

One gene to poll them all

By Jason Reding, geneticist, SA Stud Book

The genetics of polledness has been of major interest to cattle breeders and livestock geneticists. With the revolution of genomics, this has allowed for the unravelling of the true genetic mechanism that controls the expression of horns or polledness. Referred to as the polled gene, this gene is located on chromosome 1 of the cow genome.

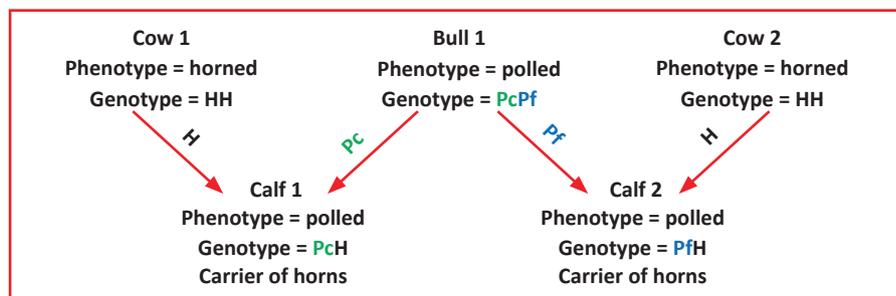
The first mutation was identified in Brahman cattle and is called the Celtic variant. This is the main mutation causing polledness in beef and dairy cattle worldwide, and was confirmed in the Bonsmara and Drakensberger breeds by Grobler *et al.* (2018). The Celtic variant is the main mutation causing polledness in South African cattle breeds but is not the only one.

A few researchers noticed that some cattle breeds were still phenotypically polled but were homozygous horned (HH) for the Celtic variant. This indicated that a different mutation on the polled gene may be responsible. Further research has revealed three other variants within this polled gene, such as the Friesian variant discovered in Holsteins, the Mongolian variant in Kazakh breeds, and more recently the Guarani variant identified in Nelore and Gyr breeds (Nicholas *et al.*, 2023). Currently, all four of these polled gene mutations can cause polledness in all cattle breeds.

Breeds carry both variants

With the roll-out of the recent Beef Genomics Project 2 (BGP₂), SA Stud Book beef breeders are actively genotypically testing their animals on the latest SNP or single nucleotide polymorphisms chip – the SASB-Unistel 50K. This chip has both

Figure 1: Inheritance pattern of an animal that is phenotypically polled, genetically PcPf, and the resultant calves when mated with horned cows.



the Celtic and Friesian polled variants. With numerous breeds testing on this chip, it has become apparent that both the Celtic and Friesian variants occur within South African breeds.

This polled mutation shows dominance over the natural or wild type horned variant, meaning that an animal that is heterozygous for the Friesian variant, known as PfH, will be phenotypically polled. The Friesian variant is now known to be present in breeds such as the Beef Shorthorn, SA Jersey, SA Holstein, SA Beefmaster, SA Hereford, Santa Gertrudis, and Senepol.

An interesting observation in certain populations, such as the SA Jersey, SA Beefmaster and Santa Gertrudis breeds, is the occurrence of animals that carry both the Celtic and the Friesian variants and are genomically assessed to be PcPf. *Figure 1* indicates an animal that is phenotypically polled and is genetically PcPf, meaning they carry one copy of the Celtic variant and one copy of the Friesian variant. As both variants show dominance over the wild type horned variant, a bull that is PcPf will always produce phenotypically polled calves when mated with horned cows.

The resultant calf population would be 50% PcH and the other 50% would be PfH, all phenotypically polled but carriers of the horned variant. Although the SNP chip carries these two mutations, certain breeders of Sanga and Indicine cattle have pointed out that their animals are testing as genetically horned (HH) at both the Celtic and Friesian variants but are seen to be completely phenotypically polled.

This leads one to hypothesise that these animals may carry the Guarani polled variant identified in Nelore and Gyr Indicine cattle breeds, or that an additional, possibly unique Sanga mutation that is probably located in the polled gene, is also influencing the horn/poll status of the Sanga breeds.

In summary

Polledness in cattle is due to mutations within one specific gene – the polled gene. Separate variants of this gene all result in the animal being polled. Although availability of the newer Guarani and Kazakh variants is limited, upcoming updates to the genomic SNP chip and inclusion of these variants may reveal the alternate polled variants in the Indicine and Sanga breeds. **SF**