EXPERIMENT NO. 9

AIM:- To calculate Mendelian-ratio from the given seed sample and correlate it with particular gene interaction involved.
[Each seed of the sample represents a single plant of F2 generation.]

Requirements :- given seed sample

Theory:-

Mendelian postulates :-

1. Each genetic character is controlled by a pair of unit characters (called **alleles**).

2. Among two dissimilar factors, one is dominant and other is recessive unit factor.

3. When an individual produces gametes, the alleles separate randomly and do not blend. **"Principle of Segregation" or "Purity of Gametes".**

4. **Principle of Independent Assortment** :- when two independent events occur simultaneously, the combined probability of two outcomes is equal to the product of their individual probabilities of occurrence.

Symbolic rules:-

- Same letter of an alphabet is used to symbolize a trait and that too of the recessive one.
- E.g., green seed color is recessive as compared to yellow color. Therefore, 2 forms of 'g' can be used ----- G and g.
- For a diploid plant ⟶ 2 alleles.

  ↓

  3 combinations

  GG, Gg, gg

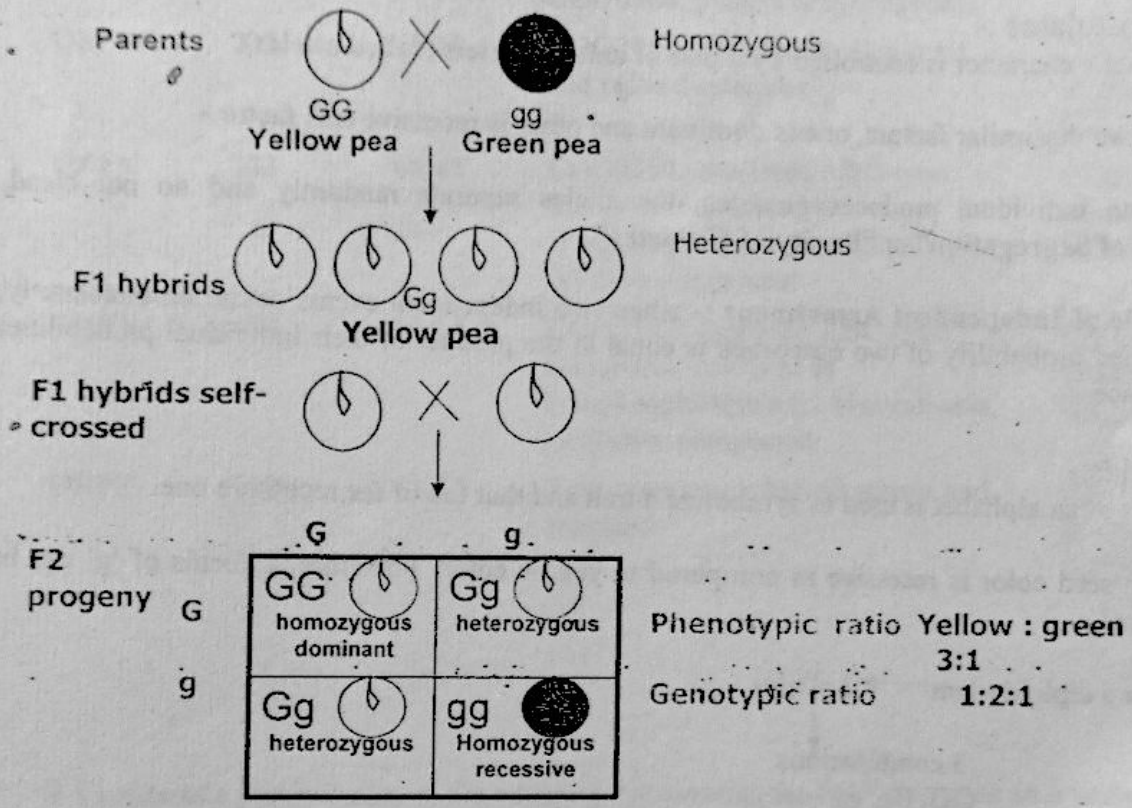
Monohybrid ratios:-

Gregor Mendel (1822-1884) was an Austrian monk who discovered the basic rules of inheritance. From 1858 to 1866, he bred garden peas in his monastery garden and analyzed the offspring of these matings. The garden pea was good choice of experimental organism because:

- many varieties were available that bred true for clear-cut, **qualitative** traits like
  - seed texture (round vs wrinkled)
  - seed color (green vs yellow)
  - flower color (white vs purple)
  - tall vs dwarf growth habit
  - and three others that also varied in a qualitative - rather than quantitative - way.

peas are normally **self-pollinated** because the stamens and carpels are enclosed within the petals. By removing the stamens from unripe flowers, Mendel could brush pollen from another variety on the carpels when they ripened.

