

Lecture :

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زانکۆی سه‌لاحه‌دین - شه وێر
Salahaddin University-Erbil

PRACTICAL
ANIMAL

GENETICS

Subject :

Genetic Dominance:
Genotype-Phenotype
Relationships

Department: Animal Resources

Stage : 2

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Introduction

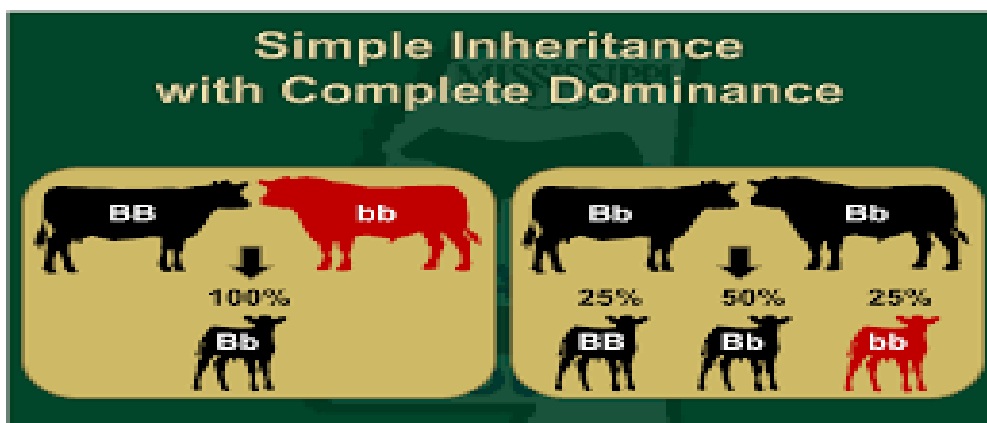
Why can you possess traits neither of your parents have? The relationship of genotype to phenotype is rarely as simple as the dominant and recessive patterns described by Mendel.

One of Gregor Mendel's greatest contributions to the study of heredity was the concept of dominance. Mendel observed that a heterozygote offspring can show the same phenotype as the parent homozygote, so he concluded that there were some traits that dominated over other inherited traits. However, the relationship of genotype to phenotype is rarely as simple as the dominant and recessive patterns described by Mendel. As the study of inheritance expanded beyond the seven traits Mendel initially examined and also included organisms other than pea plants, biologists began to notice a variety of relationships between alleles that code for the same trait. These allelic interactions were not exclusively recessive or dominant, and they greatly enriched our understanding of how genotype leads to phenotype.

Complete Dominance


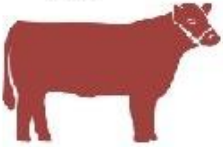


Dominance affects the phenotype derived from an organism's genes, but it does not affect the way these genes are inherited. Complete dominance occurs when the heterozygote phenotype is indistinguishable from that of the homozygous parent.

There are also simply inherited traits which are traits that are controlled by a single gene and often with one allele being dominant to the other. Some examples of traits that are simply inherited with complete dominance are red/black coat color, horned/polled.



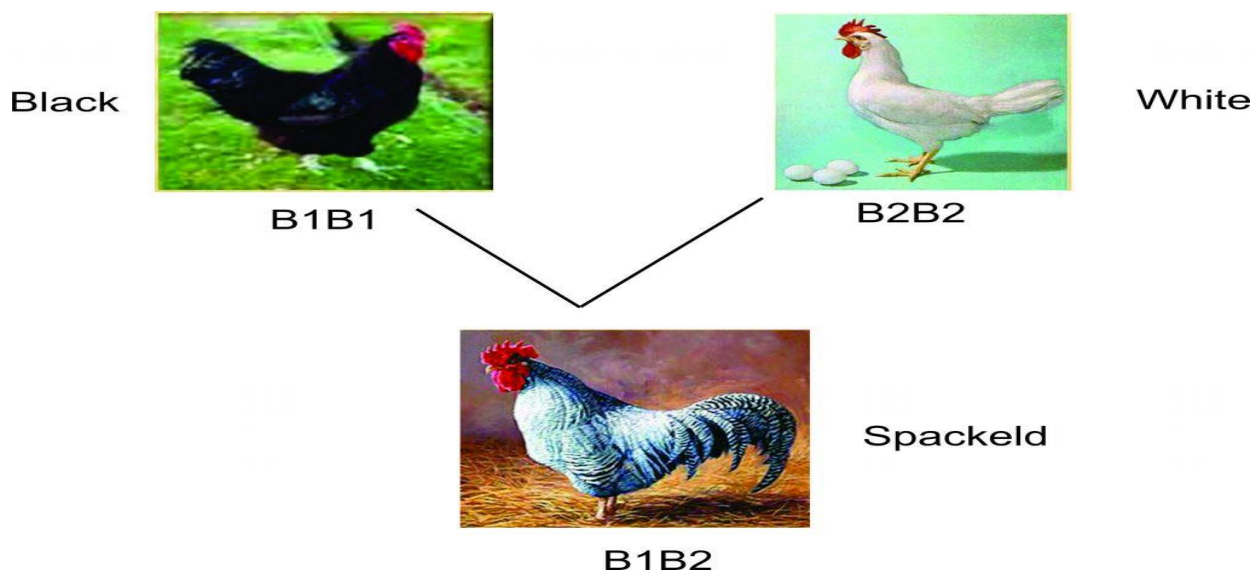
- Homozygotes are Homozygous (same alleles) BB or bb
- Heterozygotes are Heterozygous (different alleles) Bb
- BB, Bb, and bb are genetic allelic pairs that express the "black" (B) or "red" (b) trait of cow coat color; also called genotypes found in cells. Genotype is determined by the sample ½ of the genes an offspring receives from their sire and the sample ½ from the dam.
- Black or red are phenotypes or outward appearances of cow coat color.

