

The Australian Poll Gene Marker test

Frequently Asked Questions (FAQ)

The new Australian Poll Gene Marker test has been developed and tested for use in Australian commercial cattle populations.



- Works very well in Brahman
- Shows promise in other breeds
- Needs more validation work in many breeds

“In the last six years or so the breed has certainly seen premiums for polled bulls at auction sales and we get a lot of requests for polled bulls in our paddock sales. The frequency of the polled gene is still low in Brahmans, so I believe that anyone who wants to make genetic progress for polled will be valuing a homozygous poll. Without this test we have no confidence in whether an animal is a homozygote or a heterozygote.”

Sarah Streeter, whose family's Fairy Springs Brahman Stud near Bowen, QLD, has been selecting for polledness for the past 15 years.

“I have always dipped into the horned Hereford gene pool because it's around 50% of the total Hereford population. My client base generally prefers non-scurred bulls. We've always wanted to identify carriers of horns. At this stage the CRC test is working a treat for what I want.”

Ian Locke, of Wirruna Poll Hereford stud in southern NSW, took part in the Beef CRC and MLA trials. Up until now Mr Locke has tested about 15% of his sale bulls. In his most recent sale a few buyers competed strongly for a number of tested homozygous polled bulls, and the premium paid was sufficient to pay for the next calf crop's tests.



What is the Australian Poll Gene Marker test?

The Beef CRC and its collaborators have recently completed industry testing in commercial cattle herds to measure the effectiveness of a new **Australian Poll Gene Marker test** that has been developed for Australian herds.

The new gene marker was developed by the Beef CRC in partnership with CSIRO, MLA the UNE Animal Genetics and Breeding Unit and the University of Queensland Animal Genetics Laboratory.

The test aims to identify whether cattle are “true polled”. Some visibly polled animals may still carry a recessive gene

for the horned trait and throw a proportion of horned offspring. This mixed heterozygous genotype is also associated with scurs, which are incomplete horns.

A true polled animal is “homozygous” – it carries a double copy of the poll gene and in most cases, will not throw horned offspring. It is valuable for breeders and producers to have the tools to help predict the horned trait in their herds.

It is important to understand a result from a laboratory for the **Australian Poll Gene Marker test** will come with an accuracy percentage figure associated with it. The percentage of accuracy will vary for each animal tested.

How is the data presented to producers?

The Beef CRC's **Australian Poll Gene Marker test** generates the probability of the sample being one of three categories:

1. Homozygous PP (true-polled)
2. Heterozygous, PH (carrier of horns) or
3. Homozygous HH (horned animal)

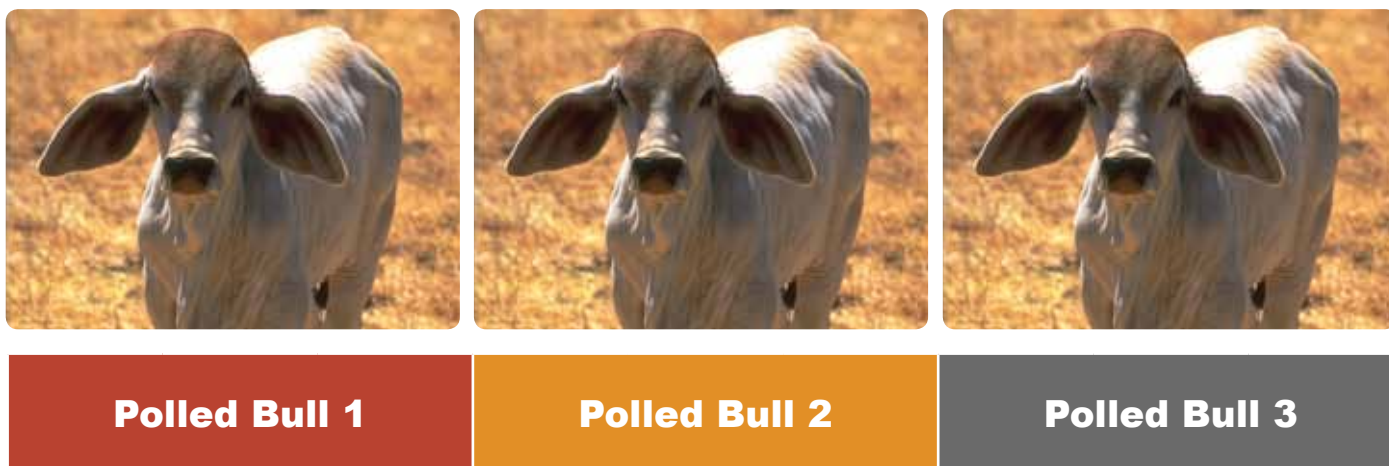
In Brahman cattle, the test returned a result 89% of the time.

