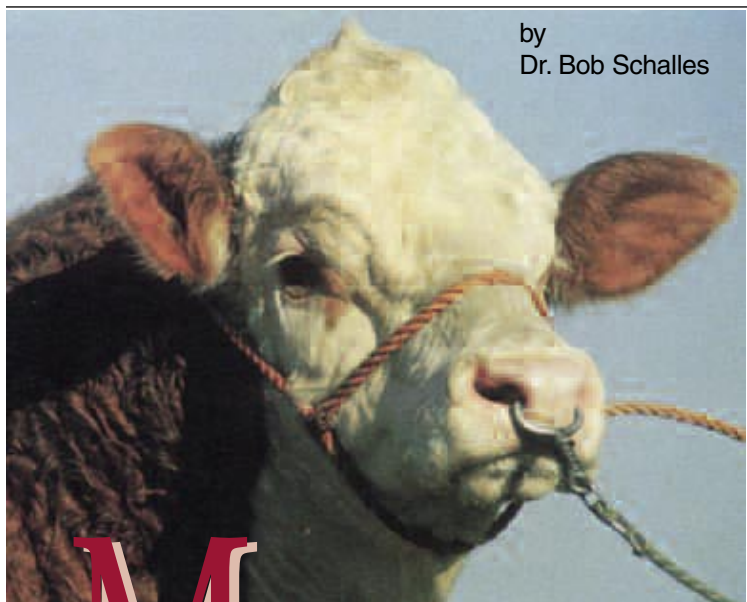


INHERITANCE OF POLLEDNESS

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by
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ost traits involve large numbers of different genes. Very complex genes are responsible for a trait like weaning weight (environmental factors like nutrition must also be taken into account), but the polled trait depends on just one gene, expressed by the upper case

“P”. The opposite condition, the presence of horns, is expressed as the lower case “p” gene.

The polled gene (P) is dominant to the horned gene (p). So when an animal inherits the dominant P gene from one parent and the recessive p gene from the other parent, it is the dominant P that shows up in the individual’s appearance as the polled trait. The only time the recessive horn gene (p) can express itself is when the dominant P gene is not present. There are three possible gene combinations involving the polled trait. They are PP, Pp, and pp. Half of each combination is inherited from each parent.

The PP individual is polled and said to be homozygous because it possesses two identical genes (“homo” means “the same”). It will have all polled offspring regardless of whether the other parent is horned or polled, because it has only the dominant P gene to pass on to its progeny. PP bulls are sometimes referred to as 100% dehorners.

The Pp individual is also polled but is heterozygous (“hetero” means “not the same”). The Pp individual possesses two different genes, so it won’t breed true for the polled trait. Fifty percent of the time, the Pp individual will pass on the horn gene, p, to its progeny.

The pp individual is horned, and is also homozygous because it has two identical genes. The pp individual will always pass on the p (horned) gene to its progeny because that is all it possesses.

To date, most of the research on the polled characteristic has been with the British breeds. But scientists are reasonably certain that the modes of genetic inheritance in the Simmental

breed are similar to British and other Northern European cattle, unless the individuals involved have been bred up from breeds with Zebu ancestry, like Brahman, Santa Gertrudis, and others. An additional gene affects the inheritance of horns in Zebu-type cattle, and complicates the issue somewhat.

A third factor that comes into play is, of course, the inheritance of scurs. Scurs and smooth polledness are separate traits from the horned and polled conditions. Inheritance of scurs is a separate process from inheritance of horns, and involves a different set of genes. (See Scurs).

Here are some examples of breeding for the polled condition. Keep in mind that each parent passes one-half of its genetic makeup to its offspring. (The genes causing scurred calves are not considered in these examples.)



- 1) Homozygous polled sire (PP) Homozygous polled dam (PP) All calves will be homozygous polled (PP)



- 2) Homozygous polled sire (PP) Heterozygous polled dam (Pp) 50% of calves will be homozygous polled (PP), and 50% heterozygous polled (Pp)



- 3) Homozygous polled sire (PP) Horned dam (pp) All calves will be heterozygous polled (Pp)



- 4) Heterozygous polled sire (Pp) Horned dam (pp)
50% of calves will be heterozygous polled (Pp) and 50% horned (pp)



- 5) Heterozygous polled sire (Pp) Heterozygous polled dam (Pp) 25% of calves will be homozygous polled (PP), 50% heterozygous polled (Pp) and 25% horned (pp). (Note that even though the horned calves resulted from mating two polled animals, they are genetically the same as if they were from horned parents.)