Mendel considered only one trait and that too the seed color. Both the seed colors were true breeding and homozygous. Mendel cross bred them and in F1 generation, he got all yellow colored seeds. Where did green color disappear?
When Mendel allowed F1 generation seeds to self pollinate, the green seed color again appeared.
Interpretations:- Random union of equal numbers of **G** and **g** gametes produced an F_2 generation with 25% **GG** and 50% **Gg** - both with the yellow color phenotype - and 25% **gg** with the green color phenotype.



MONOHYBRID CROSS

In a dihybrid cross, two traits are considered. E.g. Mendel crossed peas that had round yellow seeds with plants that had wrinkled green seeds green, in the first generation all had yellow round seeds

The F_2 generation (self-pollinated the F_1's): he got the following ratios:

1. 9/16 of the offspring dominant for both traits, yellow/round seeds
2. 3/16 of the offspring dominant for one trait and recessive for the other trait, yellow/wrinkled seeds

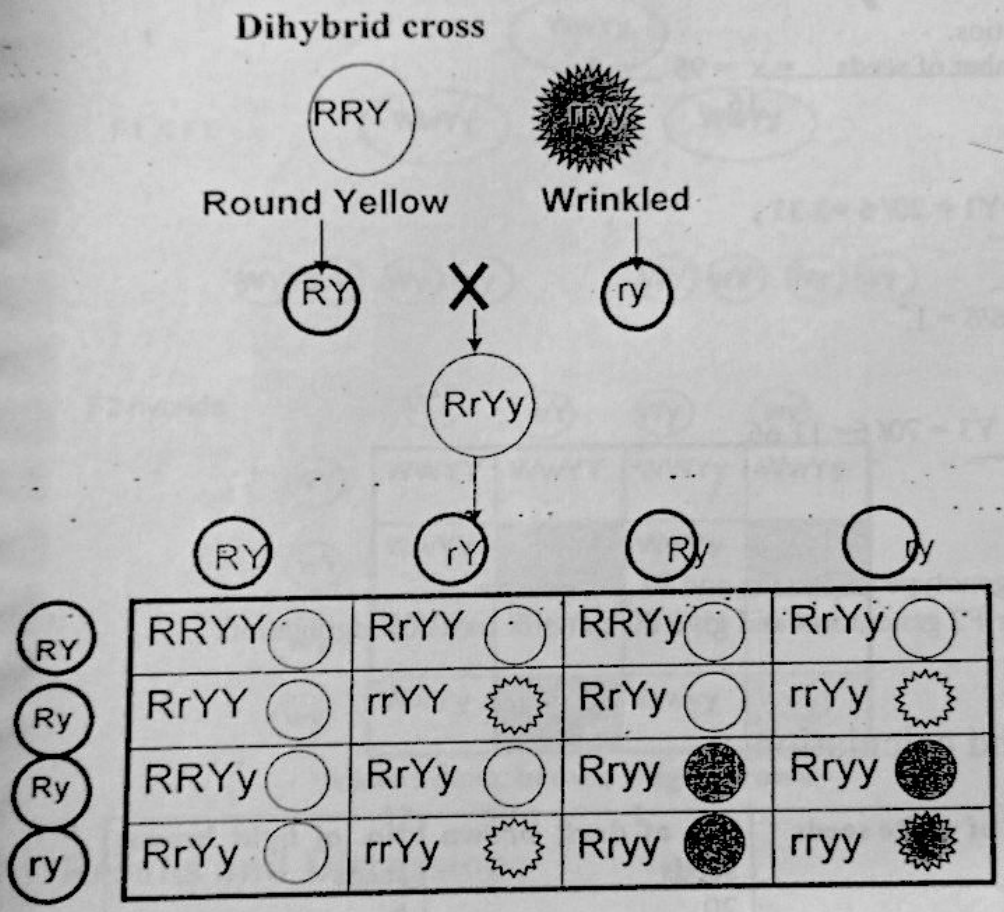
3. 3/16 of the offspring dominant and recessive opposite of the previous proportions, green/round seeds

