

This webinar will begin shortly .....

## Utilising DNA to Change Type Traits



Presented by:



Philip Mann



Andrew Byrne



John Henshall

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## “Know Your Genes”

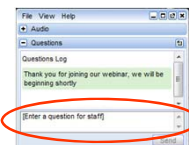
- A course discussing the application of DNA based technologies within a beef seedstock operation

Date	Topic
June 20th	DNA Technology – Understanding the Basics
June 27th	Utilising DNA for Parentage Verification
July 4th	Managing Genetic Conditions with DNA
July 11th	Utilising DNA to Change Type Traits
July 18th	Improving Production Traits with DNA
July 25th	Assessing the Cost – Benefit of DNA Technology



## Housekeeping

- To ask the presenter questions – Simply type your question into the “Questions” field and “send”.
- If your questions box disappears, click the two arrows to get it back.



## In this session, we will :

- Outline what we mean by “type traits”
- Discuss the genetics of coat colour and what DNA tests are available
- Discuss the genetics of polledness and what DNA tests are available



## What Do We Mean By “Type Traits”

- Those traits in which there is a sharp distinction between phenotypes and where only one or few pairs of genes are involved in the expression of the traits
- Also referred to as qualitative traits
- In this presentation, we are specifically referring to:

### Coat Colour



### Polledness



## Understanding the Genetics Behind Type Traits

- Remember 30 pairs of chromosomes – inherit one from sire and one from dam. Therefore, inherit two copies of each gene.
- Genes come in different forms called “alleles”.
- When an animal inherits two identical alleles – Homozygous  
When an animal inherits two different alleles – Heterozygous
- In Heterozygous animals, expression of trait determined by interaction between alleles  
Dominant v Recessive
- Leads to what we call “carrier” animals



## The Genetics of Coat Colour



## The Genetics of Coat Colour

- Three basic colours in beef animals
  - Black
  - Red
  - Reddish Brown to Brownish Black (Brown)
- All other colours are caused by other genes acting on these three basic colours (known as epistasis)
  - Spotting (Whiteface, Dorsal Stripe, Spotted, Solid Coloured)
  - Dilution (White, Cream, Fawn, Skunk Tail)
  - Roaning
  - Brindle



## The Genetics of Coat Colour

- The three basic colours are controlled at the “extension locus”
- Three possible alleles
  - Black ( $E^D$ )
  - Red ( $e$ )
  - Wild Type ( $E^+$ )
- Black is dominant to other two alleles
  - Black animals –  $E^D E^D$ ,  $E^D e$ ,  $E^D E^+$
  - Red animals –  $ee$ ,  $eE^+$
  - Other –  $E^+ E^+$  (rare - can be any colour)



## Mating Combinations (Black Animals)

		Black		Black	
		$E^D$	$E^D$	$E^D$	$E^D$
B l a c k	$E^D$				
	$E^D$				
B l a c k	$e$				
	$e$				

		Black	
		$E^D$	$e$
B l a c k	$E^D$		
	$e$		

- Can substitute “e” for wild type in the above



## Mating Combinations (Red Females)

		Black		Black	
		$E^D$	$E^D$	$E^D$	$e$
R e d	$e$				
	$e$				

- Remember other genes can interact with these alleles
- Generally black is dominant though



## DNA Tests for Coat Colour

- Historically, only way to identify underlying genotype was progeny testing
- Now some DNA tests available to determine genotype at the “extension locus”
  - Differentiation between Homozygous & Heterozygous Black animals
  - Investigation of incidence of “wild type” allele
- Available from:
  - University of Queensland (Red Factor / Dominant Black)
  - Pfizer Animal Genetics (GeneSTAR Black)
  - Several Overseas Labs

➤ Indicative cost : \$30



## The Recording Process

- Contact your Breed Society or the DNA lab for a DNA Collection Kit
- Collect DNA samples
- Complete the required forms
- Mail form plus DNA sample to lab
- Wait for results to be returned



## Questions



## The Genetics of Polledness



## The Genetics of Polledness

- Several genes involved
  - Polled (Chromosome 1)
  - Scurs (Chromosome 19)
  - African horn gene ??
- Many alleles at polled locus
- Polled dominant to horned



