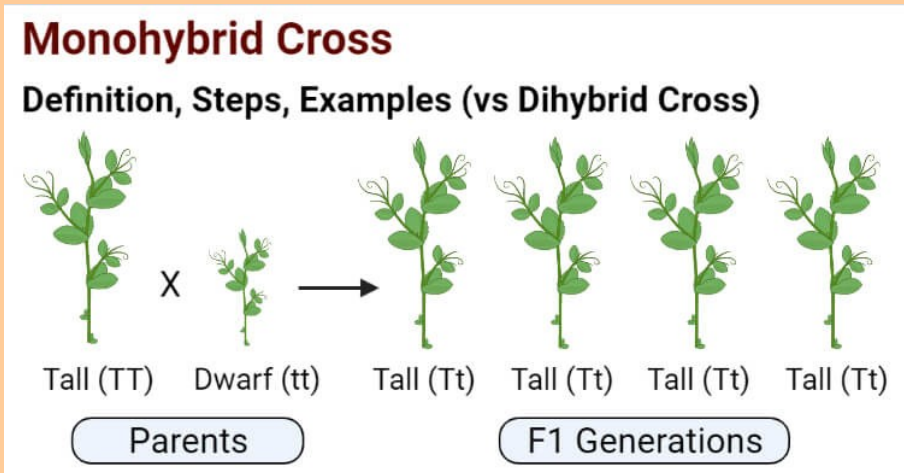


**CHAPTER 08**

# Heredity and Evolution

Monohybrid cross between two individuals that differ in only one observed trait.



Let us consider the monohybrid cross of a pure breed of yellow and green seed bearing plant.

In this case, these two pure breeds are called parents.

When we cross-pollinate the parents, we get the first filial generation or F<sub>1</sub> generation. Where the term filial means progeny.

All the F<sub>1</sub> generation plants produced plants that gave yellow seeds. There were no green seeds.

Further, he self-pollinated this F<sub>1</sub> plants and observed the second filial generation. 75% of the plants

produced yellow seeds, while the rest 25% of plants gave green colored seeds.

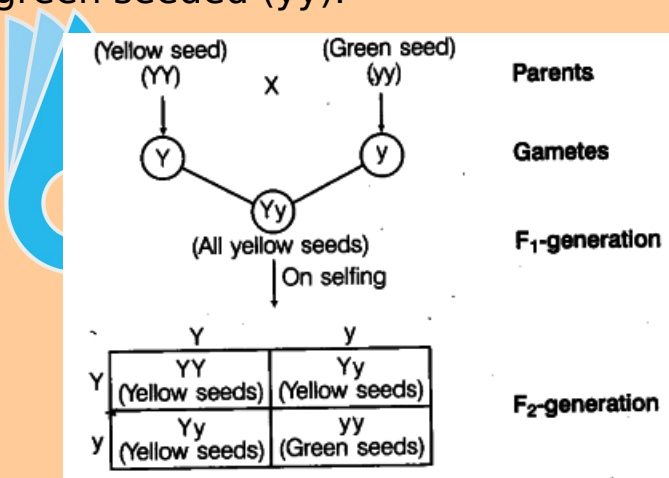
So what were his Observations?

- Set of peas i.e. about 25% obtained in  $F_2$  gave only yellow seed giving pea plants (YY).

On self-pollination, they keep producing yellow seeded plants, they are called Homozygous dominant.

- A set of peas (about 50%) obtained in  $F_2$  generation are heterozygous yellow (Yy) and gave yellow and green seeds in 3:1 on self-pollination.

- A set of peas (about 25%) obtained in  $F_2$  generation are green seeded (yy).



On self-pollination, they keep producing green seeded plants; they are called (Homozygous recessive). Based on the observation he came up with some assumptions.

### Assumptions of Mendel:

- Every pea plant has two 'factors', which are responsible for producing a particular character or

trait. The determining agent responsible for each trait is called a factor.

- During reproduction, one 'factor' from each parent is taken to form a new pair in the progeny.
- One of these factors will always dominate the other if mixed together. The trait expressed in  $F_1$  generation is called dominant. While the other, which did not express in  $F_1$  is called recessive.

Mendel carefully chose the plants, which did not produce a mixed result.

