



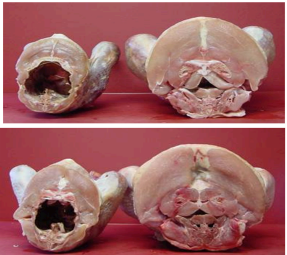
Sorting Through the Science, Marketing, and Realities of DNA Tools for Genetic Prediction

Milt Thomas, J. E. Rouse Chair

GENETIC IMPROVEMENT IN TURKEYS

RBC 1966 Modern 2003

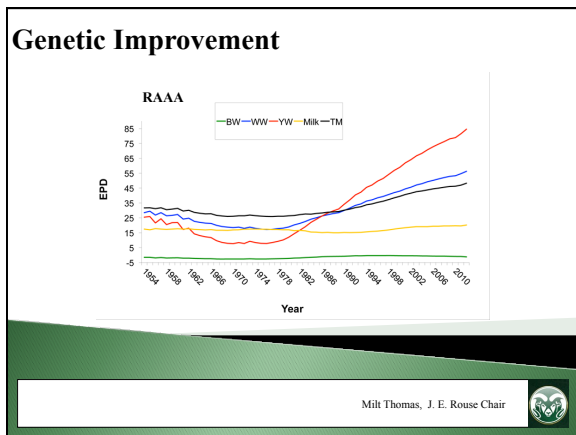


112 days

Havenstein and Qureshi, 2004

196 days

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SNP

Single nucleotide polymorphism

AGCT

TCTA

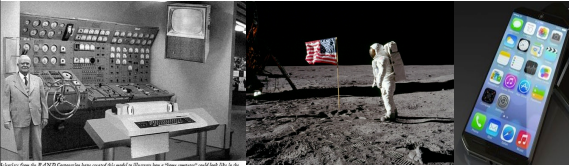
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Outline:

- I. Why genomics.
- II. What does a gEPD Program look like.
- III. Evolution of DNA technology (NexGen).
- IV. How do we keep up with advancing technology.

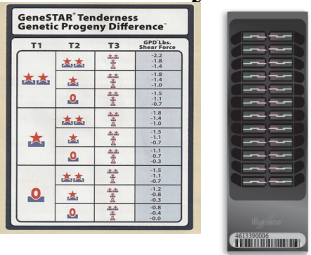
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Why Genomics



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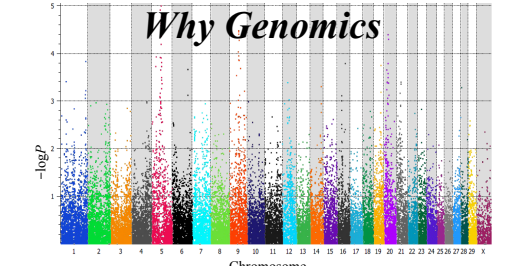
Why Genomics



	T1	T2	T3	Overall SNP Effect
1	1.8	1.2	1.5	1.5
2	1.5	1.0	1.2	1.2
3	1.2	0.8	1.0	1.0
4	1.0	0.6	0.8	0.8
5	0.8	0.4	0.6	0.6
6	0.6	0.2	0.4	0.4
7	0.4	0.0	0.2	0.2
8	0.2	-0.2	0.0	0.0
9	0.0	-0.4	-0.2	-0.2
10	-0.2	-0.6	-0.4	-0.4
11	-0.4	-0.8	-0.6	-0.6
12	-0.6	-1.0	-0.8	-0.8
13	-0.8	-1.2	-1.0	-1.0
14	-1.0	-1.4	-1.2	-1.2
15	-1.2	-1.6	-1.4	-1.4
16	-1.4	-1.8	-1.6	-1.6
17	-1.6	-2.0	-1.8	-1.8
18	-1.8	-2.2	-2.0	-2.0
19	-2.0	-2.4	-2.2	-2.2
20	-2.2	-2.6	-2.4	-2.4
21	-2.4	-2.8	-2.6	-2.6
22	-2.6	-3.0	-2.8	-2.8
23	-2.8	-3.2	-3.0	-3.0
24	-3.0	-3.4	-3.2	-3.2
25	-3.2	-3.6	-3.4	-3.4
26	-3.4	-3.8	-3.6	-3.6
27	-3.6	-4.0	-3.8	-3.8
28	-3.8	-4.2	-4.0	-4.0
29	-4.0	-4.4	-4.2	-4.2
30	-4.2	-4.6	-4.4	-4.4
31	-4.4	-4.8	-4.6	-4.6
32	-4.6	-5.0	-4.8	-4.8
33	-4.8	-5.2	-5.0	-5.0
34	-5.0	-5.4	-5.2	-5.2
35	-5.2	-5.6	-5.4	-5.4
36	-5.4	-5.8	-5.6	-5.6
37	-5.6	-6.0	-5.8	-5.8
38	-5.8	-6.2	-6.0	-6.0
39	-6.0	-6.4	-6.2	-6.2
40	-6.2	-6.6	-6.4	-6.4

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Why Genomics




Supplement Figure 6. Whole genome analysis of LM area in Brangus heifers (n=874). Each spot represents the SNP effect on BovineSNP50.

