Marker Assisted Selection – Current and Future Applications

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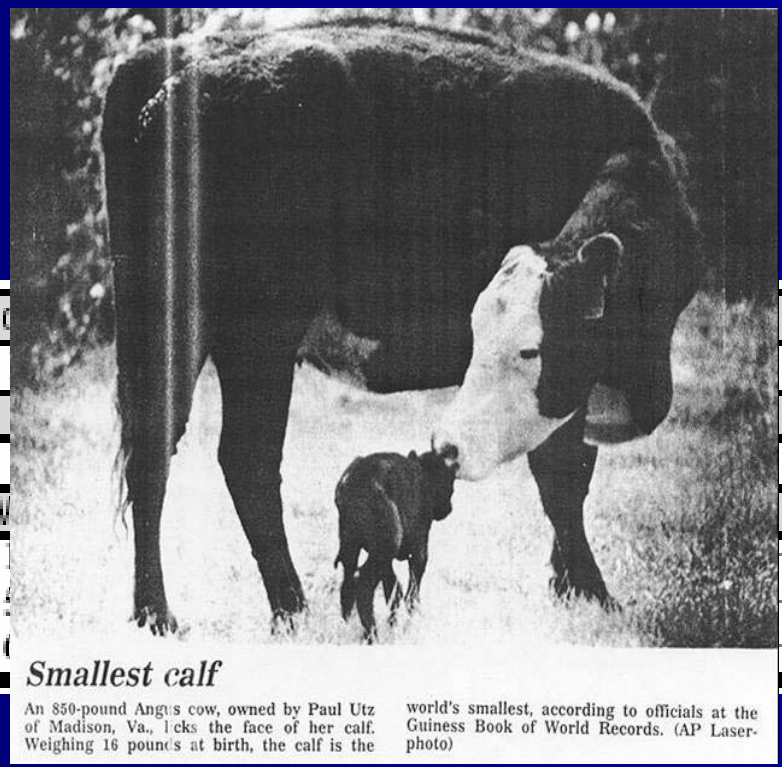
Overview

- Introduction to DNA
- Introduction to marker-assisted selection
- Traits that are suited to marker-assisted selection
- DNA tests currently on the market
- Should I use marker-assisted selection ?

