Genetic Gain Full Throttle - Acceleration of genetic improvement through today's technologies

Dr. Mark Allan

Director Marketing and Genomics

Trans Ova Genetics

Forward-Looking Statements

Some of the statements made in this presentation are forward-looking statements. These forward-looking statements are based upon our current expectations and projections about future events and generally relate to our plans, objectives and expectations for the development of our business.

Although management believes that the plans and objectives reflected in or suggested by these forward-looking statements are reasonable, all forward-looking statements involve risks and uncertainties and actual future results may be materially different from the plans, objectives and expectations expressed in this presentation. All information in this presentation is as of the date marked on the cover page, and Trans Ova Genetics undertakes no duty to update this information unless required by law.

TRANS OVA genetics

Multiply Success℠

8.17.2015

The Toolbox

TRANS OVA genetics
Multiply Success℠

Sorted Semen

Recipient Solutions

In Vitro Fertilization

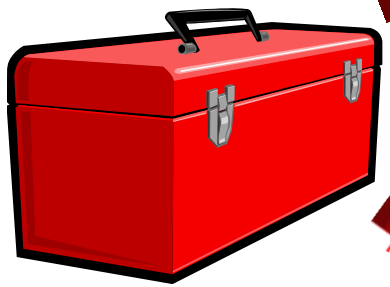
Genetic Resources

Embryo Transfer

Cloning

Artificial Insemination

Precision Breeding
Gene Editing

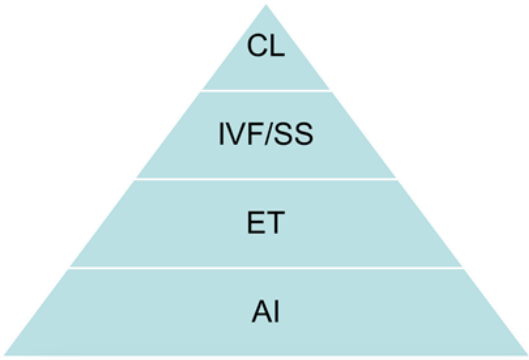


Reproductive Toolbox

Why use ART?

TRANS OVA genetics
Multiply Success℠

- Assisted reproduction tools coupled with Genomic Selection will accelerate: **genetic gain** 2X – ?X
  - AI started in 1950's
  - ET started in 1970's
  - IVF started in 1990's
  - GP/Cloning started in 1990's
  - SS started in 2000's

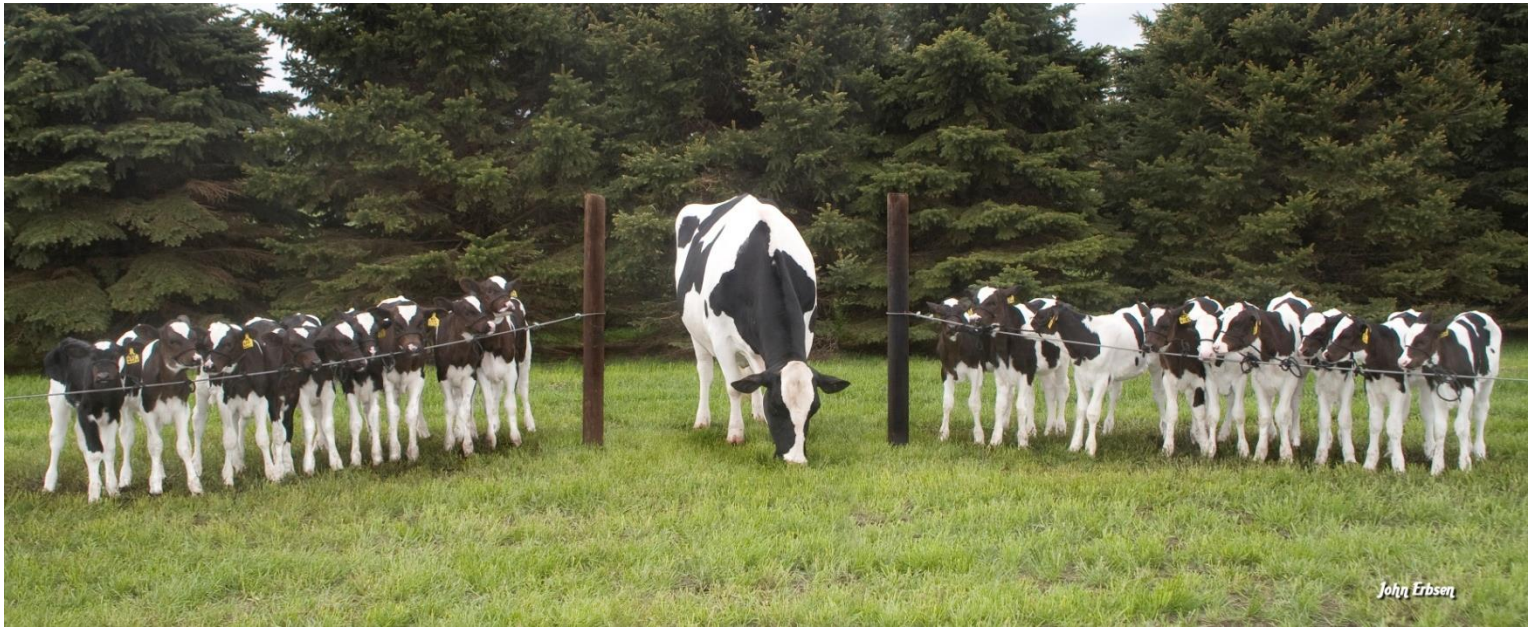


Hierarchy of ART

$$GG = \frac{\text{Var x Acc x Selection Intensity}}{\text{Gen. Interval}}$$

Why Utilize These Tools?

