Utilization of EPDs and genomics in the selection of herd traits

Lundbreck
8th September 2016

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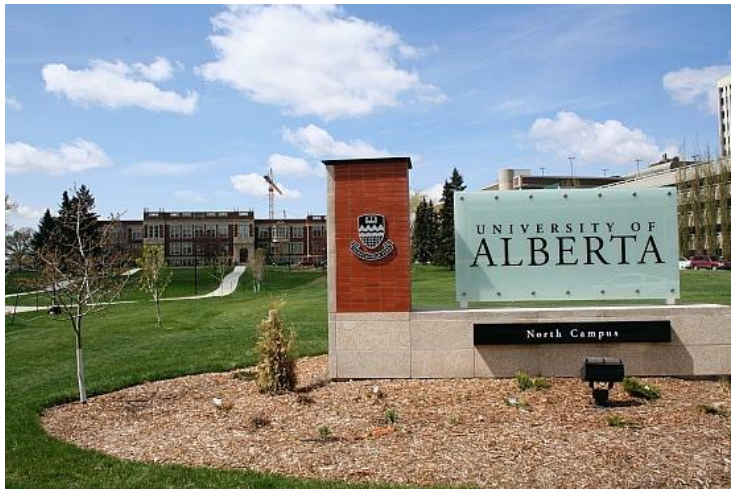
UNIVERSITY OF ALBERTA
FACULTY OF AGRICULTURAL, LIFE & ENVIRONMENTAL SCIENCES

Canadian Beef Breeds Council

- Founded in 1994
- 16 beef Breed Associations and 12 associate members (Export Companies)
- Responsible for
  - Government and industry relations
  - International market development
  - Domestic issues (animal health, research, promotion of reg'd cattle)
  - Coordinating genetic improvement programs
  - Scientific advancement

Livestock Gentec and UofA

- Livestock Gentec; Alberta Innovates Bio Solutions center
- Carry out and capitalize on world-class genomics research
- Commercial benefits to the Canadian livestock industry



- Created out of the Agriculture Food and Nutritional Science faculty at UofA

Genetics and Genomics

- **Genetics** - the study of inheritance

- **Animal breeding** - using knowledge of genetics to improve animals

- **Genomics** – branch of molecular biology concerned with the structure, function, evolution, and mapping of genomes

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Genetics creates potential, management delivers

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What are Your Goals

- How do you choose your cows and bulls?
- Increase my bottom line without a lot of extra time and labour
- Create Efficiencies
- Benefit the Environment
- Animal Welfare
- Low Maintenance Cattle
- World leader in cattle production

1957 Genetics -ACRBC Males

2001 Genetics-Ross Males – 2001 Feed

Day 43 **Day 57** **Day 71** **Day 85**

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(Havenstein *et al*., 2003a)

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Past Success in feed efficiency (Plastow 2012)