Typical EPD Genetic Evaluation

- Birth Weight
- Weaning Weight
- Yearling Weight
- Milk
- Scrotal
- %IMF
- REA
- %RP
- a mix of others

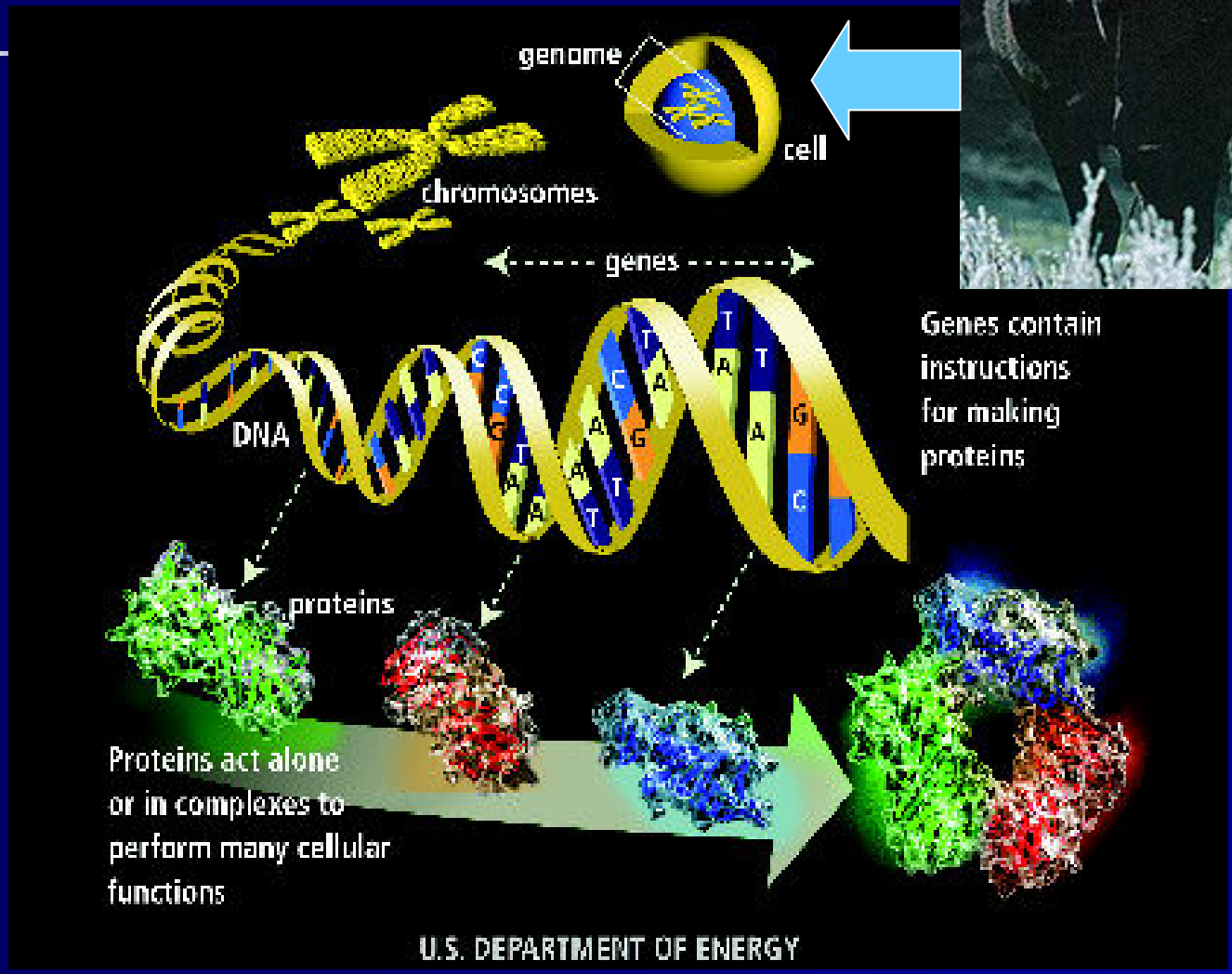
Birth Wt.	Co	Test Index	
79		106.0	
Final Wt.		Conf. Score	
1161		87.5	
EPDs	BW	REA	%RP
Individual	+3.	+.36	-.23
Sire	+2.	+.71	+.44
DAM	+3.	+.04	-.09



