Polygenic Inheritance

Continuously varying characters are due to the combined or cumulative action of several genes, each of which exerts a small effect on the same character. Such genes are called the cumulative genes or additive genes or polygenes.

A cumulative gene is one, which if added to another identical or similar gene, affects the intensity or degree of expression of a quantitive character. In other words a quantitative character is simultaneously ~~governed~~ governed by several genes (= polygenes) and the effect or action of such genes is cumulative or additive in nature. This is also known as the multiple-factor hypopthesis. Gene-pairs which act in a cumulative way to result into a quantitative trait, are known as multiple-factors.

Since quantitative inheritance is controlled by many genes, it is also known as polygenic inheritance

Few examples of polygenic inheritance in both plants and animals are listed below—

1) Grain colour in wheat.
2) Ear length in maize.
3) Seed colour in wheat.
4) Height of man.

Seed colour in wheat:

The Swedish botanist, H. Nilsson-Ehle in 1908 first studied the inheritance pattern of the colour of the grain in wheat. He crossed two varieties of wheat with red and white grain colour. He found that all the F_1 offspring were intermediate between red and white.

When the F_1 hybrid-plants were self-fertilized the F_2 progeny showed a ratio of 15 red and 1 white. The red progeny, however carried various shades between the red and white (such as dark red, medium red, light-red and pink)

The ratio 15:1 clarifies that this was dihybrid cross in which two identical genes were involved ~~the~~ producing the red colour.

In this example, two pairs of segregating genes are responsible for the colour variation in the wheat coat. The red coat of ~~whi~~ wheat carries two pairs of dominant genes ($R_1R_1R_2R_2$) both of which contribute some quantity of redness to the grain. These genes are duplicates of each other. The white coat of wheat had recessive alleles of both these pairs ($r_1r_1r_2r_2$) and doesn't contribute anything to red colour.

The F_1 hybrid possesses two dominant genes (($R_1r_1R_2r_2$); hence it is intermediate between red and white. In the F_2 generation, the colour varies depending on the number of dominant genes that the offspring gets from the hybrid-parents i.e. 9, 3, 2, 1 or zero.

P.T.O →

Parents: Red $R_1R_1R_2R_2$ × White $r_1r_1r_2r_2$

R_1R_2 ↓ r_1r_2

F_1 → $R_1r_1R_2r_2$

Gametes → R_1R_2, R_1r_2, r_1R_2, r_1r_2

F_2 →

Female gametes ↓ / Male gametes →	R_1R_2	R_1r_2	r_1R_2	r_1R_2
R_1R_2	$R_1R_1R_2R_2$ Red	$R_1R_1R_2r_2$ Dark	$R_1r_1R_2R_2$ Dark	$R_1r_1R_2r_2$ medium
R_1r_2	$R_1R_1R_2r_2$ Dark	$R_1R_1r_2r_2$ medium	$R_1r_1R_2r_2$ medium	$R_1r_1r_2r_2$ Light
r_1R_2	$R_1r_1R_2R_2$ Dark	$R_1r_1R_2r_2$ Medium	$r_1r_1R_2R_2$ Medium	$r_1r_1R_2r_2$ Light
r_1r_2	$R_1r_1R_2r_2$ medium	$R_1r_1r_2r_2$ Light	$r_1r_1R_2r_2$ Light	$r_1r_1r_2r_2$ White

Phenotypic ratio and phenotypes —

1/16 = Red, 4/16 = Dark red, 6/16 = medium-red

4/16 = Light-red, 1/16 = White.

Phenotypic ratio = 1:4:6:4:1