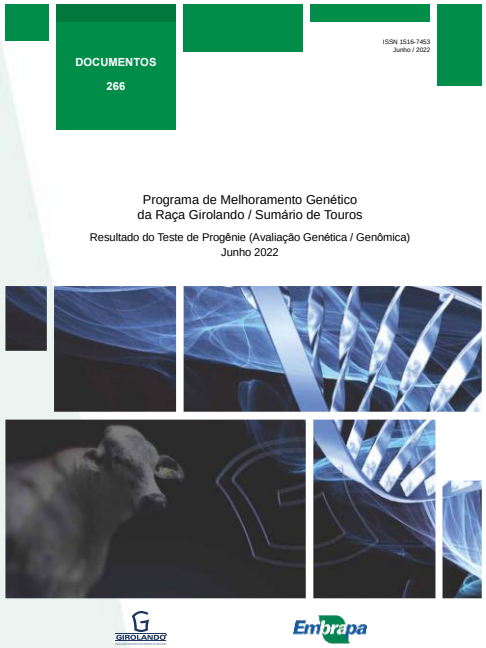
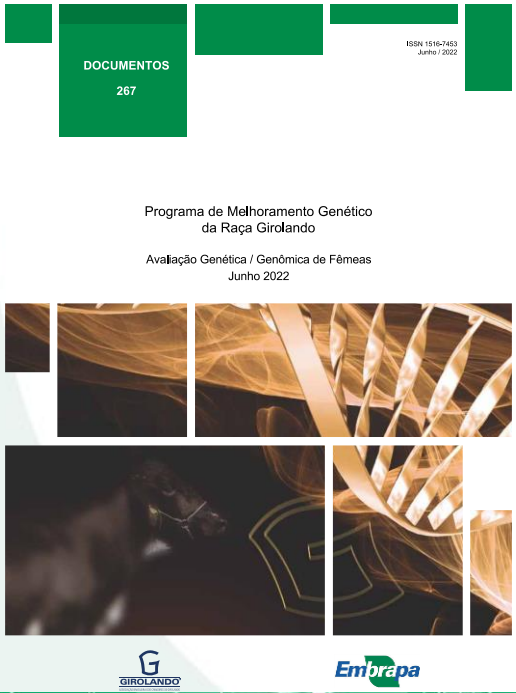
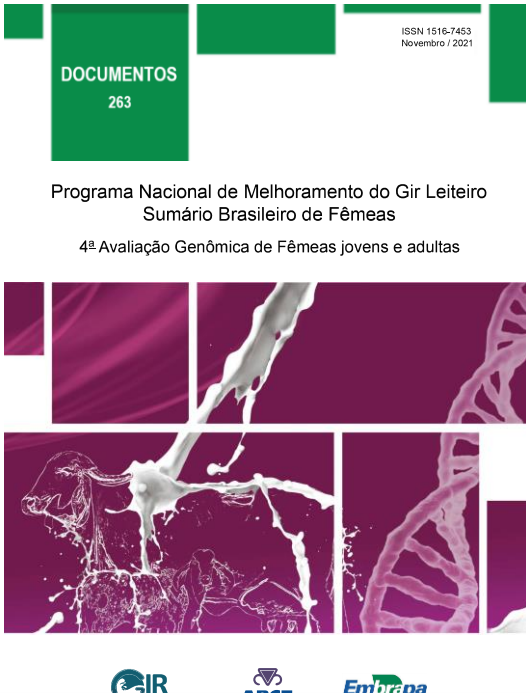
Sire and Cow Summaries







Holstein and Jersey Breeds

- For Holstein and Jersey breeds, the farmers are using mostly The Council of Dairy Cattle Breeding (CDCB) and Canadian Dairy Network (CDN) genomic predictions;

- Holstein: around 50,000 cows
- Jersey: around 15,000

Embryo Genotyping (and GPTA) will be offered to the farmers soon!

Project SEG/EMBRAPA

03.13.05.004.00.00

PI: Dr. Luiz Sérgio Camargo

Multi-breed Genomic Evaluation

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Multiple trait and random regression models using linear splines for genetic evaluation of multiple breed populations

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Invited Review

Genomic selection in multi-breed dairy cattle populations

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Genetic analysis of productive and reproductive traits in multiple-breed dairy cattle populations

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GIROLANDO

Conclusions

- Pasture based genetics

- ✓ Viable progeny testing schemes in Brazil for both Girolando and Gir breeds;
- ✓ New testing schemes based on genomics;
- ✓ Farmers are using GS for for young non-phenotyped candidate males and females;
- ✓ Sourcing genetics worldwide to complement Brazilian genetics (Holstein => Girolando);

Conclusions

- ✓ A greater accuracy of predicted genetic merit for young animals.
- ✓ A shorter generation interval because of heavier use of young, genetically superior males and females.
- ✓ An increased intensity of selection because breeders are using genomic testing to screen a larger group of potentially elite animals (both male and females).

Thank you!

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