1972

836 pounds

220 pounds

FCR: 3.8

32%

2007

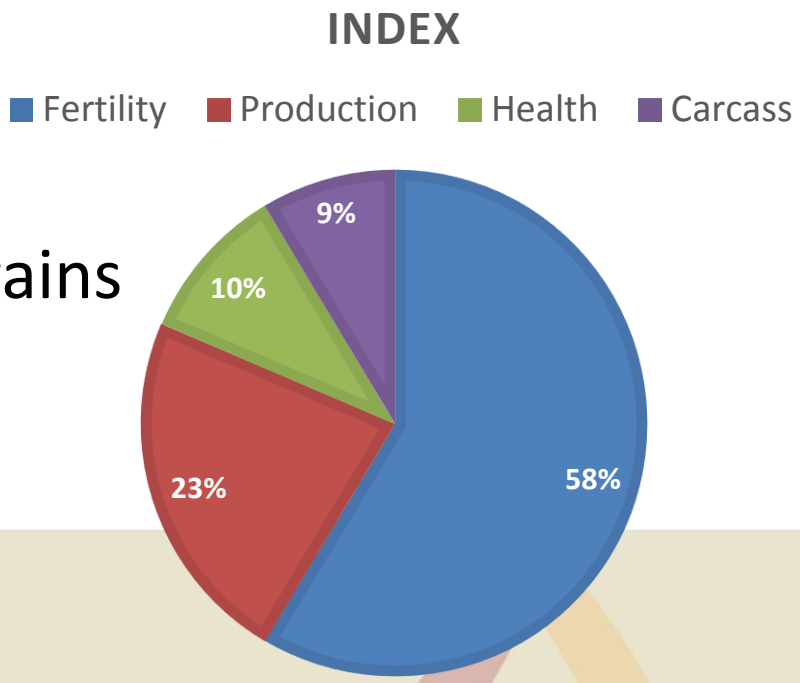
715 pounds

275 pounds

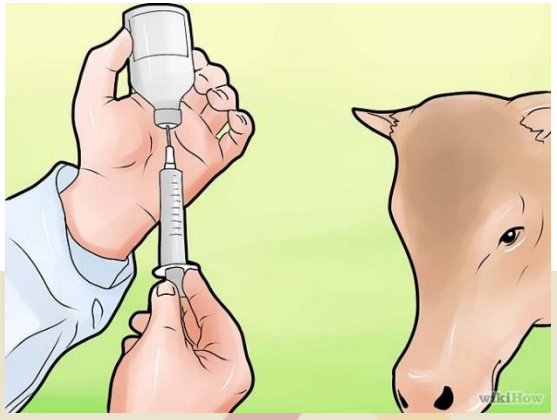
FCR: 2.6

Improving Genetic Merit

- Expected Progeny Difference (EPD)
  - Phenotype and pedigree
  - GxE=P
- Multi-trait selection indices
  - Economics and/or desired gains
  - Overcomes unfavourable correlations



Phenotypes + Pedigree



Understanding EPDs

EPDs	Hrds Prog DIP	CE Acc %	BW Acc %	WW Acc %	YW Acc %	Milk Acc %	TMAT Acc %	SC Acc %	CWT Acc %	REA Acc %	FAT Acc %	LY Acc %	MARB Acc %
	0	46	1.5	40	76	17.9	38	N/A	15	0.47	-0.11	1.16	0.09
	0	0.17	0.39	0.27	0.24	0.15	0.19		0.10	0.06	0.08	0.00	0.05
	0	85	45	70	70	85	85		65	30	20	15	50

EPDS Spring 2015

Where do I start?

13 AGA 2U BRIT
C02986647 ALNK 13A

BW:	81
205:	558
'15 EPDs	
CE:	+0.3
BW:	+3.2
WW:	+38.1
YW:	+62.4
MCE:	-0.2
Milk:	+14.7
TM:	+33.8

DP BRITISHER AGA 46E
AGA 46E BRITISHER ET 2U
AGA 22B MISS BRIGADER 511E
DO BRITISHER WEYMORE LADY AGA 5A
CTY BRIGADER 22B
AGA MISS 42X STANMORE 94Z

CC 77J JARROD 26T
AGA 26T MISS JARROD EXCITE 13X
AGA 53L MISS RED DOMINO 80S
CC 129D SUPERMAN 77J
CC 14N JOCELYN 33R
AGA 22B BRIGADER 53L
AGA 277D MISS STANDARD 810H

Ranked 121 / 918 published RFI EPDs
Long & solid marked with a woolly, yellow haircoat with a great top, thick quarters and great pants, this 2U son placed far above average on the RFI EPD report. The ultrasound scanner revealed a REA of 1.25/100 lbs. Retaining semen interest

												Marb Acc %RK
	80	60	55	60	100	50	15		60	70	80	-0.26 / 0.16 / 100

EPDS Spring 2015

	Birth Weight	Weaning Weight	Yearling Weight	Milk	Total Maternal	Scrotal Circ.	Calving Ease	Mat Calving Ease	Yield Grade	REA	Carcass Weight	Marbling
EPD	+4.3	+52	+93	+19	+45	-	+2.0	+9.0	-	+0.41	+33	+0.19
Acc	72	61	18	24	-	-	35	17	-	13	9	12
TOP %	85	20	15	45	30	-	55	20	-	25	10	75