- Scurs sex dependent and only expressed when a polled allele present
  - Males – ScSc, Scsc / Females - ScSc



## DNA Tests for Polledness

- The precise location of the polled gene has not been identified
- Several DNA tests available that evaluate genotype at a “linked” gene marker. No gene marker for scurs.
- Companies offering tests
  - University of Queensland (A\$33)  
Beef CRC Developed Test
  - Pfizer Animal Genetics (Not released yet)  
Beef CRC Developed Test
  - Igenity (US\$55)  
Charolais, Gelbvieh, Hereford, Limousin, Simmental, Shorthorn
  - MMI (US\$110)  
Charolais, Gelbvieh, Hereford, Limousin, Salers, Simmental



## Why DNA Test for Polledness?

		Polled	
		P	P
H o r n s	h		
	h		

		Polled	
		P	h
H o r n s	h		
	h		

		Polled	
		P	P
P o l l e d	P		
	h		

		Polled	
		P	h
P o l l e d	P		
	h		

Enables you to dehorn your herd more quickly .....



## The Beef CRC Developed Test

- Developed for *Bos indicus* cattle
- Identifies genotype at a linked marker
- At marker locus, many alleles present:
  - Some always associated with polled
  - Some always associated with horned
  - Some associated with both polled and horned  
Referred to as “ambiguous alleles”
- Frequency of ambiguous alleles varies between breeds and determines how useful the test is. Also some inconsistencies in phenotype.



## The Beef CRC Developed Test



- Three sources of validation data

Table 1 - Counts of animals tested from each group (experimental population, industry sire or breeder submitted) for each phenotype (horned, scurred and polled) by breed.

Breed	Experimental Population			Industry Sires			Breeder Submitted		
	Horned	Scurred	Polled	Horned	Scurred	Polled	Horned	Scurred	Polled
Brahman	180	136	86	84	0	5	9	8	116
Brangus	32	27	37	0	0	0	0	0	0
Charolais	0	0	0	57	3	36	0	0	0
Droughtmaster	33	22	39	24	16	60	0	0	0
Hereford	71	27	96	105	0	109	0	0	0
Limousin	22	1	29	64	5	79	0	1	142
Santa Gertrudis	102	31	52	13	1	7	0	1	40
Shorthorn	0	0	0	3	0	105	0	0	0
Tropical Composite	116	47	84	0	0	0	0	0	0
Simmental	0	0	0	60	1	36	0	0	0



## The Beef CRC Developed Test



- Full results available from CRC website  
<http://beefcrc.com.au/PolledGeneMarkerTest>

Table 2 - Results of Field Testing for Animals with a Polled Phenotype

	PP	PH	HH	PA	HA	AA	% Ambiguous	% Inconsistent with Phenotype
Brahman	84	96	4	9	10	4	11%	2%
Brangus	5	9	0	16	2	5	62%	0%
Charolais	13	13	0	8	1	1	28%	0%
Droughtmaster	34	37	1	15	7	5	27%	1%
Hereford	102	44	2	49	4	4	28%	1%
Limousin	59	38	0	102	11	40	61%	0%
Santa Gertrudis	15	60	1	16	6	1	23%	1%
Shorthorn	12	24	0	17	35	17	66%	0%
Simmental	8	12	0	14	0	2	44%	0%
Tropical Composite	43	18	1	21	0	1	26%	2%



## Take Home Messages

- Beef CRC test is not perfect but neither are overseas tests
- Works very well in Brahman
- Shows promise in other breeds
- Need more validation work in many breeds



## Reporting of Results



- No longer reporting definitive genotype
- Test now generates probability of each genotype

Homozygous PP	Heterozygous PH	Homozygous HH
91%	8%	1%

- University of Queensland now reporting probability of homozygous polled as standard



- Pfizer reporting most likely genotype and probability



## The Recording Process

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## Questions



## Housekeeping

- Feedback on tonight's webinar – Poll
- Following the completion of the webinar:
  - The webinar will be made available for viewing from the SBTS & TBTS websites
  - A copy of the slides will be emailed to you
  - You need to register for next week's webinar if you haven't already
  - You can access answers to any of your unanswered questions by contacting the technical officer for your breed



## For Further Information Contact:

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