A pure breed (parental) yellow seed-giving pea will have both the 'factors' of the same type. Let us denote them by 'YY'

A pure breed (parental) green seed-giving pea will have both the 'factors' of the same type. Let us denote them by 'yy'.

Assume that 'Y' (the one causing yellow color) is a dominating 'factor'.

That means if 'Y' and 'y' come together, 'Y' will dominate and the pea seeds will always be yellow in colour.

From assumption-2, the breed after cross-pollination will have one factor from purebred yellow (Y) and one from the purebred green (y). That is, all the peas will have the paired factor 'Yy', i.e. heterozygous.

By assumption-3, all the peas will be Yellow as 'Y' factor is dominant.

The trait expressed in  $F_1$  is dominant, and the unexpressed trait is recessive.

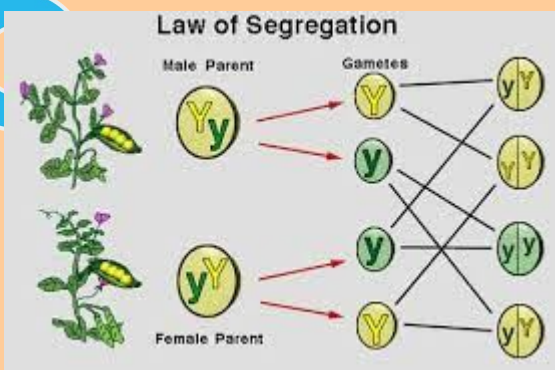
All the pea plants are yellow in  $F_1$  - Generation, hence yellow is the dominant trait whereas green is recessive.

### Self-pollination in $F_1$ - Generation:

The  $F_1$  generation plants have the factors Yy. They can produce gametes that will have either Y or y in it.

Here we can cross Y with Y, Y with y, y with Y and y and Y to produce  $F_2$  generation.

The progeny can be YY, Yy, yY or yy. All of them are in equal ratio.



When we look at the  $F_2$  - Generation we will get approximately equal number of YY, Yy, yY and yy peas.

Any pea that has a Y factor will be yellow. Any pea that has both yy will be green. Since all combinations are equally likely.

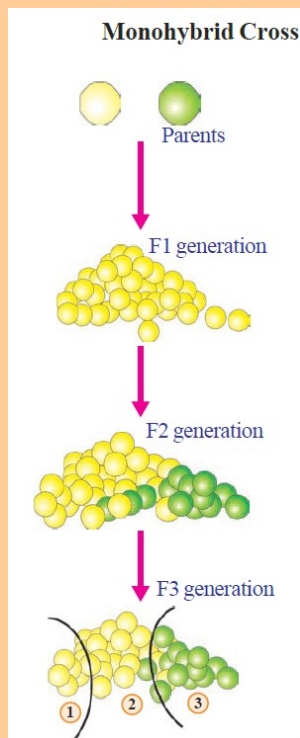
YY will be approximately 25% and is yellow,

yY will be approximately 25% and is yellow,  
 Yy will be approximately 25 % and is yellow,  
 yy will be approximately 25% and is green.

**Q.** Can we determine internal character based on external visible character?

**Ans.** No

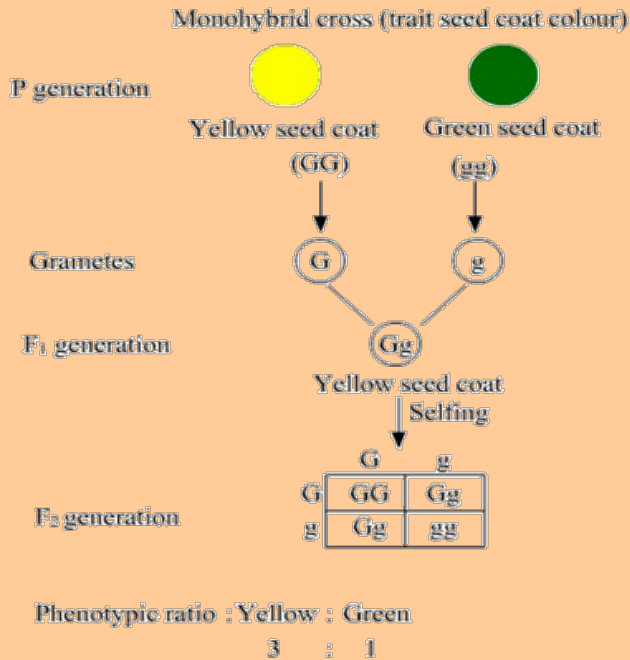
Because the seed was yellow in color in F<sub>1</sub> generation, But when F<sub>1</sub> plants were self-pollinated, some of the progenies produced green coloured seeds. We cannot determine internal character based on external visible character.