281 LLB 9188 KODIAK 341A

April 17 2013 #1749747 LLB 341A

HF KODIAK 5R AMF CAF NHF MAF DDF
SOO LINE KODIAK 9188
LLB EULIMA 283R

WOODHILL ADMIRAL 77K AMF CAF NHF DDF
SANE ADM BLACK KERRIE 103W
KLT BLACKBIRD MINNIE 24M AMF NHF

SANDY BAR ADVANTAGE 43M
WILBAR RUBY 955N
K G POWER DESIGN DDF
LLB EULIMA 104K
S A F FOCUS OF E R AMF CAF NHF DDF
WOODHILL LASS 344-1178
C A FUTURE DIRECTION 5321 AMC
KLT BLACKBIRD'S KERRI 12K

BWT **85** lbs. Adj 205D **787** lbs. Adj. 365D **1436** lbs. Dams Age **4** Calving Ease **2**

BW +4.1 35% WW +55 25% YW +84 14% MILK +19 14% TM +47 205 Index 108

A bull with top weaning and yearling weight records. Note his grand dam LLB Eulima 104K is the mother of the Lot 1.

Understanding EPDs

Accuracies; quickly tells you the status of a bull

	Birth Weight	Weaning Weight	Yearling Weight	Milk	Total Maternal	Scrotal Circ.	Calving Ease	Mat Calving Ease	Yield Grade	REA	Carcass Weight	Marbling	Fat	Stay	HPG
EPD	+4.3	+52	+93	+19	+45		+2.0	+9.0		+0.41	+33	+0.19	0.013		
Acc	72	61	18	24	-	-	35	17	-	13	9	12	11	-	-
TOP %	85	20	15	45	30	-	55	20	-	25	10	75	8	-	-

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Possible EPD changes

Accuracy %	Birth Wt	Wean Wt	Milk
10	±2.4	±10.4	±8.7
30	±1.8	±8.1	±6.8
50	±1.3	±5.8	±4.9
75	±0.8	±2.9	±2.4
90	±0.3	±1.2	±1.0

Understanding EPDs

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So what are all the figures based against?

	Birth Weight	Weaning Weight	Yearling Weight	Milk	Total Maternal	Scrotal Circ.	Calving Ease	Mat Calving Ease	Yield Grade	REA	Carcass Weight	Marbling	Fat	Stay	HPG
EPD	+3.3	+36	+72	+22	+40	+0.93	0.0	+3.0	-	-0.06	+19	+0.41	-0.005	-	-
Acc	37	28	27	20	-	P	23	15	-	20	24	19	16	-	-
TOP %	75	80	65	30	55	25	75	85	-	97	60	35	20	-	-

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Understanding EPDs

JOE

- Joe is the bull that all bulls are compared to
- He is just a very average bull
- All of Joe's trait figures are zero
- Joe is what is called the base bull and doesn't actually exist

	BWT	CE	WWT	YWT	MLK	CWT	FAT	REA
EPD	0	0	0	0	0	0	0	0

Understanding EPDs

- His progeny will be 40lb heavier at weaning than my progeny
- In the top 70% of his breed

WW	Acc %
40	
0.27	70

Understanding EPDs

- His daughters will have more milk than mine
- Their calves are 17.9 lbs heavier at weaning
- A lot better than him in his breed though

Milk
Acc
%
17.9
0.15
85

Understanding EPDs

- He's easier calving than I am
- Incidence of calving difficulty will be 2% less than on my calves