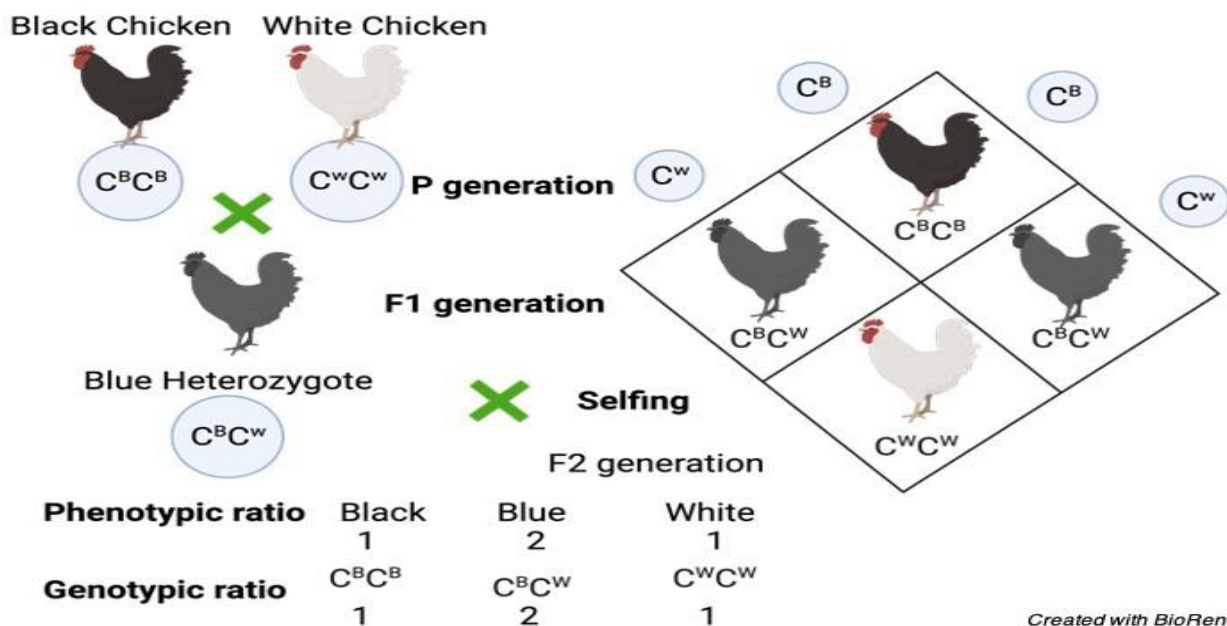
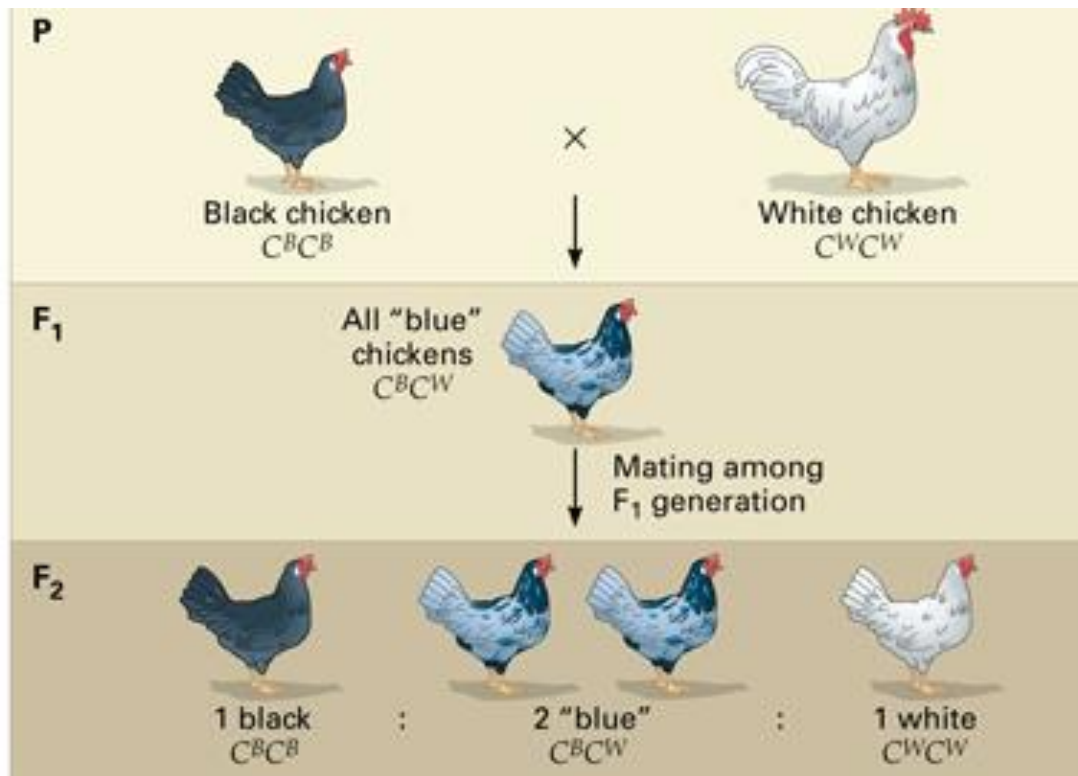
Examples (In the following examples we are assuming black is dominant to red coat color and polled is dominant to horned)

