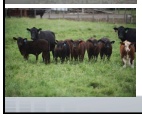
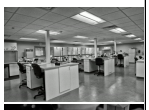
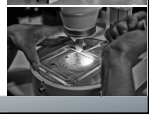
New Technologies in Cattle Reproduction and the Correlated Acceleration of Genetic Gain

Mark Allan, PhD
Director of Genetic Technology
Trans Ova Genetics-ProGentus

Genetic Selection – Animal Breeding

- Been going on for thousands of years
- Has accelerated dramatically last 100 yrs
- Massive progress in the last 50 yrs
- Extremely organized systems of genetic improvement in the livestock sectors


2

Beef- Genetic Improvement

Year	lbs beef per female #s
1965	375 lbs
1975	398 lbs
1985	508 lbs
1995	523 lbs
2007	618 lbs

- 1975 23.1 billion lbs beef with female counts of 58 million.
- 2007 26.3 billion lbs beef with female counts of 42.5 million

Calculated: Annual Total lbs Beef Produced/Total Numbers of Females

USDA –National Agriculture Statistics Service

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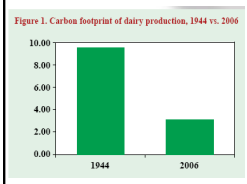
Dairy



lb CO_2 per lb Milk

1940s
- 25 M cows 4500 lbs per lactation

2008
- 9.2 M cows 22,000 lbs per lactation

❖2.7 fold reduction in cow numbers
❖4.9 fold milk yield per cow increase

1940 cows required 4.5 times more land and produced 2.6 times more Methane.

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Selection Information – Genetic Tool box

- Visual appraisal
- Pedigree information
- Pedigree verification
- Performance data
- Genetic Evaluation and accuracy
- Economic indexes
- Genetic tests for simple recessives
- Targeted panels
- High density panels
- Genomic enhanced EPDs
- Imputation
- Whole genome sequence


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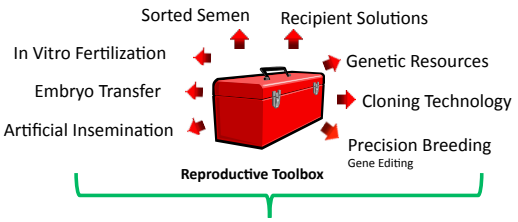
The ART Toolbox – Compliments Genomic/Genetics



Animal Husbandry

Confidential 6

Why use ART?

Assisted reproduction tools coupled with genomic enhanced selection will accelerate:

genetic gain

AI started in 1950's
ET started in 1970's
IVF started in 1990's
GP/Cloning started in late 1990's
SS started in 2000's

Genetic Improvement –

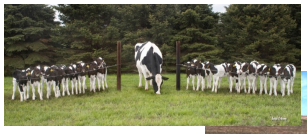
Genetic Gain and Genetic Specifications

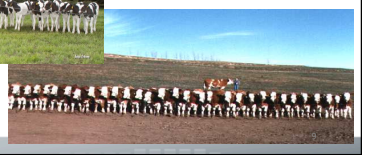
Genetic Gain= accuracy x genetic variation x intensity
generation interval

Embryo Transfer – *in vivo, in vitro*

ET allows you to increase the genetic impact of superior females.

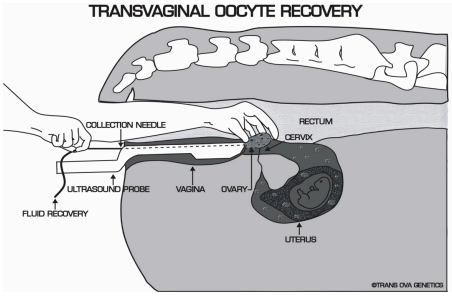
More than one calf per year out of those really good cows.



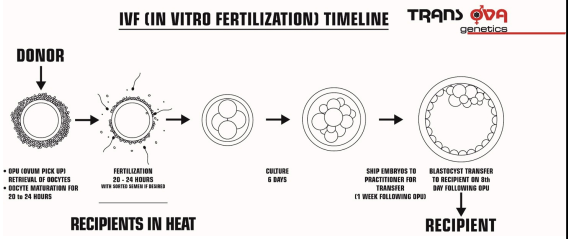


Embryo Production by IVF TOG Early 90's

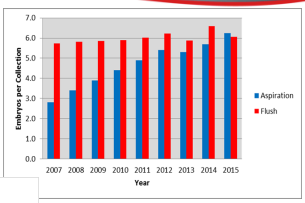
TRANSVAGINAL OOCYTE RECOVERY

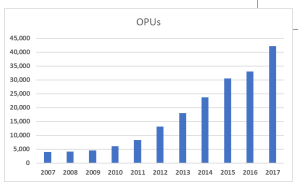


The IVF Process



IVF and genomics

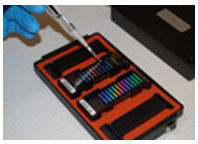




Genetic Gain- Dairy the Race to win

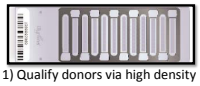
Genetic Gain= acc x genetic variation x intensity
generation interval