Calving Ease	
+2.0	Epd
35	Acc
55	% rank

Rankings

CBBC
Canadian Beef Breeds Council

Black Percentile Bands for all Calves born in 2015

Percentile Band	Birth Weight	Weaning Weight	Yearling Weight	Milk	Total Maternal	Scrotal Circ.	Calving Ease	Mat Calving Ease	REA	Carcass Weight	Marbling	Fat
Top Value	-6.600	87.000	141.000	36.000	77.000	1.825	21.183	21.034	1.425	62.334	2.346	-0.106
Top 5%	-0.600	60.000	106.000	27.000	54.500	1.315	10.500	11.500	0.740	38.290	0.865	-0.021
Top 10%	0.100	57.000	101.000	25.000	51.500	1.170	9.000	10.000	0.625	34.747	0.720	-0.015
Top 15%	0.550	54.000	97.000	24.000	49.750	1.085	8.000	10.000	0.555	32.272	0.630	-0.010
Top 20%	0.900	52.500	93.500	23.000	48.000	1.025	7.000	9.000	0.505	30.300	0.560	-0.006
Top 25%	1.200	51.000	91.000	22.000	47.000	0.965	6.000	8.500	0.460	28.595	0.510	-0.002
Top 30%	1.450	50.000	88.500	22.000	45.500	0.910	6.000	8.000	0.420	27.161	0.465	0.002
Top 35%	1.700	48.000	86.000	21.000	44.500	0.865	5.000	7.500	0.385	25.784	0.425	0.005
Top 40%	1.900	47.000	84.000	20.000	43.500	0.825	4.000	7.000	0.360	24.495	0.400	0.008
Top 45%	2.100	46.000	82.000	20.000	42.500	0.780	4.000	7.000	0.335	23.249	0.375	0.011
Top 50%	2.300	45.000	80.000	19.000	41.500	0.740	3.000	6.000	0.305	21.954	0.345	0.014
Top 55%	2.500	43.000	78.000	18.500	40.500	0.705	3.000	6.000	0.280	20.763	0.325	0.017
Top 60%	2.700	42.000	76.000	18.000	39.500	0.660	2.000	5.500	0.250	19.449	0.305	0.020
Top 65%	2.900	41.000	74.000	17.000	38.500	0.610	2.000	5.000	0.225	18.148	0.275	0.023
Top 70%	3.100	39.500	71.500	16.500	37.000	0.560	1.000	5.000	0.200	16.780	0.250	0.027
Top 75%	3.300	38.000	69.000	16.000	36.000	0.505	0.000	4.000	0.170	15.206	0.225	0.030
Top 80%	3.600	36.000	66.000	15.000	34.500	0.435	-0.500	4.000	0.140	13.460	0.200	0.035
Top 85%	3.900	34.500	63.000	14.000	32.750	0.350	-1.000	3.000	0.105	11.423	0.165	0.041
Top 90%	4.300	32.000	59.000	12.500	30.500	0.255	-2.500	2.000	0.060	8.805	0.125	0.047
Top 95%	4.900	29.000	53.000	10.500	27.000	0.120	-4.000	1.000	-0.010	5.130	0.065	0.057
Low Value	12.500	6.000	6.000	-2.000	3.000	-0.440	-20.000	-10.000	-0.295	-26.208	-0.494	0.108

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Rankings

Black Percentile Bands for all Calves born in 2015

Home Animal Inquiry EPD Inquiry Mating Predictor Member Inquiry Sale Catalogs Semen Catalogs Download Files Online Transactions

Percentile Band	Birth Weight	Weaning Weight	Yearling Weight	Milk	Total Maternal	Scrotal Circ.	Calving Ease	Mat Calving Ease	REA	Carcass Weight	Marbling	Fat
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Top 5%	-0.600	60.000	106.000	27.000	54.500	1.315	10.500	11.500	0.740	38.290	0.865	-0.021
Top 10%	0.100	57.000	101.000	25.000	51.500	1.170	9.000	10.000	0.625	34.747	0.720	-0.015
Top 15%	0.550	54.000	97.000	24.000	49.750	1.085	8.000	10.000	0.555	32.272	0.630	-0.010
Top 20%	0.900	52.500	93.500	23.000	48.000	1.025	7.000	9.000	0.505	30.300	0.560	-0.006
Top 25%	1.200	51.000	91.000	22.000	47.000	0.965	6.000	8.500	0.460	28.595	0.510	-0.002
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Low Value	12.500	6.000	6.000	-2.000	3.000	-0.440	-20.000	-10.000	-0.295	-26.208	-0.494	0.108

