

# COLOR INHERITANCE OF THE ROYAL YAK

By Lawrence G. Richards

The "Royal Yak" is a very rare strain of Yak in North America. Approximately 10% of the total Yak population in North America. I believe the name "Royal Yak" is a misnomer applied by zealous North Americans and has no significance in Tibet - nor special connection with Tibetan Royalty. This opinion is reinforced by my friend; Richard Olsen, Santa Cruz, CA., who has traveled extensively in Tibet and Nepal (Private communication, Spokane, WA., June, 1991). Nevertheless, the name Royal Yak once applied has captured the imagination of North American Yak breeders and the Royal Yak remain on their own merit the most sought after and valuable Yak in North America today. The color pattern is most attractive and it would seem safe to say that the Royal Yak is indeed a rare strain in North America and at the very least an inheritable color pattern that breeds true. Living Diamonds Ranch will continue to promote Royal Yaks under the name Royal Yaks and the rest of this article will deal with color inheritance. The Royal Yak may not be royal in Tibet, but in North America he reigns supreme among the Yaks.

The Royal Yak presents a black and white pinto color pattern that closely resembles the tobiano paint pattern in pinto horses. Figure A. of Sargeant Pepper shows the typical pattern of the Royal Yak. Notice the full white tail, white and black under-belly frill, white legs, and white facial stripe. A full white tail is typical, but not an absolute requirement. Generally the legs are fully white and the white extends to the under-belly frill. Although we have frequently seen a blend of white and black in the under-belly frill. The hooves are generally white ie; unpigmented and grow faster than black hooves. The presence of black in the underbelly fringe and in the upper legs and tail may be determined by modifying genes to the royal color pattern gene, not expressed in the absence of the royal color gene. Unlike the tobiano paint horse where the head is marked like that of a solid-colored horse, every Royal Yak I have seen has a facial stripe, which extends from the horn base to the nostril or upper lip. The side of the face is usually black, but the black never appears to cross over the bridge of the nose in a full Royal Yak.

The Royal Yak has a pink (unpigmented) tongue and mouth, whereas black yaks have pigmented (dark) tongues. I have not reached my conclusions on tongue and mouth coloration in the White Trim intermediates.

The best way to study the pattern is to take extensive pictures of individual animals and compare them on a desk surface. Generally most of the torso white is towards the rear of the animal with the shoulder and neck area usually black. Generally the color patches are large patches but Figure B. of Susie Ky Yak presents smaller patches of an almost appaloosa pattern. This article is not meant to be the definitive article on the Royal Yak color pattern. Time and photographs may reveal more unique patterns as presented in Figure B. In a future article we will develop this concept farther with lots of photographs of individual Royal Yaks.

I must reveal two important concepts presented in GENETICS OF THE HORSE by William E. Jones Ph.D and Ralph Bogart, Ph.D, 1973 by CABALLAS PUBLISHERS. "Schiab (1963) gives evidence that the movement of melanoblasts is restricted to definite patterns in the mouse fetus. He illustrates that there are fourteen unique areas of the body in terms of melanoblast migration. Consequently some areas of the body may lack melanocytes and this deficiency results in a characteristic white spotting. One such process is exemplified by the belted gene." An example of the belted gene in livestock would be the Belted Galloway cattle, which is a dominant gene. On the second concept of melanoblast migration he states, "Most appaloosa breeders are familiar with the movement, enlargement, and even sudden disappearance of spots in the breed. Wagner (1969) gave specific example of changing spots in a number of horses. One mare had small white migrating spots. This characteristic in many Appaloosas is strong enough evidence to conclude that with some particular genetic backgrounds the melanoblast continue to migrate throughout adulthood."

This would be interesting to watch for in Royal Yaks, but probably impossible to track without extensive photographs over time. Now back to the central theme of the article.

Inheritance of the Royal Yak color pattern:

My observations suggest the inheritance of the Royal Yak color pattern fits the pattern of Incomplete Dominance.

All specific examples I have seen fit this interpretation. However, this "data" was collected from ranch breedings by McRoberts and Richards and not by controlled breeding experiments. Background on Incomplete Dominance from Genetics of Livestock Improvement by John F Lasley. Three different coat colors exist in the shorthorn breed: red (RR), roan (Rr), and white (rr). The heterozygote (Rr) expresses itself phenotypically in a different manner than either homozygote (RR) red or (rr) white. Incomplete dominance is also called a blending type of inheritance. In the heterozygote the R allele could produce red hairs and the r allele could produce white hairs (ie: lack of color) in a 50:50 ratio resulting in the roan coloration. In this type of inheritance the genotypic and phenotypic ratios are the same. However, while the red (RR) animals bred *interse* and the white (rr) animals bred *interse* will breed true the roans (Rr) bred *interse* will not breed true, but rather as 1RR, 2Rr, 1rr producing 1 red, 2 roan, 1 white from the *interse* (Rr x Rr) breeding. The phenotypic expression (ratio) equals the genotypic ratio.