- "Race" – genetic improvement
  Young Animals



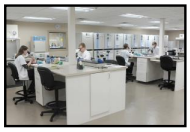
Today's Elite Genetic Selection

USDA/University/Illumina Consortium Bovine



1) Qualify donors via high density genomic chips-GPTAs

2) Collect juvenile donors



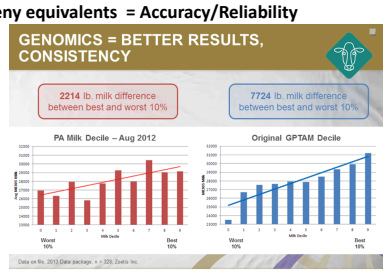
3) IVF with sexed/conventional semen

4) Gestate all embryos-Generation interval

Confidential

Genomic Enhanced Results Dairy

Progeny equivalents = Accuracy/Reliability

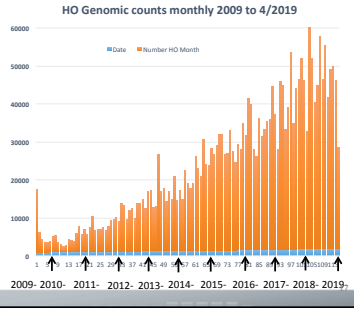


Large commercial data sets line up well with a genetic tool!!!!!

Genomics Impact on the Dairy Industry

Total Animals submitted to CDCB April2019
3,124,849

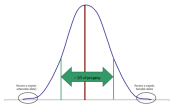
Testing cost $
$30-$50 /animal



Keys to the Success of HO and JE Genetic Evaluations

- Data
- Progeny testing with commercial driven data sets
- Phenotypes- dairy industry has excellent records
  - Repeated records per female per lactation
- Large amounts of unbiased data -clean
- Connectivity North America and aboard
  - AI greater 95% US dairy population

History Parent Averages and Full-sibs



Data traditionally available

(Reference: Zoetis Clarified)

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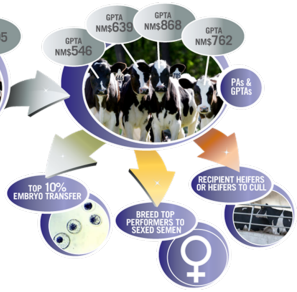
Value Distribution of Genetics

Data traditionally available



Restructuring of the Industry

(Reference: Zoetis Clarified)

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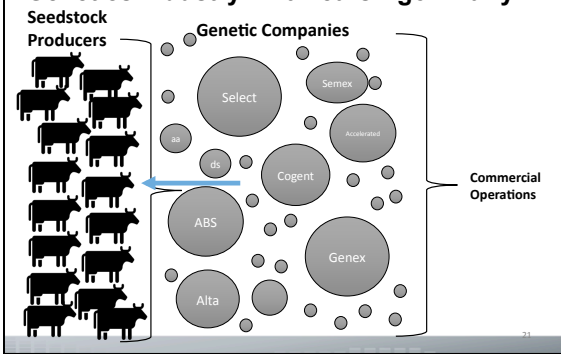
Genetics Industry – 10 Years Ago - Dairy



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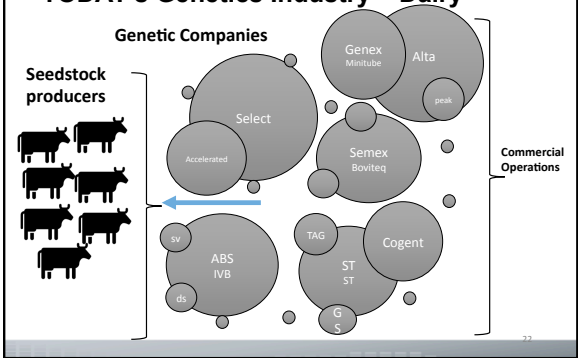
TODAY's Genetics Industry – Dairy