<p><u>Genotype</u> BB or Bb <u>Phenotype</u> Black</p> 	<p><u>Genotype</u> bb <u>Phenotype</u> Red</p> 	<p><u>Genotype</u> BBpp, or Bbpp <u>Phenotype</u> Black and horned</p> 	<p><u>Genotype</u> bbPP, or bbPp <u>Phenotype</u> Red and polled</p> 
<p>The genotype and phenotype of these two cows is <u>only</u> describing <u>one</u> trait (coat color)</p>		<p>The genotypes and phenotypes of these two cows are describing <u>more than one</u> trait (coat color and polled/horned)</p>	

Incomplete Dominance

The heterozygote displays a phenotype that is an intermediate between the phenotypes of both homozygote parents (one of which is homozygous dominant, and the other of which is homozygous recessive). This intermediate phenotype is a demonstration of partial or incomplete dominance. When partial dominance occurs, a range of phenotypes is usually observed among the offspring. Although the offspring may show a variety of phenotypes, each one will lie along a range connected by the homozygous parental phenotypes.





Codominance

As opposed to incomplete dominance, codominance occurs when the phenotypes of both parents are simultaneously expressed in the same offspring organism. Indeed, "codominance" is the specific term for a system in which an allele from each homozygote parent combines in the offspring, and the offspring simultaneously demonstrates both phenotypes.