TRANS OVA genetics
Multiply Success℠



Get More Calves from those Great Cows and Great Sires!

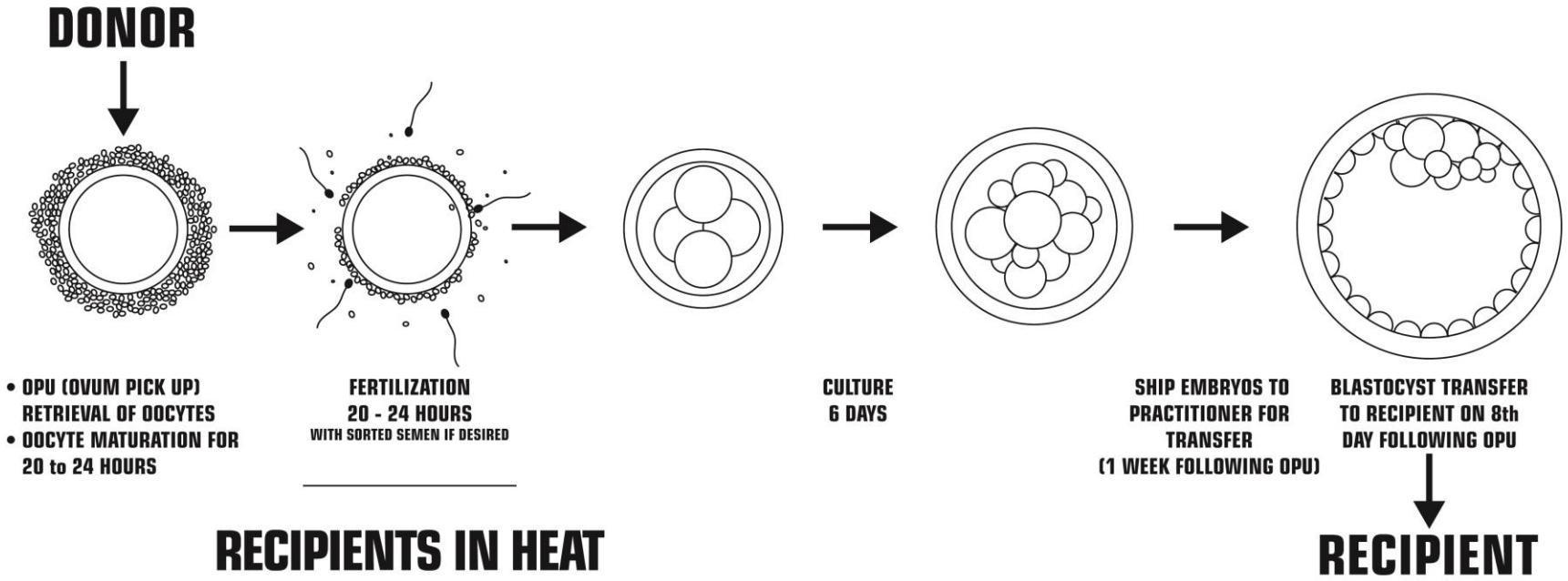
IVF

- IVF provides embryo production on open, pregnant, subfertile and pre-puberal females
- Best place to use Sexed Semen
- ***More than one calf per year out of those really good cows and heifers***
- ***….of the sex you desire most.***

IVF

TRANS OVA genetics
Multiply Success℠

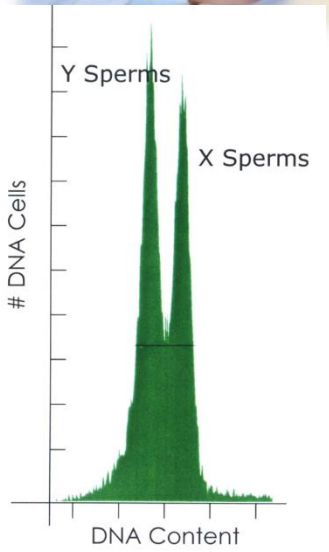
IVF (IN VITRO FERTILIZATION) TIMELINE

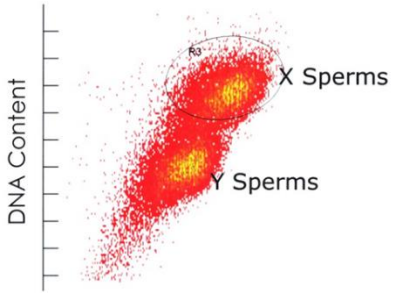


Sexed Semen

TRANS OVA genetics
Multiply Success℠

- Semen can be Sexed/Sorted.
- Over 90% accuracy for sex
- Reverse sorted semen for IVF