Finding that bull

Black Percentile Bands for all Calves born in 2015

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Top 10%	0.100	57.000	101.000	25.000	51.500	1.170	9.000	10.000	0.625	34.747	0.720	-0.015
Top 15%	0.550	54.000	97.000	24.000	49.750	1.085	8.000	10.000	0.555	32.272	0.630	-0.010
Top 20%	0.900	52.500	93.500	23.000	48.000	1.025	7.000	9.000	0.505	30.300	0.560	-0.006
Top 25%	1.200	51.000	91.000	22.000	47.000	0.965	6.000	8.500	0.460	28.595	0.510	-0.002
Top 30%	1.450	50.000	88.500	22.000	45.500	0.910	6.000	8.000	0.420	27.161	0.465	0.002
Top 35%	1.700	48.000	86.000	21.000	44.500	0.865	5.000	7.500	0.385	25.784	0.425	0.005
Top 40%	1.900	47.000	84.000	20.000	43.500	0.825	4.000	7.000	0.360	24.495	0.400	0.008
Top 45%	2.100	46.000	82.000	20.000	42.500	0.780	4.000	7.000	0.335	23.249	0.375	0.011
Top 50%	2.300	45.000	80.000	19.000	41.500	0.740	3.000	6.000	0.305	21.954	0.345	0.014
Top 55%	2.500	43.000	78.000	18.500	40.500	0.705	3.000	6.000	0.280	20.763	0.325	0.017
Top 60%	2.700	42.000	76.000	18.000	39.500	0.660	2.000	5.500	0.250	19.449	0.305	0.020
Top 65%	2.900	41.000	74.000	17.000	38.500	0.610	2.000	5.000	0.225	18.148	0.275	0.023
Top 70%	3.100	39.500	71.500	16.500	37.000	0.560	1.000	5.000	0.200	16.780	0.250	0.027
Top 75%	3.300	38.000	69.000	16.000	36.000	0.505	0.000	4.000	0.170	15.206	0.225	0.030
Top 80%	3.600	36.000	66.000	15.000	34.500	0.435	-0.500	4.000	0.140	13.460	0.200	0.035
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+

Trait Description	Min	Max	Min. Accuracy (Enter as whole number, not decimal)	Breed Avg *
Birth Weight				+2.2 -0.1
Weaning Weight				+45 +52
Yearling Weight				+80 +78
Milk				+19 +17
Total Maternal				+41 +43
Scrotal Circ.				+0.73 n/a
Calving Ease				+3.2 +3.6
Mat Calving Ease				+6.3 +3.6
Yield Grade				n/a -0.03
REA				+0.33 +0.07
Carcass Weight				+22 +16
Marbling				+0.39 +0.28
Fat				+0.015 -0.017
Stay				n/a +12
HPG				n/a +9

Sort By: Animal Name ▾ ◉ Default ○ Ascending ○ Descending

On EPD Listing Display: ◉ Name ○ Regn.#

* Black Percentile Bands for all Calves born in 2015 (Click for Percentiles)
Red Percentile Bands for all Calves born in 2015 (Click for Percentiles)

Clear Search

Other thoughts

- Be prepared before going to a sale
  - Print out the extra breed information
  - Averages, percentiles, definitions
  - What's the base year
- Don't be afraid to contact breed societies
- Genomics doesn't mean better, just more accurate

CBBC
Canadian Beef Breeds Council

"Prediction is very difficult, especially about the future"

