Topics:

Allelic and non-allelic interactions-

1. **Codominance (1:2:1)**
2. **Semidominance or Incomplete dominance (1:2:1)**
3. **Epistatic or Masking Gene Interaction (12:3:1)**

❖ 1. Codominance (1:2:1)

When both alleles of a gene are fully expressed even in heterozygous condition, they are called codominant alleles and the phenomenon is known codominance. Codominant alleles exlhibit unique pattern of equal expression. In general, the two protein products of both the alleles are functionally same but differ in amino acid sequence. The MN blood group antigens of man are a very good example of codominance. The allele L^M for M-type blood is codominant with its aliele L^N for N-type of blood.

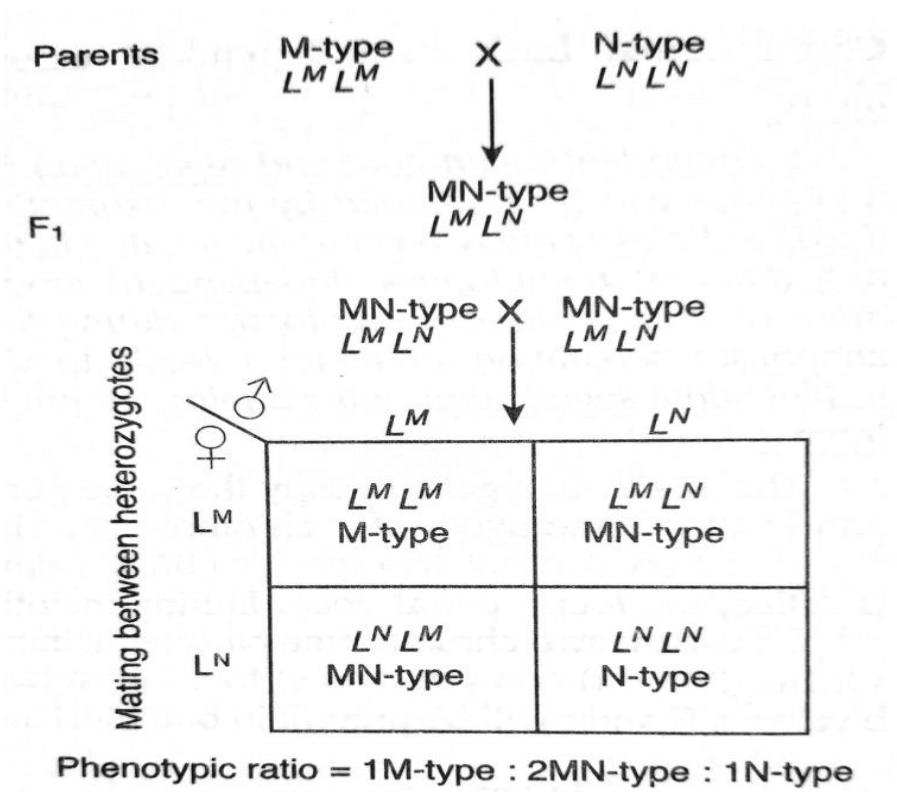


Fig: Change of phenotypic ratio due to codominance

In MN-type of blood both the M and N antigens are present on the surface of the red blood cells when heterozygous (L^ML^N), since the two alleles encode non-identical protein pro ducts. Mating between heterozygotes would result in a phenotypic ratio of 1:2:1 instead of normal 3:1 ratio.

❖ 2. Semidominance or Incomplete dominance (1:2:1)

The phenomenon of expression of both alleles of a gene in heterozygote that allows it to be distinguished from ejther of its homozygous parents is called semidominance or incomplete dominance. This semidominant allele produces the same products but in lesser quantity than its dominant counter part.