Centers & Satellites

TRANS ♀ VA genetics
Multiply Success℠

Taking IVF to the Client

TRANS OVA genetics
Multiply Success℠

Satellite location –
Donor populations

Oocytes

Regional IVF
Center
TOG OPU team

Embryos

Recipients for purchase
or
Live Calf program

Embryos

Client - recipient herd
Local ET practitioner

Today's Elite Genetic Selection

TRANS OVA genetics
Multiply Success℠

1) Qualify donors via high density genomic chips

2) Collect juvenile donors

3) IVF with sexed/conventional semen

4) Gestate all embryos

What's Changed

TRANS OVA genetics
Multiply Success℠

Components of Phenotypic Variation

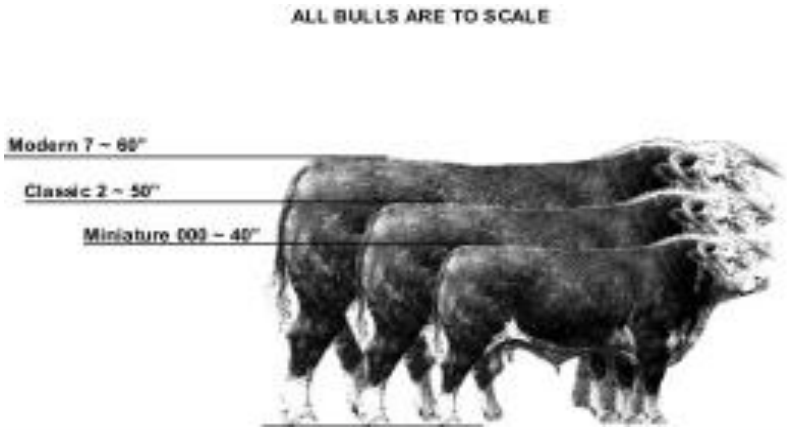
- Phenotype
  - Environment
    - Known
    - Unknown
  - Genetics
    - Non-Additive
    - Additive

Advancements In Genetic Improvement

TRANS OVA genetics
Multiply Success℠

Genetic Evaluation Evolution

- Visual appraisal
- Pedigree information
- Pedigree verification
- Performance data
- Progeny values and accuracy
- Bioeconomic indexes
- Genetic tests for simple recessives
- Targeted panels
- High density panels
- Blended evaluations
- Imputation



Why do we need more information?

TRANS OVA genetics
Multiply Success℠

- Two full-sib Angus bulls born with the same parent averages

Trait	BW	WW	Milk	YW	SC
Parent Average	4.4	36	19	63	.76

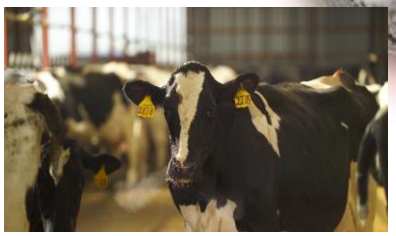
- Progeny records reveal very different bulls

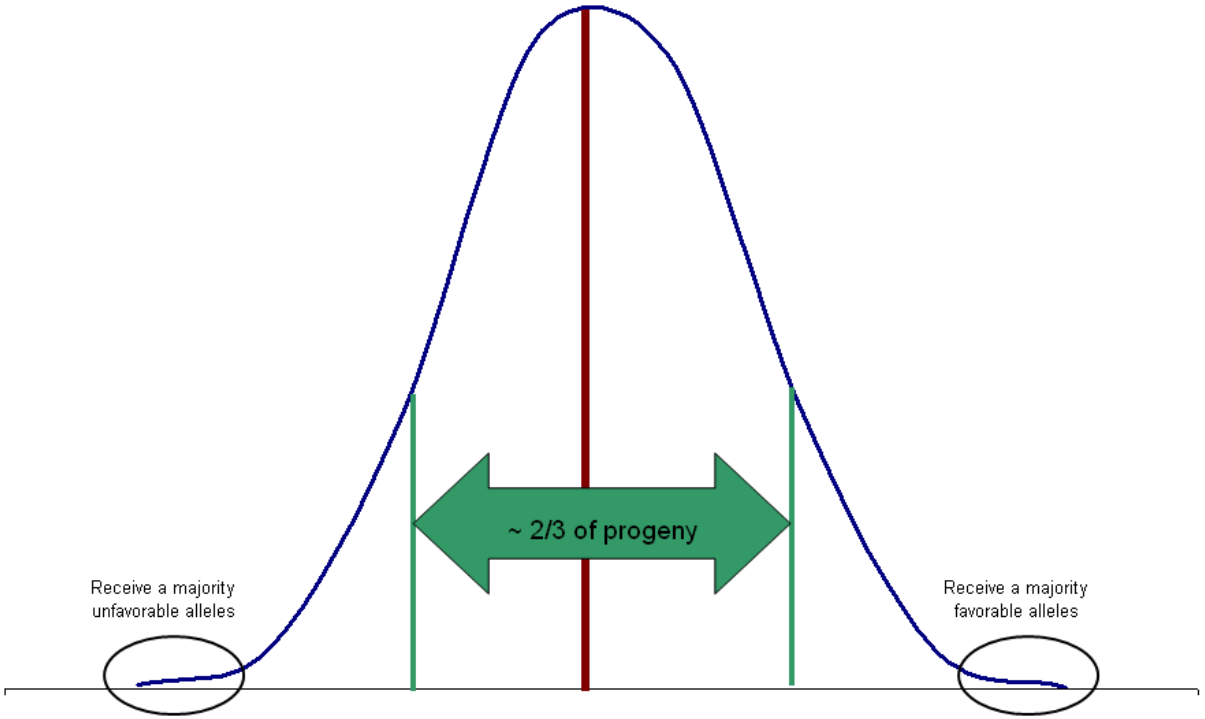
Trait	BW	WW	Milk	YW	SC
TC Rancher	-.5	19	22	38	.62
Acc.	.96	.94	.91	.92	.89
TC Stockman	8.5	41	12	80	1.02
Acc.	.95	.93	.91	.90	.84

