

INBREEDING

IS IT A TOOL TO BE USED BY CATTLE BREEDERS?

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What is inbreeding?

Inbreeding is the mating of animals that are more closely related than the average animals in a breed. Inbreeding increases the proportion of homozygous (identical) gene pairs and decreases the proportion of heterozygous gene pairs.

This homozygous gene pairs would be desirable if the gene the animal received from each parent leads to superior performance. However, most animals carry undesirable genes that usually remain hidden, unless the animal is homozygous. Because an inbred animal is more likely to be homozygous for any gene, the animal is more likely to express undesirable genes, and hence, undesirable traits.

Inbreeding depression

Inbreeding does not create undesirable recessive genes, but it does bring to light these unfavorable genes. This leads to inbreeding depression, which is a decline in average performance. Inbreeding depression has the greatest effect on traits associated with fitness and having low heritabilities, such as reproduction and calf survival. Other traits that are negatively affected are mothering ability, growth rate and cow productivity. Inbreeding thus has serious negative effects on overall animal performance, and hence, profitability. Inbreeding depression is essentially the opposite effect of heterosis (hybrid vigor), which is the advantage gained from crossing lines or breeds.

In a study reported in 1993 it was found that for Australian beef cattle a 1% increase in inbreeding resulted in an increase of one day in the calving interval and on average 2% less calves were weaned. For each 1% increase in inbreeding, weaning weight decreased with 0.4kg. Each 1% increase in the inbreeding of cows resulted in a further 0.3kg reduction in weaning weight of their calves, mainly due to poorer milk production.

There is scientific evidence that the rate of inbreeding is more important than the absolute value of inbreeding. Where the rate of inbreeding increases slowly, culling and strict selection criteria can be used to largely eliminate undesirable types and poor producers. Care should therefore be taken to keep inbreeding at a fairly low level by avoiding matings of brothers with sisters or parents with their offspring.

Inbreeding coefficient

Inbreeding of an animal is measured with the inbreeding coefficient. The inbreeding coefficient measures the percent increase in homozygous gene pairs in an individual relative to the average of the population from which the individual came. If an animal has an inbreeding coefficient of 0.25, it is expected to have 25% more homozygous gene pairs than a non-inbred animal from the same population. The inbreeding coefficient can have any value between 0

(non-inbred) and 1 (100% inbred). A Full brother-sister mating will result in an inbreeding coefficient of 25%; a father-daughter mating also in 25%; a half brother-sister mating in 12.5%; a grand dam-grandson mating also in 12.5% and a cousin-cousin (common grandparents) mating in 6.25% (in all cases assuming that the parents are not already inbred).

Pre-potency

Inbreeding promotes an increase in pre-potency, which is the ability of a sire or dam to consistently pass on its characteristics. Pre-potency results from an increase in homozygosity. Since an inbred animal will have more homozygous gene pairs than a non-inbred animal, there are fewer possible gene combinations for the sperm or egg cells. As a result, the offspring should be more similar to each other. The advantage of pre-potency is more than counteracted by the decline in selection intensity and loss of genetic variation due to inbreeding.

Line breeding

Line breeding is simply a type of inbreeding where the aim is to maintain a high relationship to some outstanding ancestor while keeping inbreeding as low as possible. It has the advantage of maintaining genes from outstanding individuals that are no longer available for breeding purposes. The dangers of line breeding are the inevitable buildup of inbreeding and the possibility of line breeding to an inferior son of an outstanding bull.

Conclusions

Inbreeding should only be used by breeders who have a clear understanding of its purpose and risks. Unless approached very carefully, the dangers of inbreeding far outweigh the advantages. If an animal carries undesirable recessive genes, these genes would be expected to be brought to light by inbreeding.

Perhaps the most important aspect to remember about inbreeding is that practicing a high level of inbreeding will most probably result in a decline in average performance for various traits, especially traits related to reproduction and calf survival. This will inevitably lead to fewer progeny available to sell, calves with poorer performance and less attractive to most customers.