box  
easy

**Phenotype:**

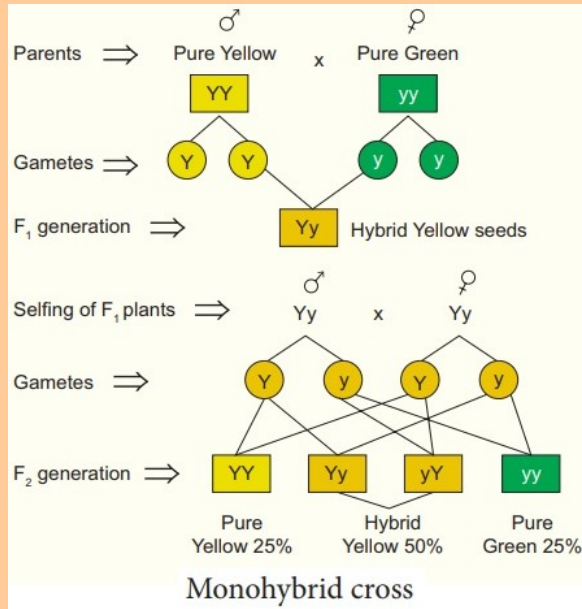
75% are yellow seed producing pea plants and 25% are green In the F<sub>2</sub> generation.



Externally visible characters like yellow or green is known as 'Phenotype' and its ratio is called 'phenotypic ratio' and the monohybrid phenotypic ratio - 3:1.

### Genotype:

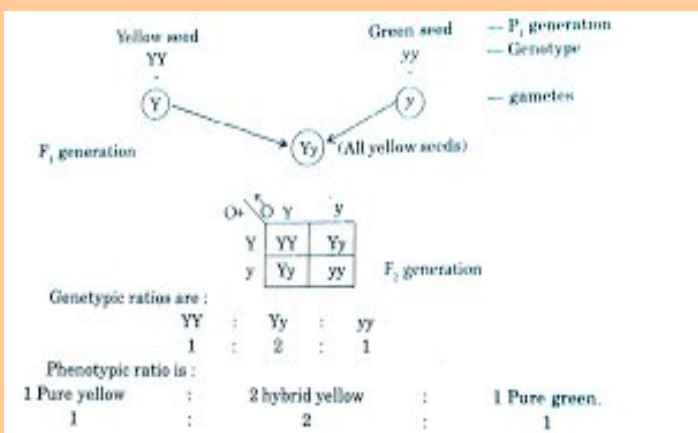
Genetically, in 75% yellow seed producing pea plants only 25% pea plants produce yellow seeds that are pure breeds (YY) and are homozygous' that is to have the same factors for representing a character.



Remaining 50% yellow seed producing pea plants are (Yy) i.e., they are heterozygous.

The remaining 25% green seed producing pea plants are pure homozygous type i.e., yy.

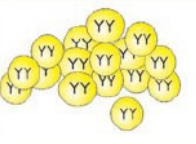


The constitution of pea plants as shown by the representative letters Y and y to show the probable nature of factors is known as genotype.



Genotype refers to the alleles or variants an individual carries in a particular gene and this ratio is known as the genotypic ratio.

The monohybrid genotypic ratio is 1(YY): 2(Yy): 1(yy).

On self-pollinating these peas of F<sub>2</sub> generation, we get three results.

																													
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- The YY peas on self-pollination give only yellow (YY) peas. This was explained with the experimental result that this set gave 100% yellow peas.
- The Yy (or) yY peas on self-pollination give about 75% yellow peas and about 25% green peas.
- The green peas that contain yy factors will give only green peas.