

Common Questions About the Inheritance of Coloration in Maine Anjou Cattle

Before answering questions that have been given to me, I think that it would be useful to give some background information about the genetics of coloration of cattle that will allow a better understanding of the questions and answers that follow. There are two sets of genes that control most of the differences in coloration and spotting that are of interest to breeders of Maine-Anjou cattle. The genes are those responsible for red vs. black pigmentation and for a solid (nonspotted) or a spotted body. The gene responsible for producing black is commonly given the symbol E while that for red is e. The gene for black is dominant over that for red meaning that if an animal carries one gene for black and one for red (his genotype would be Ee), he will be black in coloration. Such an animal is referred to a heterozygous. All black cattle, which have a red parent, are heterozygous for red. Animals that are homozygous black have two E genes and have the genotype EE. Since the red gene, e, is recessive, all red animals are homozygous, ee, in genotype. The reason for this is that if they were not homozygous (i.e., carried the black gene), they would be black not red. Therefore, if red animals are mated together, only red calves will result.

When a homozygous black bull (EE in genotype) is bred to red cows (ee), all the progeny are black but carry the red gene (are heterozygous for the red gene). When such a heterozygous bull is bred to red cows, half of the progeny will be black (Ee in genotype) and half will be red (ee). This ratio will be found in the long run. However, individual sets of calves may vary from 50:50 just as the bull to heifer ratio often does in sets of calves. The mating of homozygous black parents will always produce homozygous black progeny. When heterozygous bulls (Ee) are mated to heterozygous cows (Ee), (Remember that all black cattle which had a red parent must be heterozygous.) three-fourths of the progeny are expected to be black and one-fourth red. One-third of the black calves from the mating of heterozygous parents would be expected to be homozygous black (EE) and two-thirds to be heterozygous (Ee). Determining which of the black calves from a mating of heterozygous black parents are homozygous will require some "test matings." If a black bull is mated to red cows and produces seven or more black calves without producing any red calves, he can be said to be homozygous with only a very slight (less than one in one hundred) chance of being wrong.

The situation with regard to spotting is similar genetically to that for the red/black coloration. The gene responsible for lack of spotting (usually symbolized by S) is dominant over (covers up) the gene responsible for spotting (symbolized by s). Fullblood Maine-Anjou are spotted and, therefore, must be homozygous for this recessive spotting (ss in genotype). This is the same type of spotting carried by Holstein, Guernsey, Ayrshire and some Jersey cattle. It is also partially responsible for the spotting pattern of the Simmental. When Maine-Anjou cattle are crossed with Angus (SS) in genotype, all calves that result are Ss in genotype and would not be expected to show spotting. A minimal amount of white may be present on the underline, especially behind the sheath area and in the udder region but the same is often found in burbled Angus. Half of the calves resulting from the mating of a solid colored, heterozygous bull to spotted cows would be expected to be solid and half spotted. This is what occurs in the upgrading process when solid colored F1 cows are mated to spotted fullblood bulls. It is also equivalent to the mating of a solid-colored but heterozygous bull to spotted fullblood cows. The mating together of nonspotted animals that are heterozygous for recessive spotting will result in three-fourths nonspotted calves and one-fourth spotted calves. Just as was the case for the black gene, one-third of the nonspotted calves from such a mating would be expected to be homozygous for nonspotting (SS) and two-thirds would be expected to be heterozygous (Ss). Homozygous bulls will only produce solid calves even when mated to spotted cows. Just as with testing for the red gene, the production of seven or more nonspotted calves from spotted cows without producing any spotted calves nearly ensures that the bull is homozygous.

The genes for spotting (S and s) and the genes for coloration (E and e) are located on different chromosomes and therefore, the prediction of combinations of spotting and colorations are quite simple. If you have a black, nonspotted bull that is heterozygous for both red and spotting (Ee Ss in genotype), and he is mated to fullblood (or other red spotted cows), the chance of getting a black, nonspotted calf is determined by multiplying the chance of getting a black calf (1/2) times the change of getting a nonspotted calf (1/2) which gives a result of 1/4 (25%). It is possible, of course, to have black bulls, which are homozygous for black (EE) and also spotted (ss). Similarly, there are likely to be black, nonspotted Maine-Anjou bulls that are homozygous for one gene and heterozygous for the other. Examples of this

would be the genotypes EE Ss and Ee SS with the former being homozygous for black and heterozygous for the spotting and the latter being homozygous for nonspotting and heterozygous for red. The test for a bull which is homozygous for both genes (EE SS) is to mate him to red, spotted cows and if seven or more calves are born which are black and nonspotted without any other combinations being produced, he is extremely likely to be homozygous for both genes.

It is on the basis of this information that the questions below are answered. These questions were all raised by Maine-Anjou breeders interested in the production of black Maine-Anjou cattle.