Testing Homozygosity of Polled Bulls

Polled cattle (either smooth or scurred) of European background can have either one gene for polledness (heterozygous polled) or two genes for polledness (homozygous polled). The bull with two polled genes will sire only polled (either smooth or scurred) calves. The number of polled genes a polled animal has cannot be determined by its outward appearance. Only through the offspring produced can the number of polled genes be determined. The best test for homozygous polledness is to mate a polled bull to horned cows.

A polled bull bred to horned cows that produces one or more horned calves is heterozygous (one gene for horns) regardless of how many polled calves are produced. A homozygous polled bull (two genes for polled) will always produce polled calves (either smooth or scurred polled).

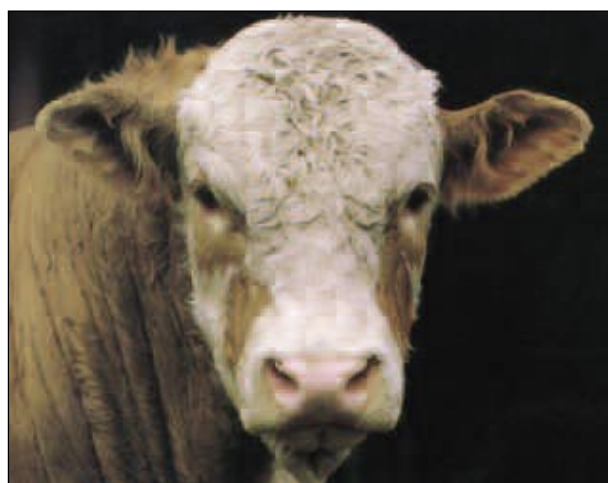


Table 3. probability of a polled bull being homozygous polled if no horned calves are produced.

No. of polled calves from horned cows	Probability of bull being homozygous polled
2	75.00%
3	87.50%
4	93.75%
5	96.88%
6	98.44%
7	99.22%
8	99.61%
9	99.80%
10	99.90%
11	99.95%
12	99.98%
13	99.99%
14	99.99%

Testing for homozygosity of polled bulls is very easy but requires accurate records.

- Step 1:** Select the polled bull to be tested. Only bulls that are polled themselves can carry two polled genes. But remember that bulls with scurs are polled. Any bull can be tested – Simbrah, Simmental, or another breed. He can be owned by you, or by someone else.
- Step 2:** Breed the bull to at least 10 (preferably 14 or more, see Table 3) horned cows of European breeding (not Zebu breeding).^{*} Do not use scurred or smooth-polled cows for the test. The cows can be bred by A.I., natural service, or embryo transplants.
- Step 3:** Check all calves – heifers, bulls and steers. If one or more calves has horns, the bull carries the genes for horns and is heterozygous polled. (If parentage of the calves is questionable, have the bull, the cows and the calves blood-typed). If no horned calves are found, keep the calves until they are yearlings, and check them again. You need to keep at least 8 calves, preferably 10 or more calves. (Remember that iden-

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tical twins count as one calf, but non-identical twins count as two calves). If you don't get enough cows bred the first breeding season, continue the next season with the same or different horned cows.

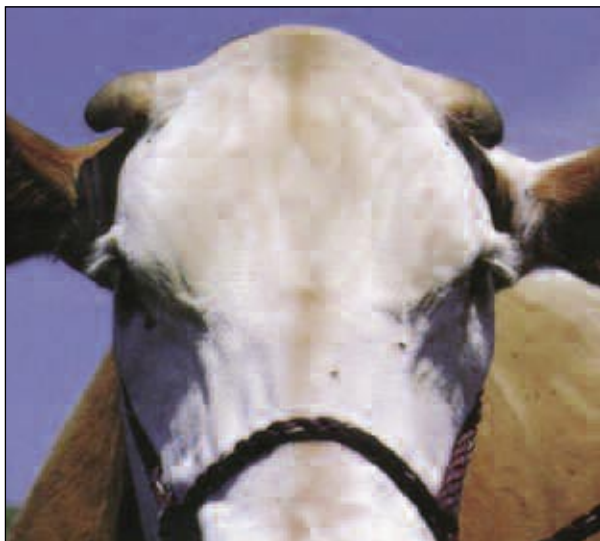
Remember, if a bull ever sires a horned calf, he carries the horned gene, even if the calf was from a cow not in the test. (the only exception would be the very rare mutation that occurs less than once out of 25,000 pregnancies). Once you are sure you have one horned calf, the test is complete. The bull carries the gene for horns.

* Zebu breeds have different inheritance of the polled trait.



Scurs

Scurred cow



There are additional genes that affect horn like growth on an animal's head. The major gene for scurs (Sc) is thought to involve an inheritance process that is separate from the processes that determine either polledness or the presence of the African horn. Absence of the scur gene is expressed by the symbol Sn.