Niels Bohr, Physicist

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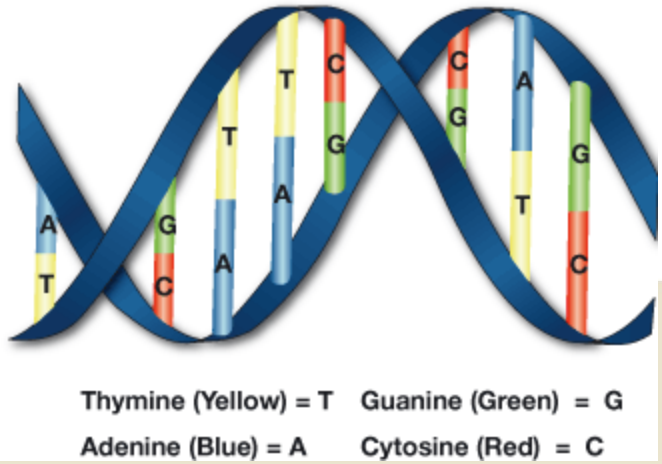
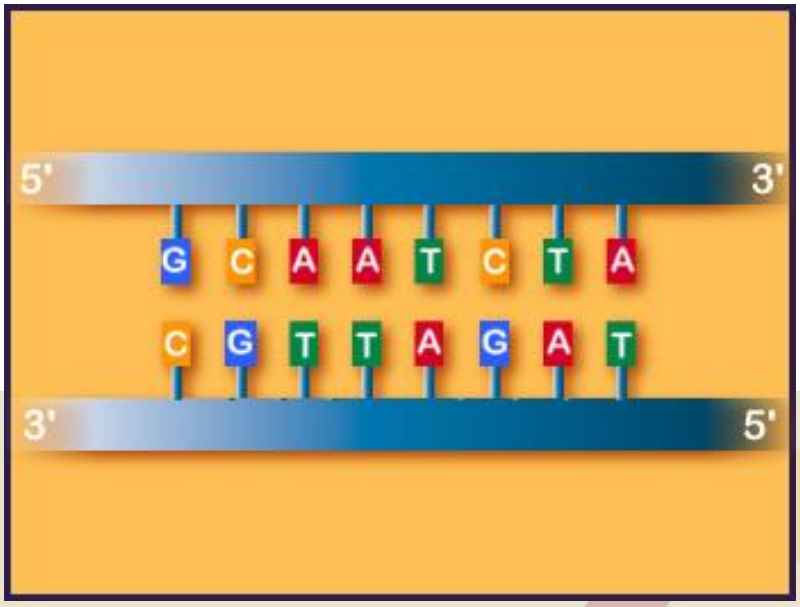
What is Genomics?

- Everyone has a DNA code
- Depending on that code, it will dictate what you will look like, good at sports, musical, etc.
- The code is made up of 4 letters, A, G, C and T and come in pairs





Genomics, DNA, and Markers

- "As easy as ACGT"- the 4 letters of the genetic code

animal 1	A C G **T** A C G T
animal 2	A C G **C** A C G T

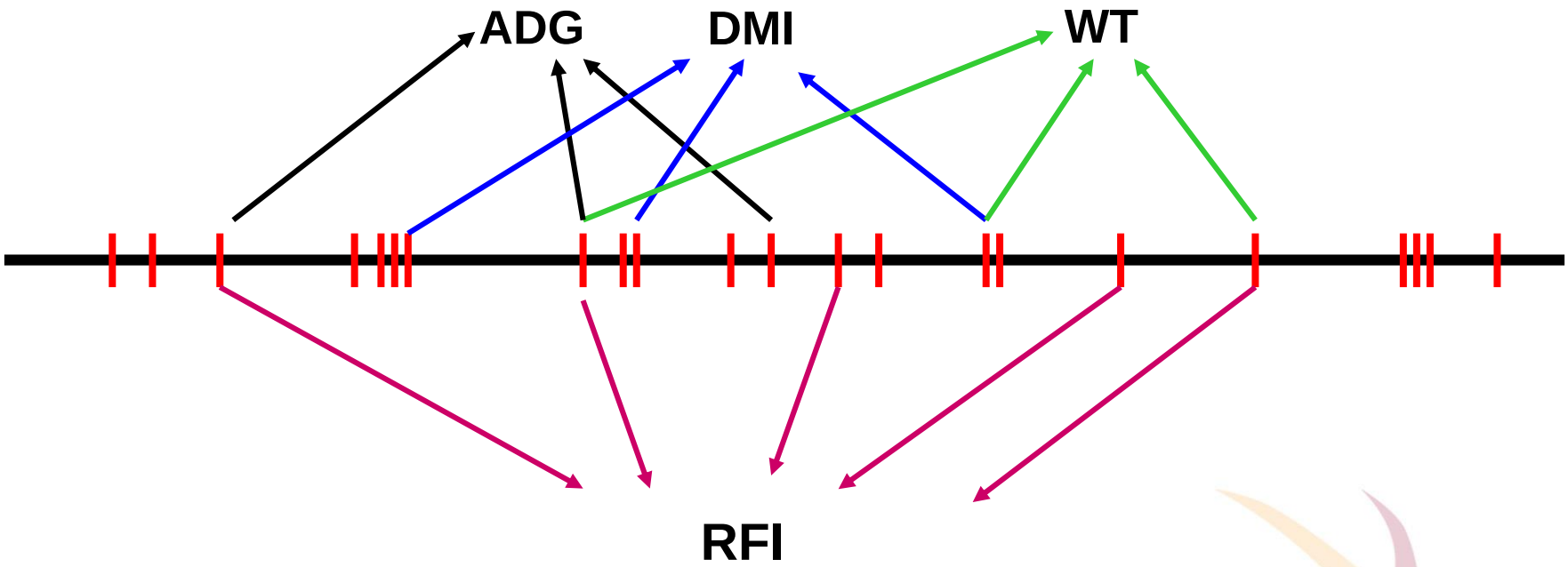
this difference is a Single Nucleotide Polymorphism or "SNP Marker"