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Outcomes Dairy

- Extreme value differentiation of young animals.
- Consolidation - genetics and commercial production
  - Continued development of nucleus populations
- Proprietary genetics
  - End user agreements-programs
- Privatizing genetic evaluation systems
- Vertical integration like pork and poultry? Conception to Consumption
- Accelerator of Dairy/Beef programs

Accelerated by technology (ART & Genomics)

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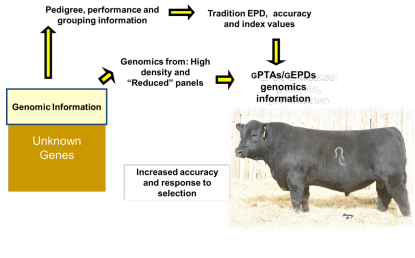
Where's the Beef



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Genomic enhanced results

Progeny equivalents = accuracy/ Reliability

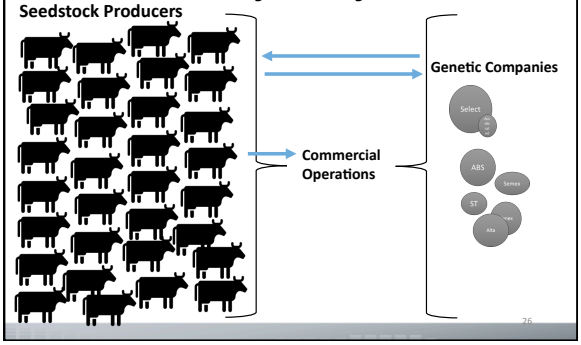
Beef

Table 1. Progeny equivalents (PE) – Carcass trait PE equate to actual carcass harvest data not ultrasound scan equivalents.

Trait	PE	Trait	PE
Calving Ease Direct	28	Heifer Pregnancy	14
Birth Weight	21	Calving Ease Maternal	18
Weaning Weight	26	Milk	33
Yearling Weight	21	Mature Weight	11
Dry Matter Intake	8	Mature Height	8
Yearling Height	11	Carcass Weight	9
Scrotal Circumference	13	Carcass Marbling	9
Docility	10	Carcass Ribeye	12
		Carcass Fat	10

(American Angus 2019)

Genetics industry –today - Beef



Future- Beef

- Generation interval - younger animals?
- Genetic landscape changing?
- Leveraging data like the dairy industry?
  - Larger progeny tests with high quality data
- Impact of technology in commercial sector increases?
- Change and Improvement

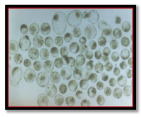
Genetic Selection – Future
Generation interval reduced

Fetal cell line selection

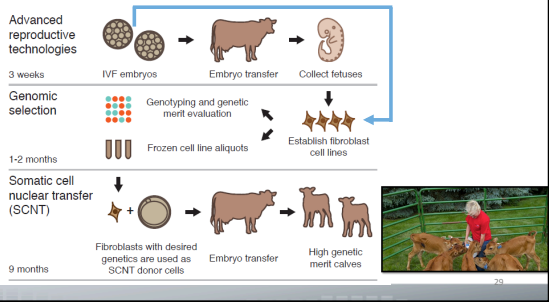
Embryo cell line selection

Biopsy – freeze embryos

Young female oocyte recovery L-OPU



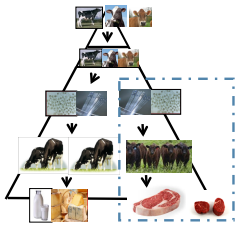
Fetal cell line selection & Embryo cell line selection



L-OPU

- Collection oocytes Donor 40 days of age.
- Calf gPTAs for selection
  - Donor Dam 11 months old
- Production in numbers
- Average donor age egg production 60 day to 150 days of age

How does the Beef genetic pyramid change over time?



Food Distribution
Steak & Hamburger with a story
Traceability, food safety

Still #1, collection of quality phenotypic data for input and output traits.

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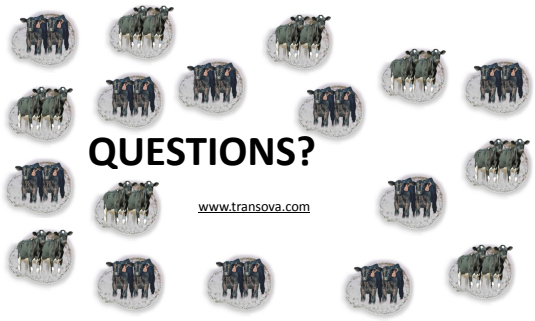
THANK YOU



QUESTIONS?

www.transova.com

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