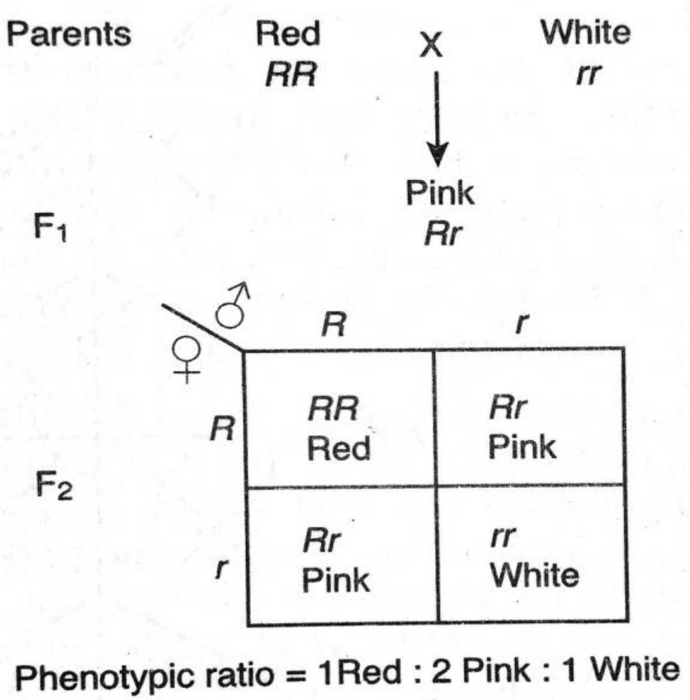


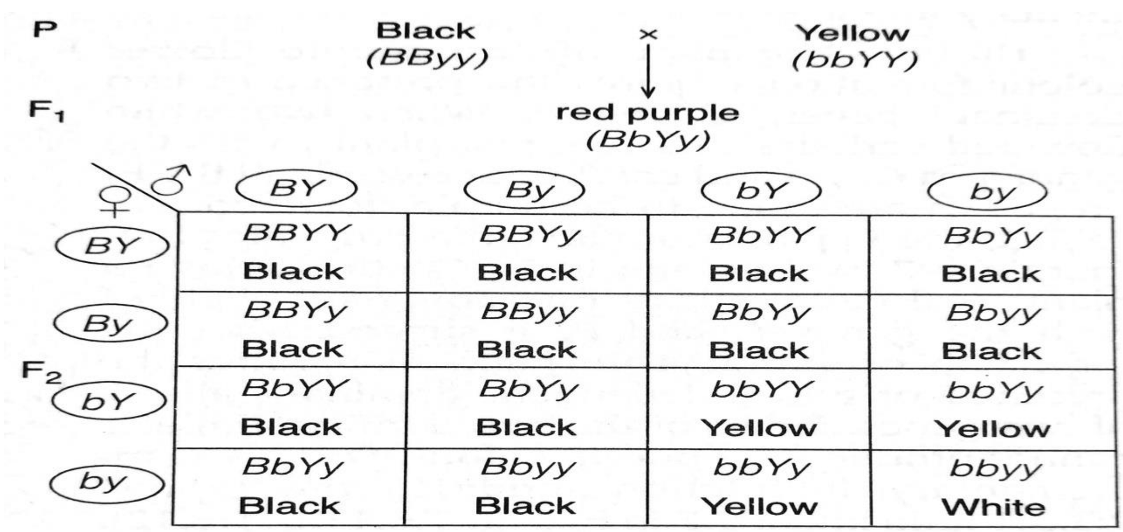
Fig: Change of phenotypic ratio due to semidominance

In the heterozygotes the total gene product is intermediate between that of the two alleles separately. So, it may appropriately be called as **blending inheritance**. The flower colour of *Mirabilis jalapa* is a very good example of such an inheritance. The F_1 plants of the cross between red-flowered variety and white-flowered variety are all pink-flowered.

The F_2 plants on selfing produce red, pink and white flowers in the ratio of 1:2:1 instead of normal 3:1, as occurs for dominant alleles. Therefore, both the genotypic and phenotypic ratios in F_2 generation are same. The red and white flowered plants breed true, while the pink flowered plant produces three kinds of progeny.

❖ 3. Epistatic or Masking Gene Interaction (12:3:1)

In this interaction, the two non-allelic genes affecting the same trait can produce distinct phenotypes alone. But when they are present together, the expression of one gene is masked by the other and a different phenotype is produced when both are present in recessive state. This phenomenon is known as epistasis. It is not a case of inhibition, but the expression of one gene is more intense than the expression of other. The former one is known as epistatic gene and latter one is known as hypostatic gene.