Distribution of Genetics

TRANS OVA genetics
Multiply Success℠

x



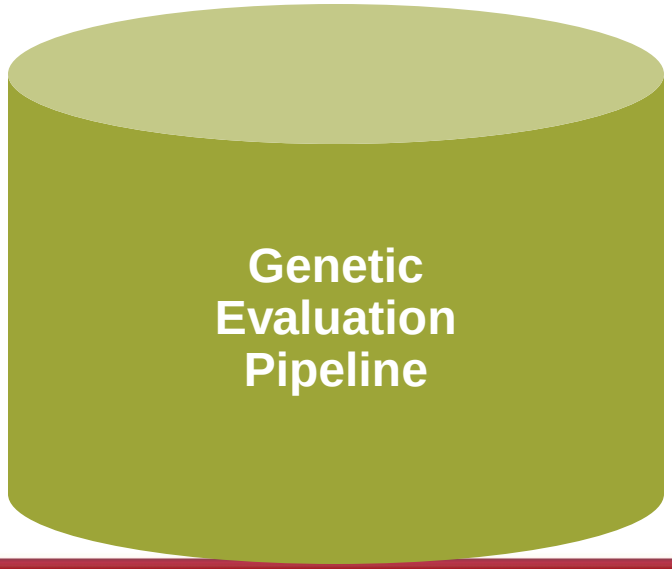


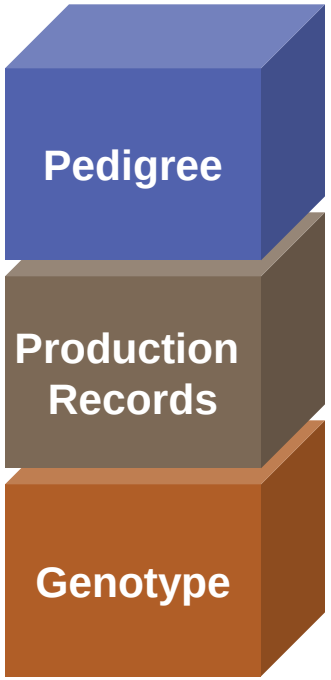
Genetic Evaluation Process

TRANS OVA genetics
Multiply Success℠

Genomic PTA (GPTA)

Higher reliability or accuracy





Different Game

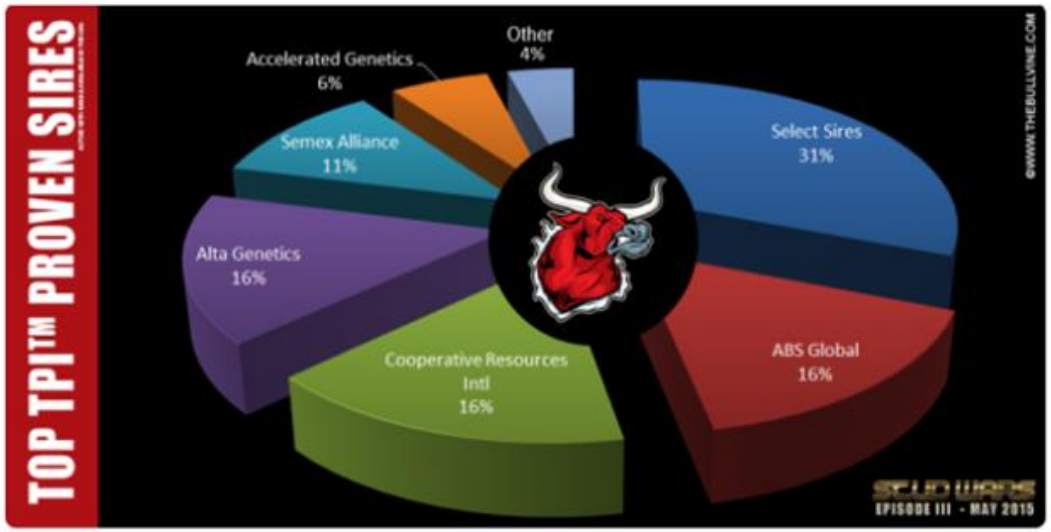
TRANS OVA genetics
Multiply Success℠

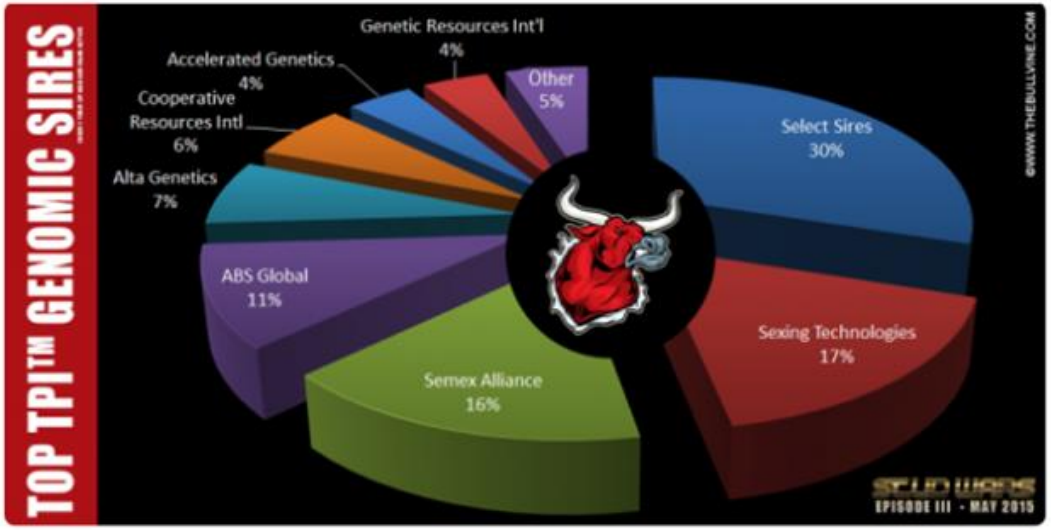
Dairy Genetic Evaluation - Large portion of data commercial industry progeny test data.