1. Inheritance of Coat Colour in Short Horn Cattle

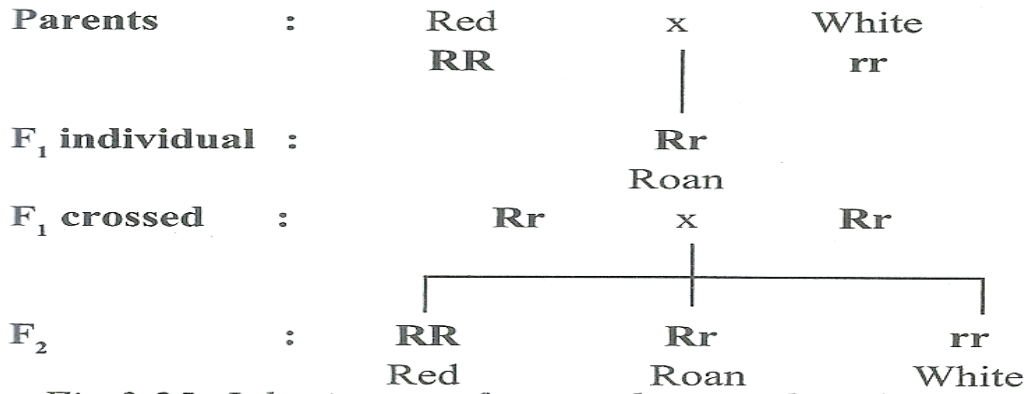
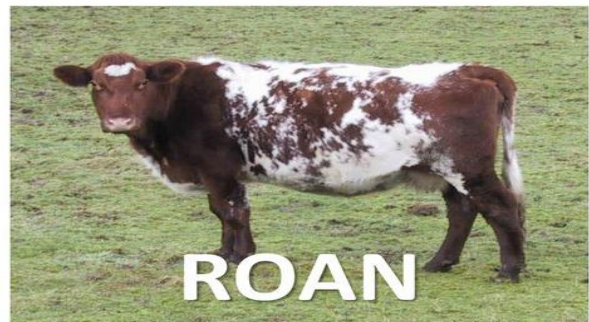
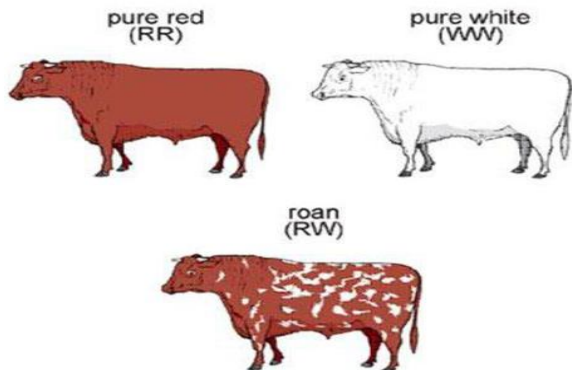


Fig.3.25: Inheritance of coat colour in short horn cattle.

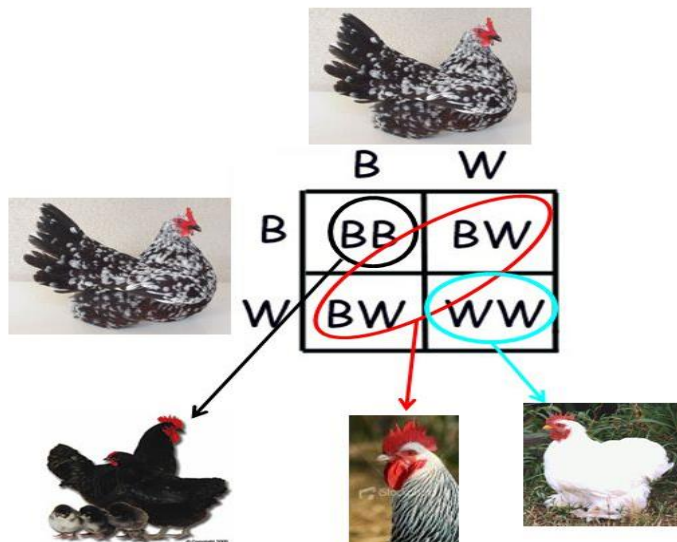
In short horn cattle, there are two colours of hair, red and white. Red colour is controlled by *R* and white by *r*. When red and white are crossed, the F₁ has *roan* colour having both red and white hairs. This is because *r* gene also expresses its character in the F₁ generation.

Codominance in Cattle

- Red Cattle = RR (homozygous)
- White Cattle = WW (homozygous)
- Roan (Red & White Hair) = RW (Heterozygous)



Codominance



Where _____ alleles contribute to the phenotype.

For example: in chickens, the allele for black feathers is codominant with the allele for white feathers. Heterozygous chickens have a color described as "erminette," speckled with black and white feathers.

Over-dominance

In some instances, offspring can demonstrate a phenotype that is outside the range defined by both parents. In particular, the phenomenon known as overdominance occurs when a heterozygote has a more extreme phenotype than that of either of its parents.

Occurs when a heterozygote animal expresses a phenotype outside the range of the homozygote phenotype



Example:
Callipyge in sheep
extreme muscle
growth

What is dominance deviation?