Table 1 provides 3 examples of test results for the Australian Poll Gene Marker test which the University of Queensland Animal Genetics Laboratory would provide to producers and breeders who submit a DNA sample for testing.

The test has been made available to commercial providers and different organisations, who may present results in a different format to the example results presented here.



Table 1: Example results for the Beef CRC's Australian Poll Gene Marker test

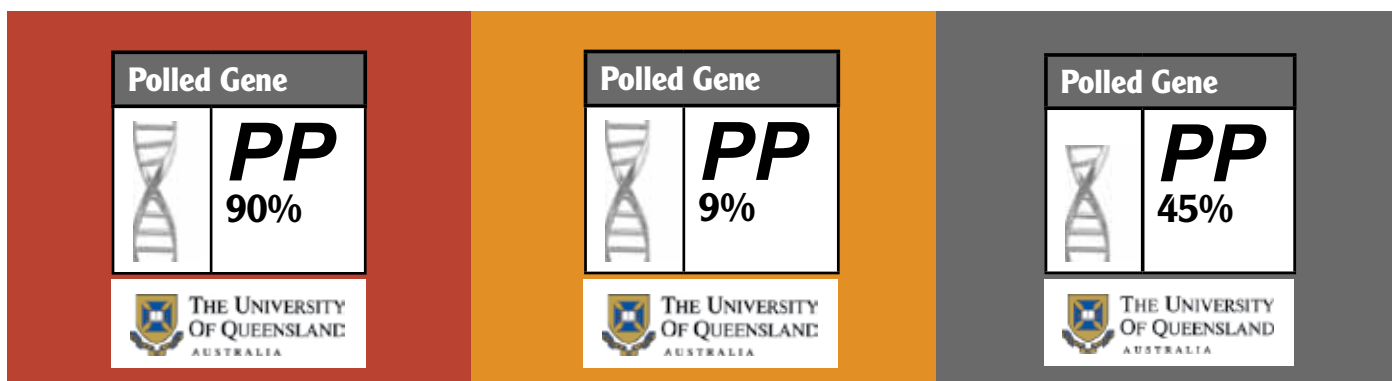


Polled Bull 1 **Polled Bull 2** **Polled Bull 3**

The test produces these results:

Homozygous PP	Heterozygous PH	Homozygous HH	Homozygous PP	Heterozygous PH	Homozygous HH	Homozygous PP	Heterozygous PH	Homozygous HH
90%	9%	1%	9%	90%	1%	45%	45%	10%
<p>The test identifies that the bull is "True-polled" with 90% accuracy.</p>			<p>The test identifies with 90% accuracy that although Polled Bull 2 does not have horns himself, he is a carrier of the horns.</p>			<p>The test does not provide a useful result. It informs you that while the bull is polled, there is equal probability of the animal being either true-polled or a carrier of horns</p>		

The breeder will receive the following certificate from The University of Queensland Animal Genetics Laboratory:



Note: Other commercial providers may present the same results differently.

How the genetics works

Animals inherit half their genes from their sire and half their genes from their dam. The combination of these genes contribute to the animal's horn status.