Genomics, DNA, and Markers

- Generate or increase accuracies of preditions
- Densities….400 (ca.), 6K, 50K, 770K (genome ~3bn)

Genomics, DNA, and Markers

- Generate or increase accuracies of predictions
- Densities….400 (ca.), 6K, 50K, 770K (genome ~3bn)

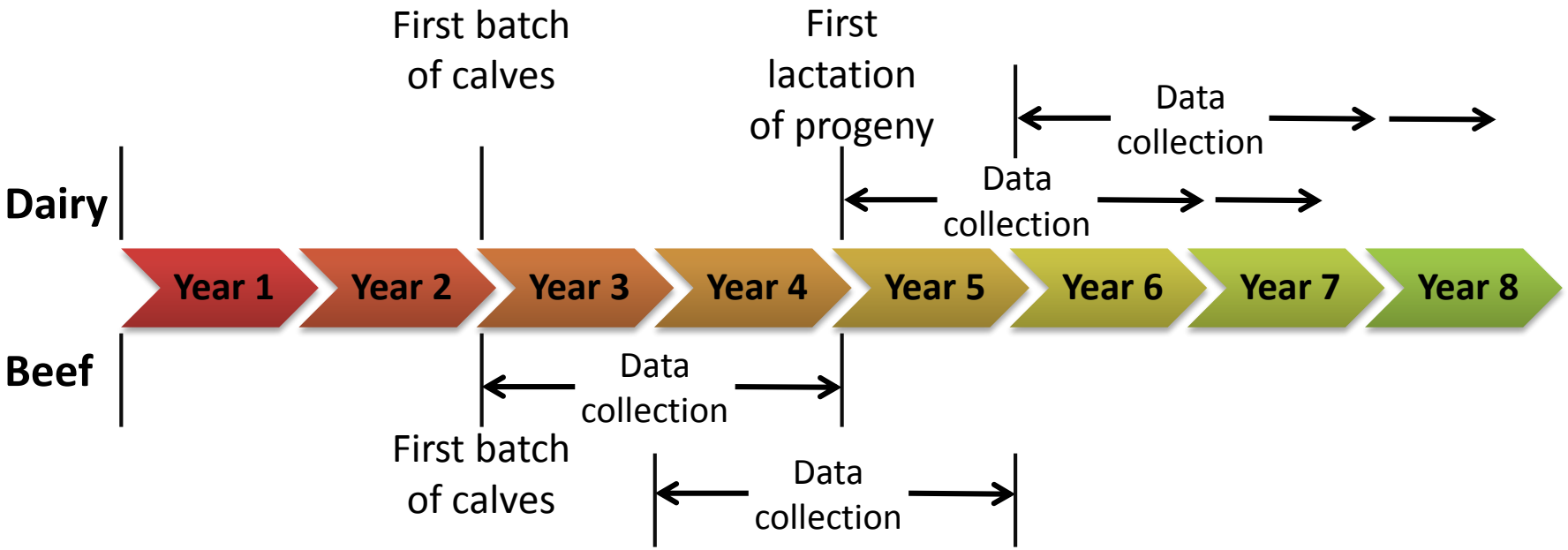


Genomics' Influence

$$\Delta G = \frac{i \cdot r \cdot \sigma_a}{L}$$

Where;
ΔG is genetic gain
i is selection intensity
r is selection accuracy
L is generation interval
σ_a is genetic SD