Smallest calf

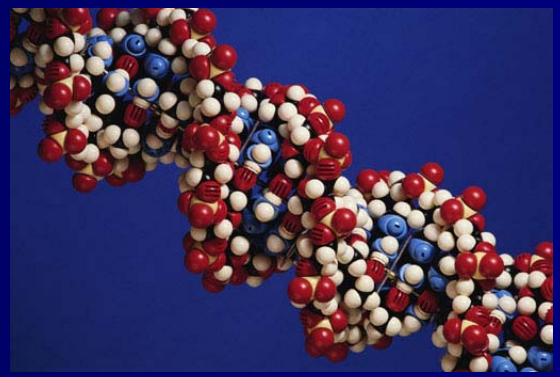
An 850-pound Angus cow, owned by Paul Utz of Madison, Va., licks the face of her calf. Weighing 16 pounds at birth, the calf is the world's smallest, according to officials at the Guiness Book of World Records. (AP Laserphoto)

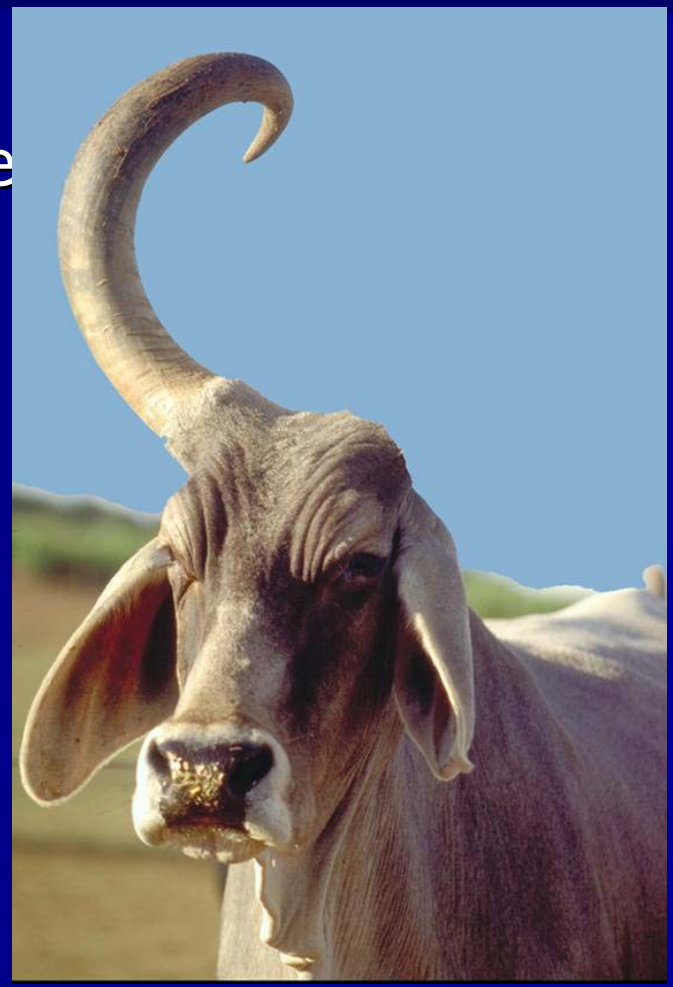
DNA backgrounder



Simple (qualitative) traits

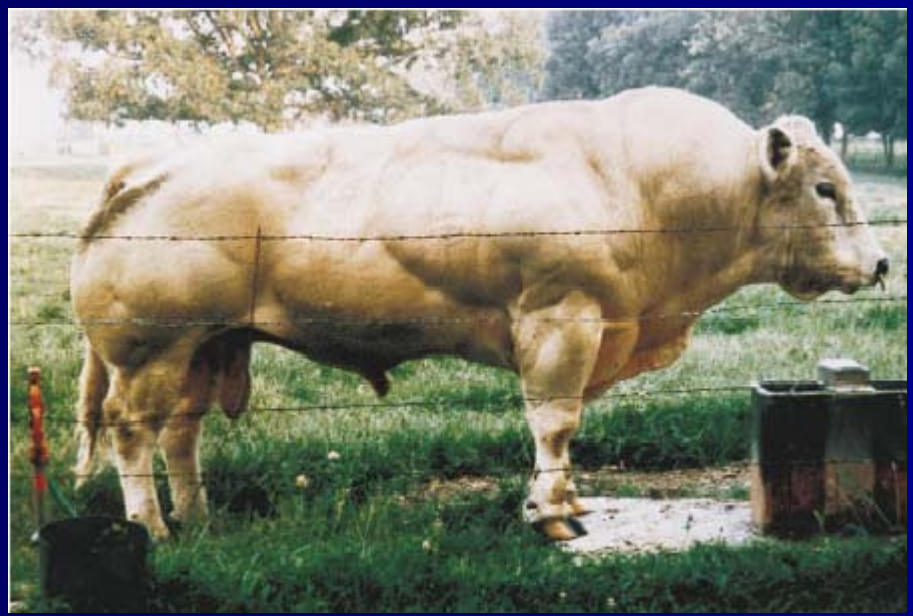
- Genotype = phenotype
  - Gender (XY = male, XX = fe
  - Coat color
  - Certain genetic diseases
  - Double muscling
  - Horns





Double muscling example

MM homozygote	Mm heterozygote	mm homozygote
Normal phenotype	Normal phenotype	Double muscled phenotype