In many breeds polled is usually dominant to horned so even though an animal is polled it could still be carrying a horned allele. An animal could have one of these three genotypes:

Table 2: Polled genotypes and phenotype descriptions

Genotype	Phenotype	Description
PP (homozygous) True polled	Polled	The animal carries two copies of the dominant polled gene alleles and throws predominantly polled calves.
PH (heterozygous)	Polled and scurred	The animal may be polled, scurred or horned, depending on breed.
HH (horned)	Horned	The animal possesses a double copy of the recessive gene alleles and will throw horned calves.

For polled animals it is impossible to differentiate between true polled and polled carriers without genetic testing or pedigree information such as extensive progeny testing.

The Beef CRC's **Australian Poll Gene Marker test** is based on a marker that is linked to the polled gene. It is not perfect, but it does provide a reliable prediction for breeders in many instances.

Why is the test not 100% accurate?

This is a gene **marker** test, not a test for the gene itself. While some of the marker results are nearly always associated with polled and some of the marker results are nearly always

associated with horned, there are also some **ambiguous** marker results for which the association between polled and horned cannot be determined.

This occurs when alleles, that is, one of a pair located at a specific location on a specific chromosome, are unable to be assigned definitively to either polled or horned status. These ambiguous alleles occur at different rates amongst different breeds.

In the research populations and industry trials in commercial populations, the Brahman samples tested recorded a very low frequency of ambiguous results (11%), which is a good result for the breed. It means that during the industry testing phase the new Australian poll gene test could provide a result 89% of the time for polled cattle.

“In breeds where ambiguous alleles are uncommon the test can be used now, and will allow producers to choose between homozygous polled and heterozygous polled bulls resulting in a shift in the population from horned to polled.”

Dr John Henshall, CSIRO Livestock Industries,
Beef CRC poll gene research leader

Gene markers and probabilities

It is never assume that an association between a gene marker allele and an allele at the polled locus is complete: we allow a small probability for the alternative association. Consequently results for the marker test are presented as probabilities, and that probability is never 100%. For example: if an animal carries two copies of a marker allele that we believe to be associated with a polled allele at the polled locus 95% of the time, then we report that the probability of being genetically homozygous polled as 90% (as $0.95 \times 0.95 = 0.9025$). If instead the animal carried one copy of that marker allele and one copy of an ambiguous marker allele that we believe to be associated with a polled allele at the polled locus only 50% of the time, then we report that the probability of being genetically homozygous polled as 48% (as $0.95 \times 0.5 = 0.475$).

How does the test perform across breeds?

To validate the **Australian Poll Gene Marker test**, the Beef CRC and MLA worked in collaboration with the Animal Genetics Laboratory at the University of Queensland and industry to test a total of approximately 1800 additional samples representing most breeds in an industry validation study.

This is in addition to the 1270 samples that were part of the earlier research populations.

In **Brahman** and **Hereford** cattle there is a large sample size from many sources, a good balance between polled and horned, and a clear majority of polled animals tested return an unambiguous result. Few horned animals carry the marker alleles we associate with polled and few polled animals carry the marker alleles we associate with horns. These conclusions also apply to **Droughtmaster**, however there are fewer records for this breed.

The Beef CRC test could provide a result 89% of the time for polled Brahman samples. The industry validation has replicated the results found in the discovery population for this breed and the Beef CRC feels confident the test can be used in Brahmans.

For **Charolais** and **Simmental** we have only a relatively small number of records, but from a reasonable number of studs. The proportion of ambiguous alleles is high but there is good evidence that in these breeds most if not all ambiguous alleles could be called as being associated with horns, suggesting that the test may be of value in Charolais and Simmental. In both breeds we require additional records to confirm the associations.

In **Santa Gertrudis** and **Tropical Composite** cattle a clear majority of polled animals tested return an unambiguous result, but data are from a limited range of studs so more data are required to confirm that these results can be generalised to the wider breed populations. Additional data may also confirm that alleles currently classed as ambiguous may in fact be reliably used to predict a horn genotype in these breeds. Additional data are also required to establish why alleles that in other breeds are almost always associated with polled are in Tropical Composite cattle often associated with horns.

For **Shorthorn** the proportion of unambiguous results is relatively low. It may be that alleles currently classed as ambiguous may in fact be reliably used to predict poll genotype in Shorthorn, but confirming this would require more samples from horned animals to supplement the 3 horned samples currently available.