Reference: Zoetis Clarified

TRANS OVA genetics

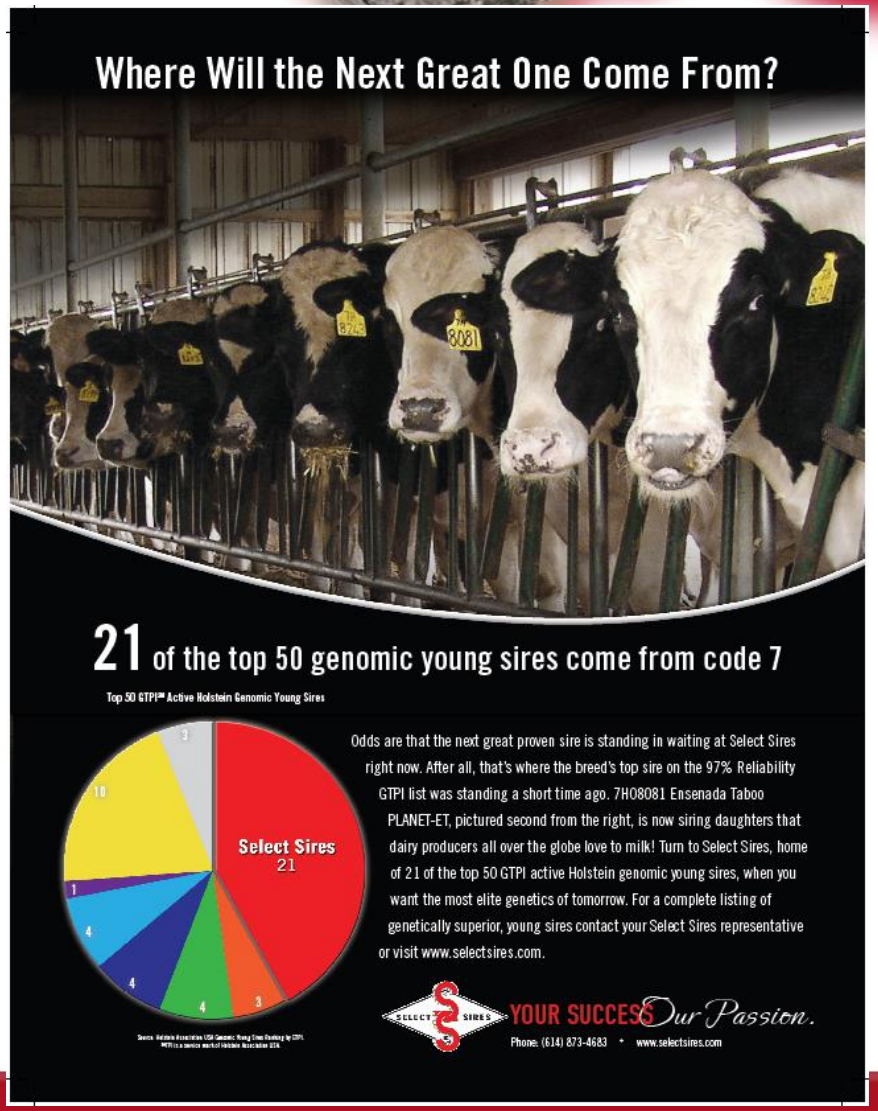
Multiply Success℠





- **April 2014 Top Young Genomic Bull List**
  - **(412 bulls)**

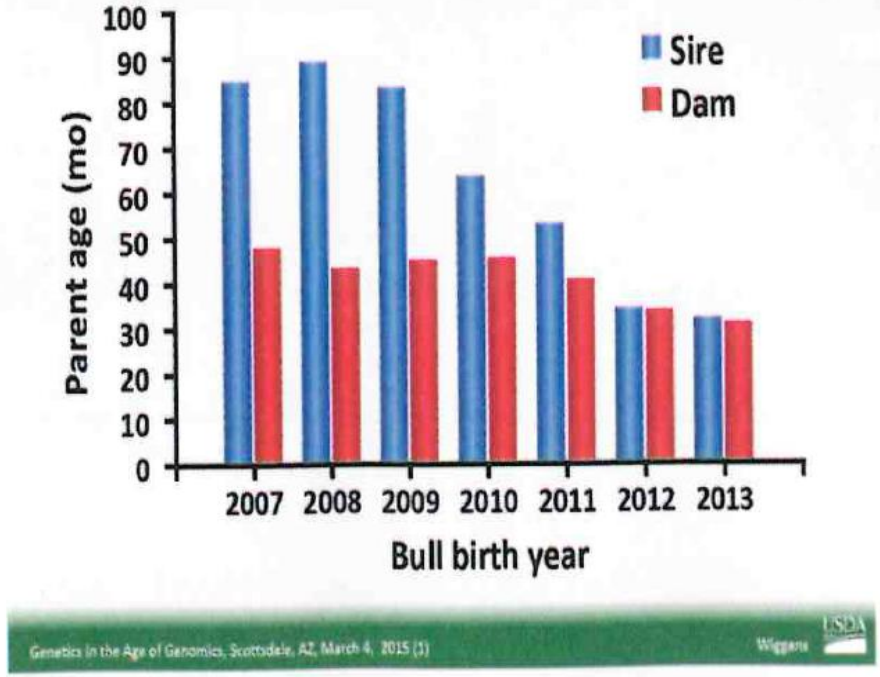
- **87% of the top 100 were produced by Trans Ova and its clients**