Phenotypic ratio = 12 Black : 3 Yellow : 1 White

Fig: Epistatic gene interaction showing 12 : 3 : 1 ratio in the development of seed coat colour of barley in F_2

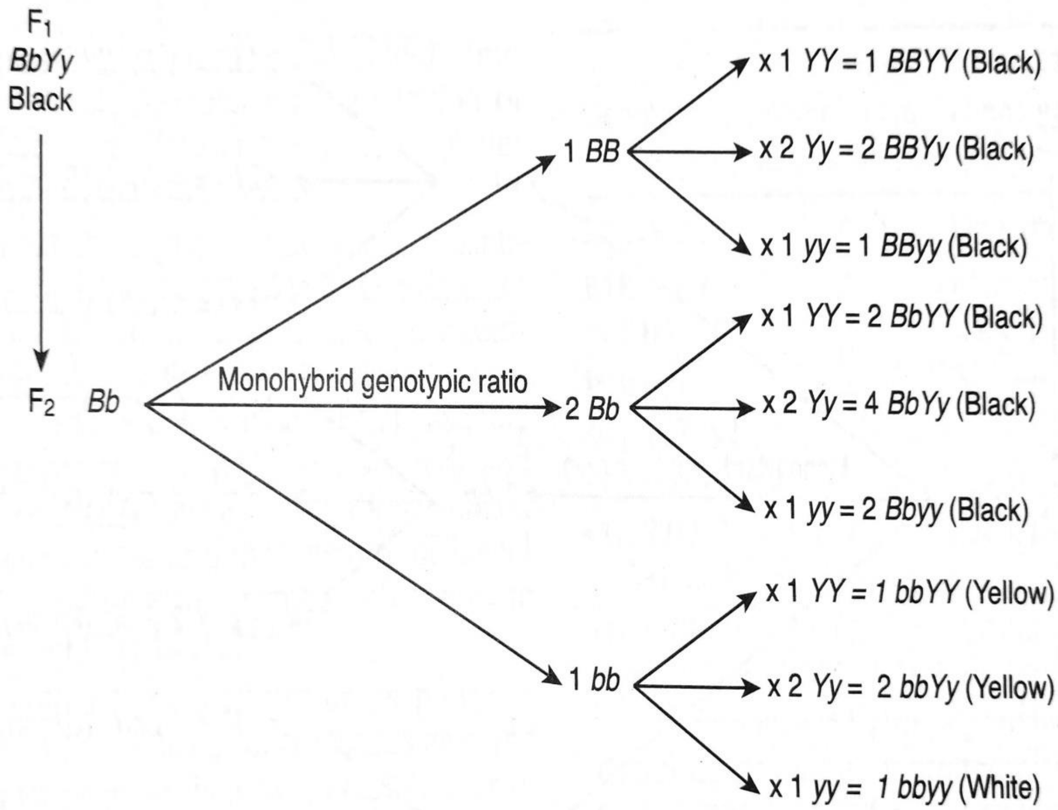


Fig: Epistatic gene interaction showing seed coat colour of barley in 12 : 3 : 1 ratio in F_2 through forked line method

The phenomenon is very analogous to the simple dominance. But they are distinguished by the fact that epistasis is involved among non-allelic genes, whereas Simple dominance is involved among allelic genes. As a result a modified dihybrid ratio 12:3:1 instead of 9:3:3:1 is obtained.

The most epistatic effects are associated with different colour formation in plants and animals.

In barley, the seed coat colour is produced by two dominant genes B and Y. Gene B is responsible for black colour. Its homozygous recessive condition produces white seeds. The other gene Y alone is responsible for yellow seed formation, while its homozygous recessive condition also produces white seeds.

When both the dominant alleles are present the phenotype is black seeded plants because the black colour produced by B gene masks the yellow colour produced by Y gene. The dominant gene Y alone produces yellow colouration. When a black seeded strain of the genotype BByy is crossed with yellow seeded strain of the genotype bbYY the F_1 (BbYy) produces black seed Coats. In the F_2, black, yellow and white seeded plants appear in the 12:3:1 ratio.

A similar interaction is also found in the inheritance of fruit colour in squash and grain colour in sorghum and millet.

References:

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