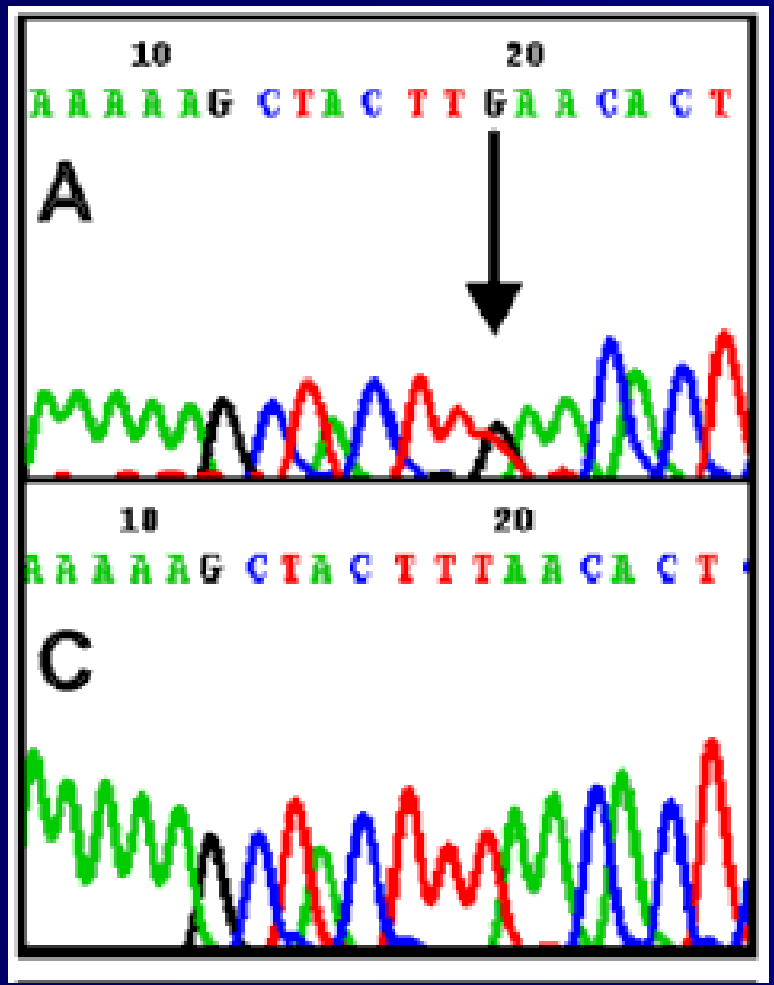


Phenotype = double muscled

Genotype = mm

Proc. Natl. Acad. Sci. USA. 1997 94:12457–12461

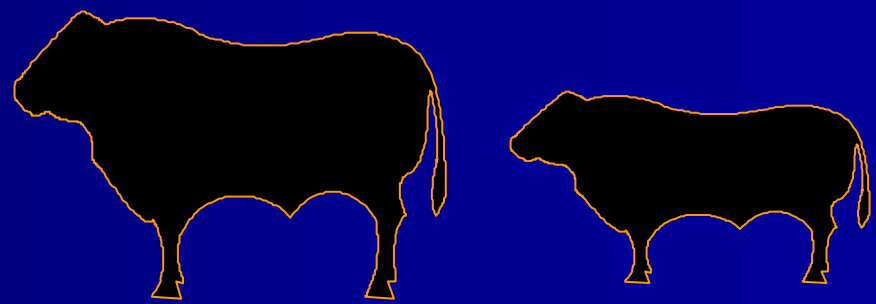
Genotyping



Heterozygous bull

½ ½

TTGAA **TTTAA**



Complex (quantitative) traits

Genotype

Environment

Phenotype

Marker-assisted selection

Marker-assisted selection works best for traits with

- **low heritability** (influence that genetics rather than environment has on a trait)
- **are difficult or expensive to measure** (disease resistance)
- **cannot be measured until after selection has occurred** (carcass data)
- **are currently not selected for due to lack of available phenotypic data** (tenderness)

Traits most likely to benefit from MAS (descending order)

- disease resistance,
- **carcass quality and palatability attributes**,
- fertility and reproductive efficiency,
- maintenance requirements
- carcass quantity and yield,
- milk production and maternal ability, and
- growth performance.

DNA tests on the market

Name	Trait	Desired Genotype	
GeneSTAR®	Quality	****	
GeneSTAR®	Tenderness	****	
Igenity™ *Tender*GENE	Tenderness	UoGCAST1	CC
		µ-calpain "4751"	CC
		µ-calpain "316"	CC

Which would you rather have???

- A bull that is 'homozygous' for a positive genetic variant with a trait EPD of +3, or

- A bull carrying no copies of that genetic variant with a trait EPD of +3

Both are important!!

- The 'homozygous' bull is a source of favorable form of the genetic variant. Can eventually be used to create homozygous calves
- The other bull contributes other favorable genes, which will improve the other genes affecting the trait.
- Breeding the marker-associated form of the gene into the bull that has no copies should improve the trait by combining all of the good forms of the genes together in one animal

Selection for Marbling

Progeny from Angus bulls with high (>.4) and low (< -0.16) EPDs for marbling were compared. 74% of high offspring graded choice versus 47% of low EPD offspring.

Vieselmeyer, B. A., R. J. Rasby, B. L. Gwartney, C. R. Calkins, R. A. Stock, and J. A. Gosey. 1996. Use of expected progeny differences for marbling in beef: I. Production traits. J Anim Sci. **74**:1009-1013.

Selection for Tenderness

SHOULD I USE MAS ?

SHOULD I USE MAS ?

1) can you ***make money*** by using MAS ?
2) what is likely to be the effect of the "marker" ***in your herd*** ? (gene frequencies, effect size)
3) ***What are you giving up*** to use animals that are carrying the marker of interest?
4) Could good progress in that trait be achieved ***without the expense of marker assisted selection*** (i.e. using EPDs)?
5) ***Herd sires and donor females*** will be the most likely candidates for the tests initially

Parting thoughts

- Markers are not a replacement of EPDs
- Good genetics will never overcome poor management (environment)
- MAS is likely to accelerate genetic progress in some traits better than others
- Ensure you weigh the cost and benefits of using MAS in your production system just as you would with any other input

Questions ?