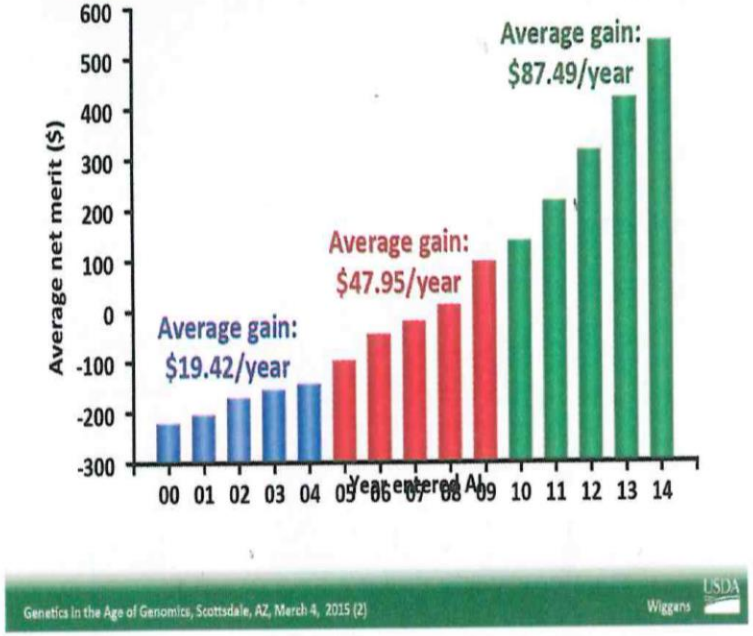
Industry Trends

TRANS OVA genetics
Multiply Success℠

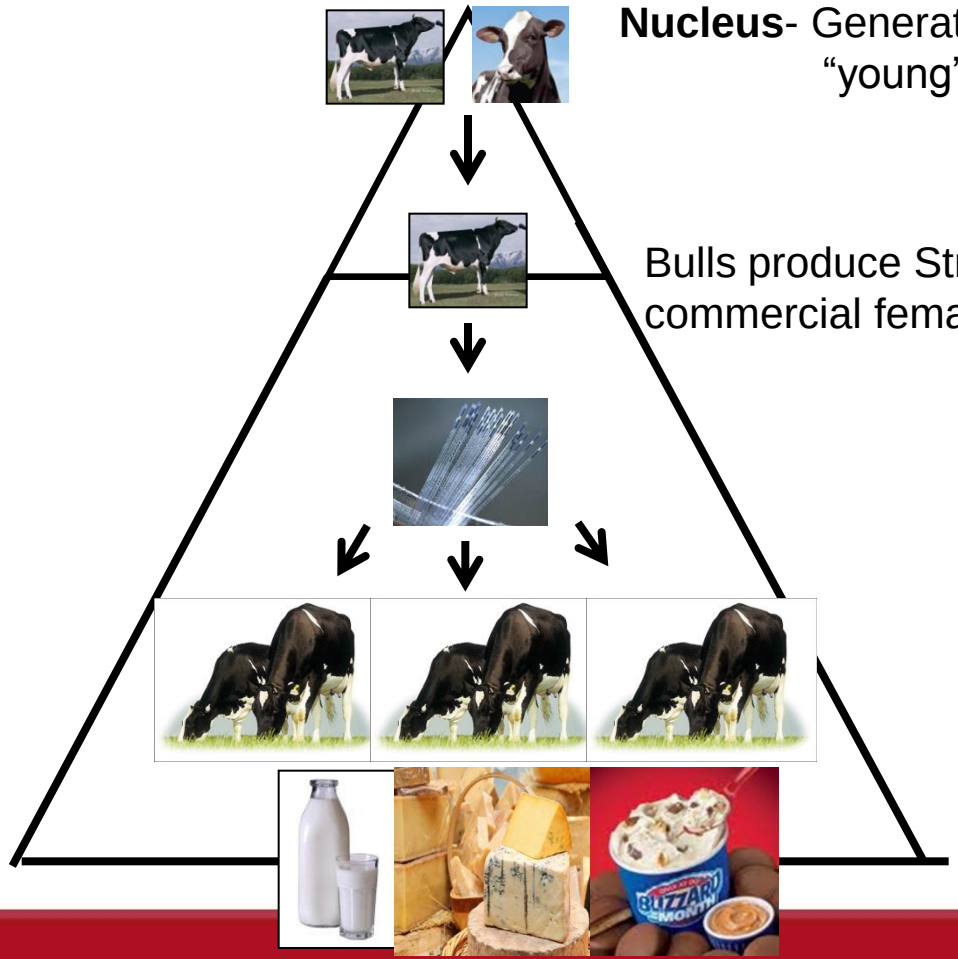
Parent ages for marketed Holstein bulls



Genetic merit of marketed Holstein bulls



Today's Industry



Nucleus- Generation Interval
"young" donors

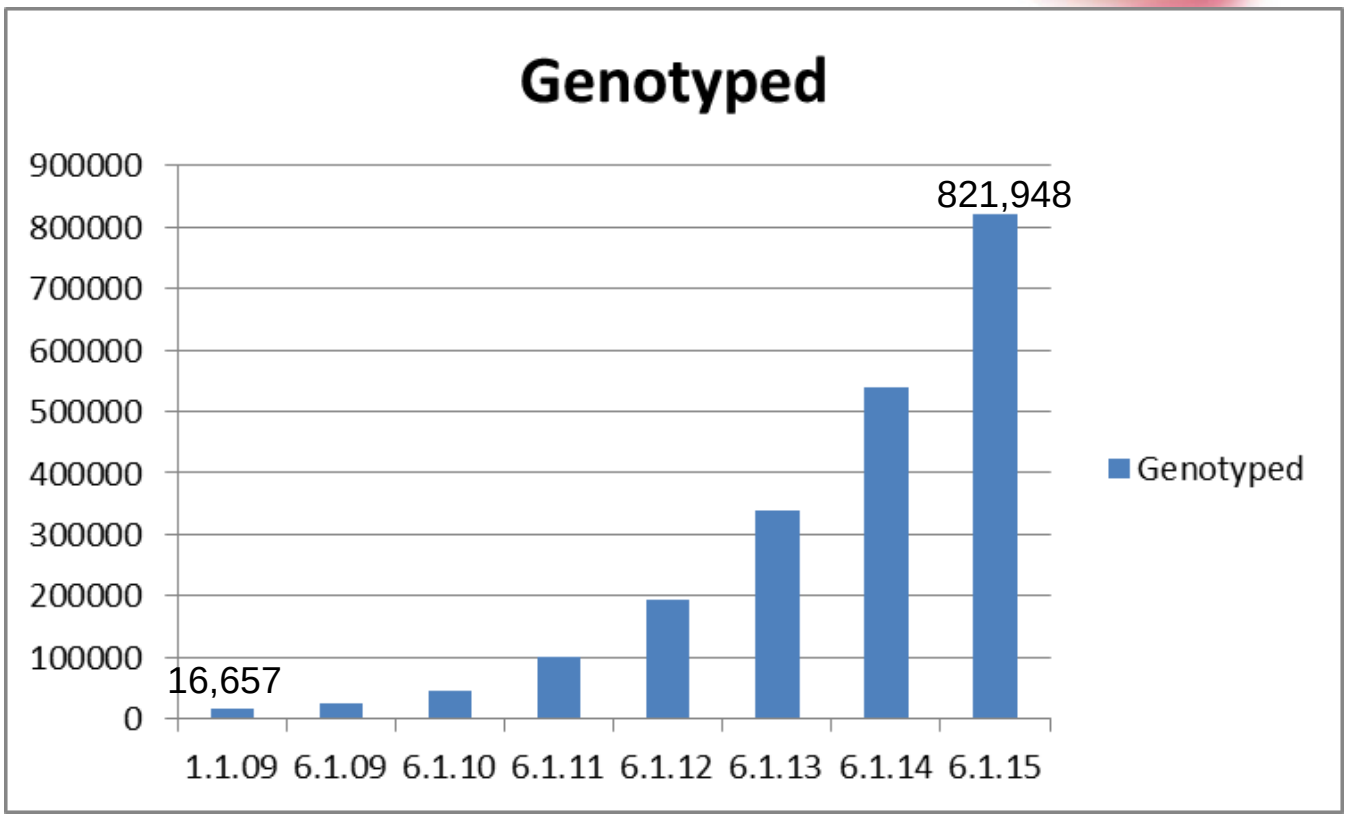
Bulls produce Straws of semen for commercial female production

Genomics Impact on the Dairy Industry?

TRANS OVA genetics
Multiply Success℠

-Leverage the GE system already in place
-Training population calibration
-Validation of concept of WGS
-Implementation into genetic evaluations

Genotype animals in the evaluation Holstein



June Genotyped all breeds 992,918

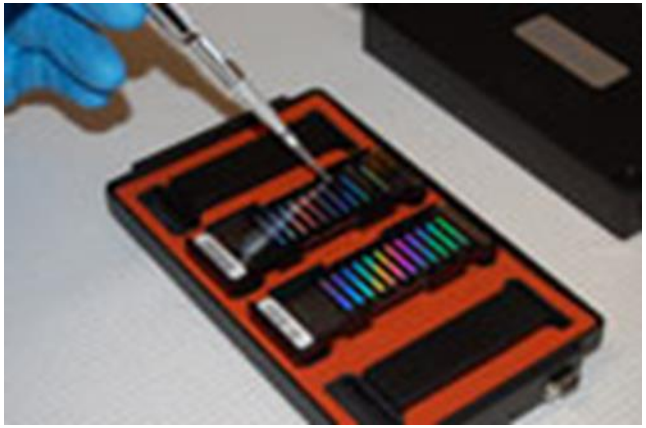
https://www.cdcb.us/Genotype/cur_density.html

Genetic Gain

Genetic Gain= **acc** x genetic variation x **intensity**

generation interval

- Race –genetic improvement
- Young Animals



Genetic Copy Later In Time

TRANS OVA genetics
Multiply Success℠

VIAGEN
MULTIPLY SUCCESS

Why do Producers Use this Technology?

TRANS OVA genetics
Multiply Success℠

Maximizing Production from Outliers

- The leading terminal sires/foundation females.

Contributing to the Genetic Pool

- Genetic Outlier that died young.

Eliminating Recessive Genes/Disease Outbreak

- Going back to a “free” founder.

Extending Reach of Rare Genetics

- Proven performer in high demand.

VIAGEN
MULTIPLY SUCCESS

Genetic Preservation and Cloning

TRANS OVA genetics
Multiply Success℠

Using the Technology to Capitalize on an Elite Bull's Genotype

- Genetic donor bull was a "lunger"
  - poor semen production
  - poor morphology
- The owners cloned him to produce a healthier version.
- Picture of health with a phenotype to match and he produces more semen than the genetic donor which is also of excellent quality.