For **Brangus** and **Limousin** the proportion of unambiguous results is relatively low, and unless augmented with additional data (for example, additional markers or progeny test data), this test has limited ability to predict genotype.



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Results of the Beef CRC poll gene testing in commercial herd

Table 3: Industry validation trials of 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	15	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%

This table presents data only from the polled animal samples submitted for testing in the validation trials in commercial cattle populations – it does not contain any of the data for testing in the research population, or any data from horned animals tested. The Beef CRC poll gene test has been developed as a tool to use in polled animals to help identify True-polled and heterozygous genotypes.

The importance of not selecting for a single trait

Breeders have raised concerns about undesirable changes in other important traits when the focus is on selection for a single trait, and where for some breeds there is a limited number of genetically similar true polled bulls available. However as with all selection decisions, breeders need to continue to select bulls based on their overall breeding objectives using subjective assessment for soundness and non-subjective tools including EBVs and genetic markers where relevant for the best outcomes.

How do I test my animals?

1. Contact your Breed Society or the DNA lab for a biological sample collection kit
2. Receive a Collection Kit
3. Collect hair sample
4. Complete the required forms
5. Mail form plus hair sample to lab
6. Wait for results to be returned.

Industry case study :

Why I like polled beasts

“There are two main reasons why I like polled cattle. You can fit an extra two beasts on each truck deck; that equates to a considerable saving in freight costs. It’s also much safer for people handling the cattle. You might get a few bruises from a polled bullock, but you won’t get gored. I previously selected polled heifers and bulls in preference to cattle with horns. But that has meant a smaller pool of cattle to choose from. This could be why some people think breeding polled cattle negatively affects productivity. But you have to remember that Rome wasn’t built in a day. If you try and eliminate horns over night by selecting only polled animals you could well be losing productivity in other areas. I welcome a test where a producer is told straight away whether a beast is going to produce a calf with horns or not. That will allow us to make our selections much earlier when we have bigger mobs of cattle to choose from.”

Tom Mann, Hillgrove Station, north of Charters Towers, is around 42,500 hectares and carries between 5000 and 8000 head of cattle.



Beef CRC scientists shout Eureka!!

A team of scientists led by CSIRO’s Dr Kishore Prayaga has been awarded a prestigious Australian Museum Eureka Prize for its work to develop a simple genetic test which has the potential to end the need to dehorn cattle in Australia.

Horn removal is a routine practice carried out by beef producers to reduce the incidence of cattle injuring other cattle and their handlers.

About half of Australia’s 21 million beef cows and calves are born with horns. However, dehorning causes short term pain and stress for the animal, is labour-intensive and time-consuming for producers, and can reduce animal weight gain for several weeks following the procedure.

The team, which is funded by the Beef CRC and Meat and livestock Australia (MLA) and involves scientists from CSIRO and Queensland Primary Industry and Fisheries (QPIF), has been researching alternatives to current dehorning practices.

“We have discovered a DNA marker in *Bos indicus* (tropically adapted cattle e.g. Brahman) which identifies the cattle that will produce polled or naturally hornless offspring,” said Dr Prayaga.

“Our aim is to commercialise this work into a simple test, so that cattle producers in the extensive, rangeland conditions in Northern Australia will be able for the first time to increase the proportion of polled cattle in their herd,” he said.

The team has also been working on effective pain reduction and alleviation strategies for producers to use in the meantime.



Acknowledgements

The Beef CRC would like to acknowledge and thank all of those cattle breeders who provided samples and phenotypes for this research and in particular Mr Tom Mann of Hill-grove Station, Charters Towers for his long term commitment to this project. The research team of scientists who developed the test were led by Dr Kishore Prayaga and were awarded a prestigious Australian Museum Eureka Prize in 2009 for this work.

Further information:

Full Technical Report:

<http://www.beefcrc.com.au/Assets/785/1/PolledGeneTechnicalReport27-6-11.pdf>

Beef CRC website:

<http://www.beefcrc.com.au/PolledGeneMarkerTest>

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