Royal Yak Color Pattern Inheritance interpreted as Incomplete Dominance.

ww = HOMOZYGOUS ROYAL PATTERN

Bw = WHITE TRIM

BB = HOMOZYGOUS SOLID BLACK

ww= would be the full Royal Pinto pattern

Bw = White Trim would be intermediate pattern with some white markings eg; star, socks, tail, facial stripe or legs

BB = would be solid black, the predominant color in North American yaks.

Unlike simple dominant/recessive genetics where the carrier heterozygote Bw would be phenotypically indistinguishable from the dominant homozygote BB as in Black and Red Angus genetics, in this mode the heterozygote Bw is phenotypically distinguishable as the White Trim pattern. In the Red Angus the heterozygote Bb is a black red carrier phenotypically indistinguishable from the true breeding homozygous Black Angus (BB). The Red Angus is the recessive homozygous (bb).

**MATINGS:**

**TYPE A.** Royal (ww) x Black (BB) Mating. 100% progeny will be White Trim intermediates. Breeding Royals to solid blacks has always added some white trim to every breeding on my ranch to date. All the field data I have seen fits this pattern, but the study is not definitive.

**TYPE B.** Royal (ww) x Royal (ww) Royals bred to Royals have consistently (99+%) produced Royals.

**TYPE C.** Royal (ww) x White Trim (Bw) Mating. 50% of progeny will be Royal and 50% will be White Trim. This is the most interesting mating and I have 2 Royal Calves this spring sired by Royal Bulls bred to 2 White Trim cows. One cow had only one white rear sock and the other had 2 white rear socks. These cows had no other white markings! We will have more data on the statistics of the cross next year. I have some reservations that 50% of progeny will be royals. I now withdraw the reservations, as I have had 2 more Royal calves by this mating type this summer.

**TYPE D.** White Trim (Bw) x White Trim (Bw) Mating. This cross works, but I have no statistical data to support the numerical conclusions 25:50:25 presented by the Incomplete Dominance Theory. Susie KyYak Figure B. is a result of this cross, as are her yearling twin royal heifer sisters. That is 3 Royal Calves from 2 matings of Bw x Bw. A lot of luck. Remember these conclusions should be made from 100 matings to get a correct statistical analysis to the pattern proposed.

**BREEDING STRATEGY TO PRODUCE ROYALS.**

Breed a Royal Bull to solid black cows (Type A Mating). Mating will produce 100% F1 White Trim progeny. Breed the F1 heifers to a second Royal Bull (Type C Mating) will produce 50% Royal and 50% White Trim. Breed all these F2 heifers to a third Royal Bull and 50% of them (The Royals) will produce 100% Royals (Type B Mating) and 50% of them (the Bw) will produce 50% Royal and 50% White Trim.

**CONCLUSIONS;**

I believe Incomplete Dominance is the mode of the Royal Yak Color Inheritance. However, I cannot provide full statistical proof of this theory. This article has postulated the existence of a royal color pattern gene in yaks which can be present in either the homozygous (ww) or heterozygous state (Bw). Whereas solid black (BB) is the predominant color in North American Yak. This article has suggested that the extent of penetration of white color (absence of pigmentation) into black areas may be determined by modifying genes to the royal color pattern gene not expressed in the absence of the royal color gene. Further, I cannot yet provide any data about modifying genes to this royal color pattern gene. We should all study modifying genes as they are most interesting.



Figure A

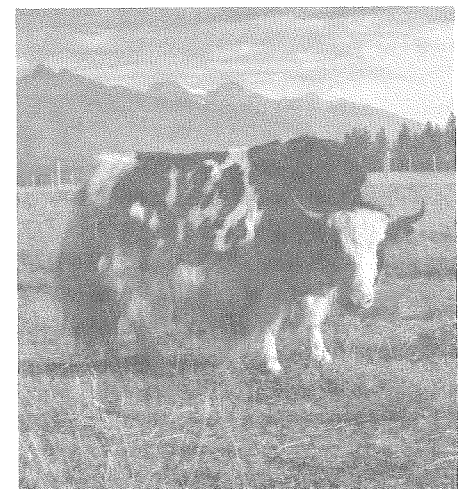


Figure B

**MATINGS:**

Royal (ww) x Black (BB) Mating

	B	B	
w	Bw	Bw	Royal x Black 100% Progeny will be White Trim Intermediates
w	Bw	Bw	

**TYPE A.**

Royal (ww) x Royal (ww) mating

	w	w	
w	ww	ww	Royal x Royal 100% Progeny will be Royals
w	ww	ww	

**TYPE B.**

Royal (ww) x White Trim (Bw)

	B	w	
w	Bw	ww	Royal x White Trim 50% Progeny will be Royal and 50% will be White Trim
w	Bw	ww	

**TYPE C.**

White Trim (Bw) x White Trim (Bw)

	B	w	
B	BB	Bw	25% Progeny will be Royal (ww) 50% Progeny will be White Trim (Bw) and 25% Progeny will be Black (BB)
w	Bw	ww	

**TYPE D.**