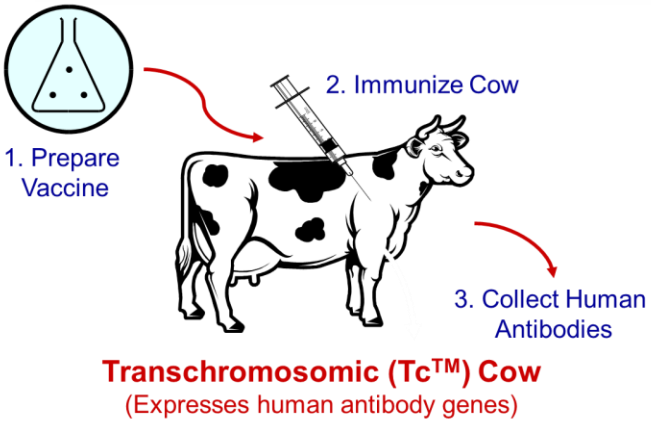
VIAGEN
MULTIPLY SUCCESS

Additional Applications of Biotechnology

TRANS OVA genetics
Multiply Success℠

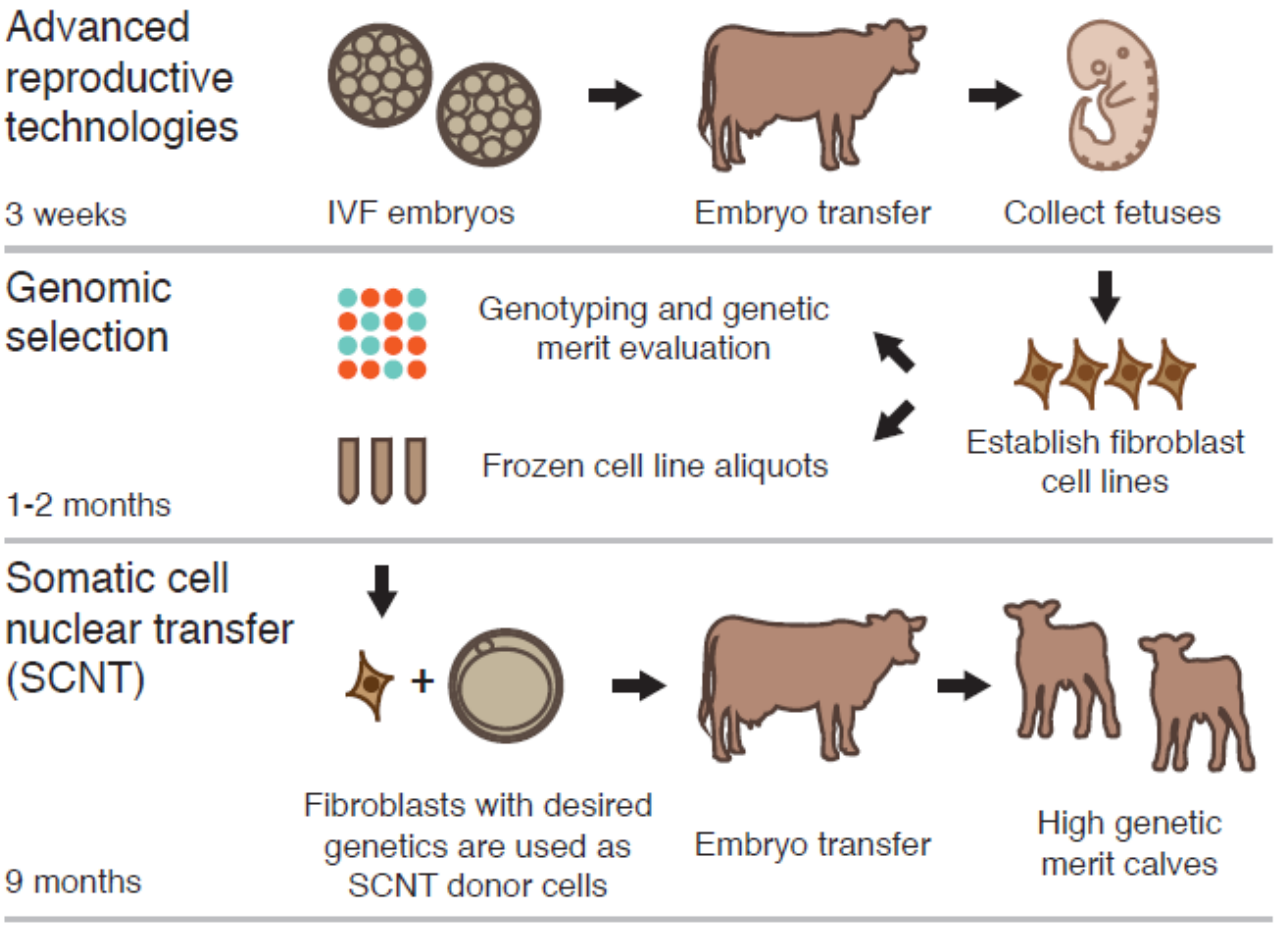
TOG also produces animals with applications in Biomedical:

- Pharmaceutical production in milk
  - Recombinant human albumen
  - Human Antibodies
- Pigs as medical models
- Organ transplant
- Medical devices



Fetal cell line selection

TRANS OVA genetics
Multiply Success℠



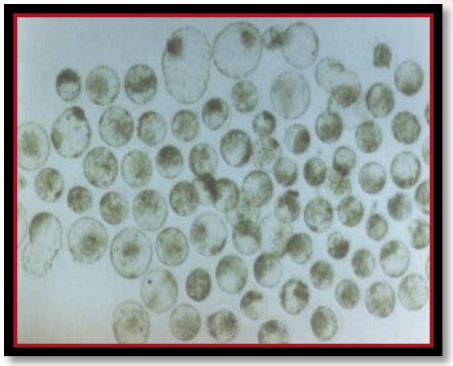
What's Next

TRANS OVA genetics
Multiply Success℠

Genetic Selection – Generation interval reduced

Embryo selection

1. Biopsy – freeze embryos
2. Screen embryos-
   GPTAs, GEPDs (genomic chips)
3. Transfer selected embryos



Fetal cell line selection

Future!

TRANS OVA genetics

Multiply Success℠

QUESTIONS?

www.transova.com
www.viagen.com