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Evolution of EPD models for beef cattle:

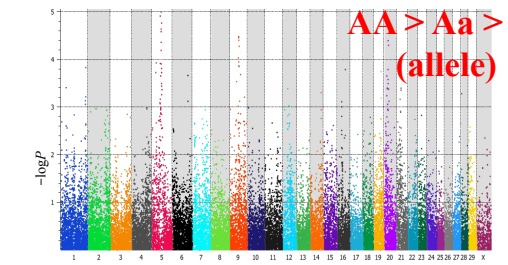
1. Animal (pedigree)
2. Multi-trait
3. Multi-breed
4. gEPD (genome enhanced)
 - a. Molecular breeding value
 - b. Genomic relationship matrix

± Value (accuracy)



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Why Genomics




Supplement Figure 6. Whole genome analysis of LM area in Brangus heifers (n=874). Each spot represents the SNP effect on BovineSNP50.

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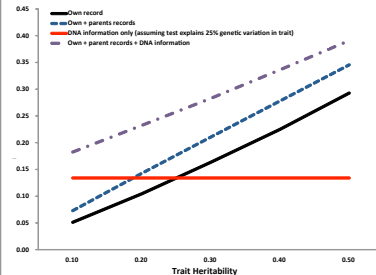
Molecular Breeding Value Procedure

REA EPD = [Pedigree] + uREA + cREA + Ywt + MBV + etc.



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EPD accuracy and Genomic information



(J. Anim. Sci. 89:307-320, 2011).

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Genomic Relationship Matrix Procedure

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Reliability Gain¹ by Breed Using bovineSNP50 Data

Yield traits and NMS of young bulls

Trait	HO	JE	BS
Net merit	24	8	3
Milk	26	6	0
Fat	32	11	5
Protein	24	2	1
Fat %	50	36	10
Protein %	38	29	5

¹Gain above parent average **reliability ~35%**
 Notes: suggest reduce time frame for sire-proof from 5 or 6 years to 1 and increase rate of genetic improvement 2x.

Slide from Dr. Paul Van Raden, USDA-ARS, **AIPL**, Beltsville, Maryland

Model for gEPD Program

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Evolution of DNA Technology and Status of Ruminant Genome Sequence and Tools

Item	Cow	Sheep	Goat	Yak
Reference genome	✓	✓	✓	✓
Additional animals sequenced	✓	✓		
50K SNP-chip	✓	✓	✓	
HD SNP-Chip	✓			
Other SNP-Chips	✓			

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Evolution of DNA Technology

New SNP-Chips, etc.

- I. BovineSNP50, Illumina
- II. BovineSNPHD, Illumina
- III.3K
- IV.9K (LD-Illumina)
- V. 9K + add-ons (Super GGP for *Bos indicus*)
- VI.GGPt (80K; ~28K from SNP50 and 50K from HD)
- VII.GGPi
- VIII.Custom (ladder vs tagSNP vs Function).
- IX.Etc.

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Imputation:

Genomic-polygenic evaluation of multibreed Angus-Brahman cattle for feed efficiency and postweaning growth using actual and imputed Illumina50k SNP genotypes. M. A. Elzo, M. G. Thomas, et al., 2013. *Additive genetic variances explained by the 50K actual and imputed SNP were 0.46 for RFI, 0.36 for DFI, 0.47 for FCR, and 0.28 for PWG. These fractions were 3.0, 3.2, 1.9, and 1.8 times larger than those obtained for these 4 traits using the 3K SNP.*


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Beneficial use of DNA technology will primarily be for genetic improvement of *traits difficult to measure*:


- a. Feed efficiency
- b. Fertility
- c. Health traits
- d. Grazing distribution
- e. Consumption traits
- f. etc.

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Evolution of DNA Technology
More Whole Genome Sequence to find advantageous alleles!




= ~\$50 million



< \$5,000

<http://www.1000bullgenomes.com/>

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Keeping-up with New Technology

1. Continue to learn!

- a. BIF: Advancements in Emerging Technology
- b. 23andme <https://www.23andme.com/>

- 1 Get your kit in the mail 
- 2 Provide saliva sample 
- 3 Log in, and learn about yourself 


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Keeping-up with New Technology

1. Continue to learn!

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2. Understand infrastructure is needed for big data management.

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Keeping-up with New Technology

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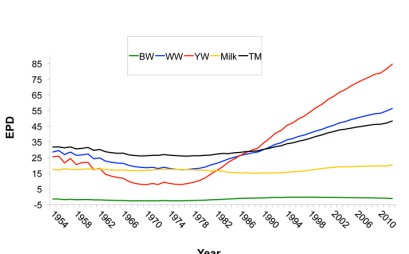
2. Understand infrastructure is needed for big data management.

3. Build partnerships and invest in research for translation!

- 150,000,000
- 500,000,000
- 5,000,000,000
- 50,000,000,000

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RAAA



Genetic Improvement includes Big Data!

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