Genomics' Influence



Genomics' Influence

Also

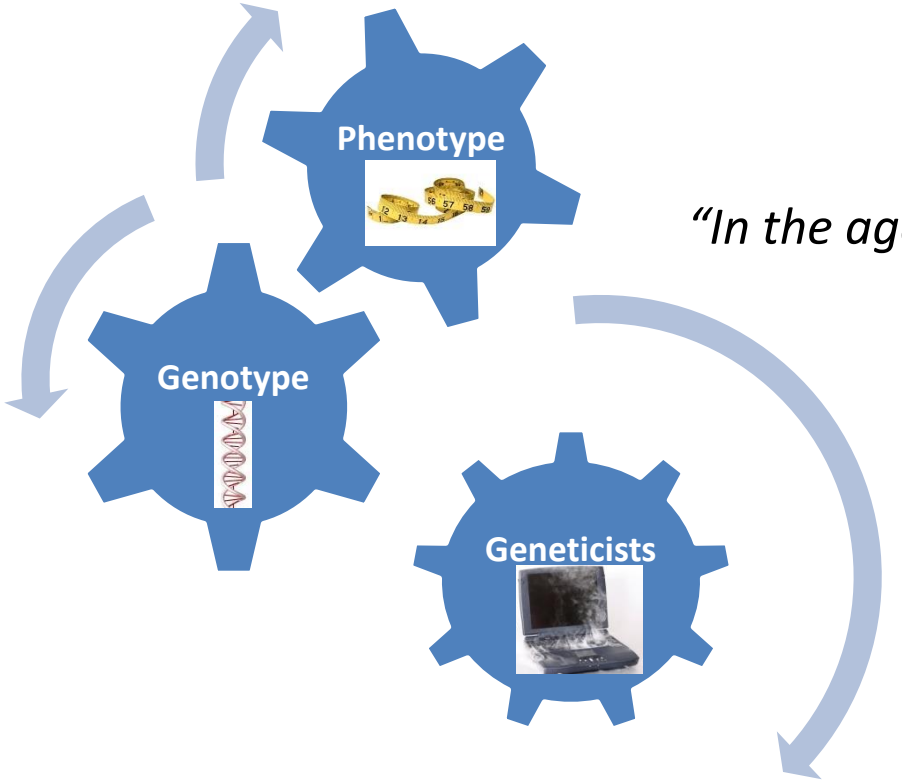
- Difficult to measure traits
- Sex limited traits
- Expensive to measure traits
- Terminal traits

Potential uses of Genomics

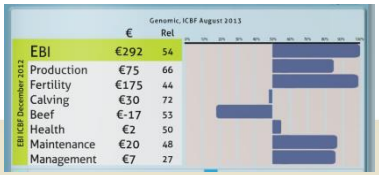
Use	Seedstock	Commercial	Feedlot	Packer
DNA Assisted Selection	✓	✓		
Parentage	✓	✓		
Recessive Allele Testing	✓	✓		
Control of Inbreeding	✓	✓		
Mate Selection	✓	✓		
DNA-based Management	✓	✓	✓	
DNA-based Purchasing			✓	✓
Product Differentiation				✓
Traceability				✓

Source: Van Eenennaam, 2012

Phenotypes…they're important!



"In the age of the genotype, phenotype is king"
Mike Coffey, SRUC



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Phenotypes…they're important!

- Canadian Agriculture Adaptation Project
  - Genotyping
  - 50% matched
- Breed Improvement
- BioBank
  - Collating and cataloguing samples
  - Strategizing their future storage

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Acknowledgments

CBBC
Canadian Beef Breeds Council

Alberta Innovates Technology Futures

Alberta Innovates Bio Solutions

GenomeCanada

ALMA
Alberta Livestock and Meat Agency Ltd.

Agriculture and Agri-Food Canada

Alberta Agriculture and Forestry

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Questions?

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