Scurs are incompletely developed horns which are generally loose and movable beneath the skin. In older animals, they may become attached to the skull. They range from tiny scab-like growths to large protuberances almost as large but not usually – as horns.

Because the gene for scurs is probably transmitted separately, it generally has no effect on the presence or absence of horns. Not all horned cattle carry the gene for scurs, and not all polled cattle lack the scur gene. In a horned herd, the presence of scurs is hidden by the horn growth, and does not show up until the horns are bred off. So scientists recommend that the cattleman at first ignore the scurred condition until he has achieved a polled herd. Then, after his animals are hornless, he can start a program to breed out scurs.

At present, scientists don't have enough information to be sure of the ways scurs are inherited. Some feel that the same gene is responsible for all types of scurs, no matter what their size, although that gene varies greatly in its expression. Others suggest that the scurred condition may be affected by more than one pair of genes, with the size of the scur determined by either (1) which pair of genes is involved, or else (2) the number of pairs of genes involved.



Heavy scurs

Medium scurs



Light scurs

Scab scurs

Scurred Inheritance Patterns

Genetic makeup of animal	Cows	Bulls
ScScPp	scurred polled	scurred polled
ScSnPp	smooth polled	scurred polled
SnSnPp	smooth polled	smooth polled

These patterns are true for polled animals that are heterozygous (Pp). It is believed that homozygous polled (PP) animals are always smooth polled and homozygous horned (pp) are always horned and the scurred condition (if present) will not be expressed.

The way the gene for scurs (Sc) is expressed depends on the sex of the animal and the genotype at the polled-horned locus

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In heterozygous polled (Pp) males, the Sc gene is dominant. This means that the presence of a single Sc gene will cause a bull to be scurred.

In heterozygous polled (Pp) females, the Sc gene is recessive. So a cow must possess two Sc genes in order to be scurred. If she possesses only one Sc gene, she may pass the scurred condition on to some of her calves, but will not herself be scurred.

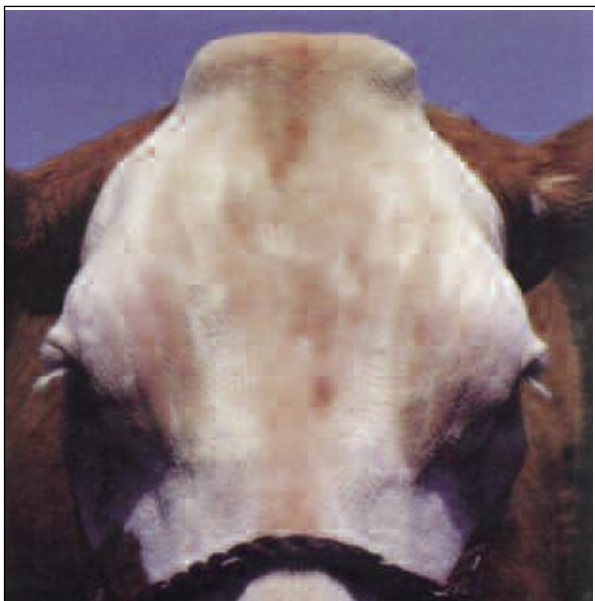
It is easy to detect the presence of the scur gene in a heterozygous polled bull since, if he carries just one Sc gene, he will be scurred instead of smooth polled.

However, a heterozygous polled cow that is smooth-polled may carry a gene for scurs (ScSn), so eliminating the scur gene from the herd is a more complex process. But you can positively identify a smooth-polled cow that carries the scur gene if she produces a scurred bull calf when mated to a heterozygous polled, but smooth-polled bull (SnSnPp).

The scurred gene is not easy to eliminate from a herd, especially since it is believed that the homozygous polled animal may carry either one or two genes for scurs that are not expressed. In time, however, a breeder can virtually eliminate the presence of scurs from the herd by exclusive use of smooth-polled bulls, and by selecting against animals that have scurs or that are known to carry the gene for scurs. When the herd becomes homozygous polled, it is believed that scurs will no longer appear, even though some animals may have genes for scurs. Of course, the breeder would continue to select for performance in the other traits at the same time.

The most convenient time for a breeder to classify his animals as horned, polled, or scurred is at weaning (6 - 9 months). But breeders should note that occasionally what appears to be scurs at weaning may develop into horns by 15 months of age or even later, particularly with heifers. When this happens, the animal must be reclassified as horned.

The breeder who wants to be positive about the horned, polled, or scurred status of his herd should continue to check polled animals for horn or scur growth up to three or four years of age, and report any changes in status to ASA so that breed records can be corrected.



Dehorned cow