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COLOR INHERITANCE IN SIMBRAH



Brindle ($E+ eBr-$).



Black nose, ear rims, switch. Probably Wild-type ($E+ -$) with unknown A allele.



Non-dilute red with blaze ($eeBl-dsds$).

There have been several advances in understanding color inheritance in cattle since the publication of the pamphlet by Dr. R. R. Schalles, "The Inheritance of Color and Polledness in Cattle."

The Extension (E) locus, which is responsible for much of the variation in cattle coat color, has been identified as the melanocyte stimulating hormone receptor ($MSHR$ or $MC1R$). The three alleles can now be determined by commercial DNA testing. The wild-type or $E+$ allele allows for the production of both black and red pigments and responds to modification by other genes such as the Agouti (A) locus alleles. A single base mutation in Extension produces the ED , dominant black, which allows for only eumelanin production and produces animals that are black from birth regardless of alleles at the Agouti locus. The homozygous recessive at Extension, is an inactive $MSHR$ and produces only red pigment. The order of dominance at Extension is $ED > E+ > e$.

Since the $E+$ allele is common in Brahman animals, some of the colors of Simbrah cattle are affected by this allele. The combination of $E+$ and $A+$ (Agouti wild-type) produces the combination red and black animal. The black may cover most of the body with only a tan dorsal stripe, muzzle ring and poll. In this manner a reddish or brown Simbrah cow ($E+$) can produce a calf that turns black sired by a non-diluter red Simmental bull.

The true red is produced by the recessive allele (e) when homozygous. Since this defective $MSHR$ does not allow for the production of black pigment, a modifying gene at Br (brindle) has no known effect on this phenotype. There are genes that modify the intensity of red which are generally thought to be quantitative and at least two dilution genes DC (Charolais) and DS (Simmental), which dilute base coat colors.

Since $ED_$ produces total black and ee produces no black, the Br (Brindle) gene only affects the $E+$ genotype. The brindle pattern seems to vary as the amount of black pigment would on the wild-type phenotype.

It seems logical that one or more recessive genes in the homozygous state have the effect of removing red pigment expression in gray

An examination of the factors involved in the inheritance of color in the Simbrah breed.

Zebu and similarly colored breeds. However, the great variation in these breeds is not completely understood.

The red Simbrah with black nose, feet, and switch suggests perhaps an $E+$ with an Agouti locus mutant limiting expression of black to these areas. Another possible modification of $E+$ with an Agouti mutant could produce black tipped ears, black ringed prepuce, black base of scrotum, black nose, feet, and switch. This coloring in Simbrah is quite similar to the bay horse color that is red bodied with black points. Gray Simbrah with this modification are born red and turn gray during the first year of life.

The roan locus found in Shorthorn and Belgian Blue cattle has been identified as the steel locus or mast cell growth factor. It can cause roan or a mixture of white hairs with any base color. In the homozygous condition, the animal is white with only a little pigmentation in the ears. This roan gene is not allelic with the Extension locus as previously thought and is in a different location in the cattle genome.

The Simmental dilution gene, DS , always dilutes true black to gray but its effect on red cattle varies. When homozygous for this gene, red cattle become yellow. This dilution gene is different from the dilution of black caused by the Rat Tail Syndrome genes.

Many spotting patterns can affect color of Simbrah cattle. The recessive spotting (ss) common to Simmental can stay hidden for generations. The white face, typical of Simmental, is symbolized by Bl for the blaze pattern it usually produces when heterozygous and in combination with $S+$ (wild-type solid color). Other spotting patterns can come from foundation breeds including some Zebu.

The inheritance of color is probably not as important as the growth, carcass, and maternal traits that we select for using EPDs, but color can have economic as well as esthetic value. Some colors, such as roan, can be associated with other problems (white heifer disease). Color can be a factor in heat and insect tolerance as well as a tendency for eye problems. The molecular genetics revolution and advances in cell biology is helping scientists and breeders better understand the actual mechanisms of color inheritance. ♦



Wild-type with dilution ($E+ -A+ -DS-$)



Wild-type ($E+ -A+ -$).



Wild-type, non dilute ($E+ -A+ -dsds$). Note tan muzzle ring, poll, and back stripe. Born red with black points.