4. 1/16 of the offspring recessive for both traits, green/wrinkled seeds

Dihybrid crosses predict phenotypic ratios of 9:3:3:1 in F_2 offspring

Mendel's dihybrid crosses allowed him to formulate his second law:

Principle of independent assortment- the inheritance of a pair of factors for one trait is independent of the simultaneous inheritance of factors for other traits, such factors assort independently, as though no other factors were present



Round Yellow : round green : wrinkled yellow : wrinkled green

9 : 3 : 3 : 1

Modifications of Mendelian Ratios :-

-**Incomplete Dominance:-** 1:2:1
-**Multiple alleles** e.g., blood groups
-**Epistasis** :- one gene masks or modifies the expression of another non-allelic gene.
15:1 ratio – Duplicate gene action
9:7 ratio - Complementary gene action
12:3:1 ratio - Dominant epistasis
13:3 ratio – Dominant suppression epistasis

Procedure :-

1. Classify the mixture of seeds into different phenotypes. i.e., count the number of white, dark brown and light brown seeds.
2. work out their probable ratios.

phenotypic ratio = $\frac{\text{Total number of seeds}}{16} = x = \frac{96}{16} = 6$

Ratios :-

no. of dark brown seeds $= \frac{Y1}{x1} = 20/6 = 3.33$,

no. of white seeds $= \frac{Y2}{x2} = 6/6 = 1$,

no. of light brown seeds $= \frac{Y3}{x3} = 70/6 = 11.66$.

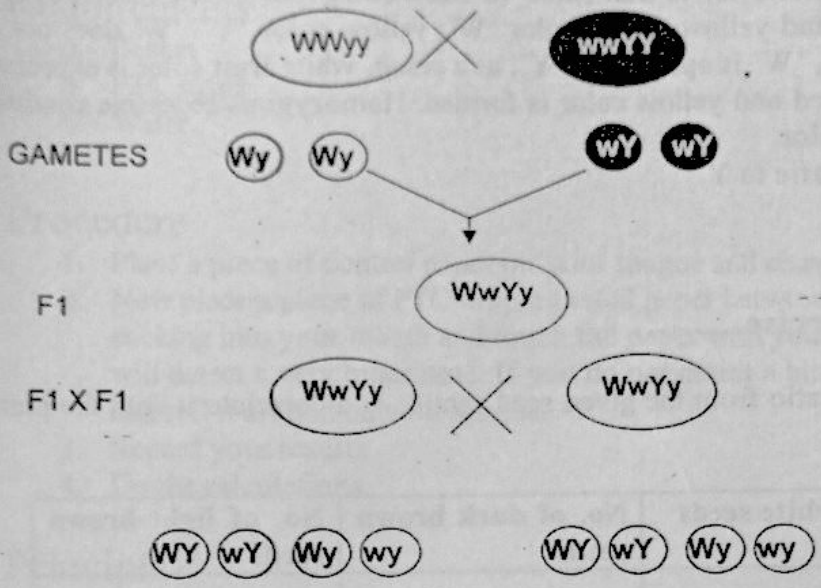
thus probable ratio is **12:3:1.**

3. With this ratio, predict the genotype of parents and F1 generation.
4. Draw the Punnett square for F2 generation and give the genetic basis of segregation.

Observation table and calculations:-

	No. of white seeds	No. of dark brown seeds	No. of light brown seeds
Observed no. of seeds	70	20	6
Expected no. of seeds	72	18	-
Deviation	-2	+2	-

Total no. of seeds =96
Dominant gene 'W' determines – white seed color
Non alleleic gene 'Y' determines – Dark brown seed color
Genotypes of parents –WWYY and wwYY
Genotype of F1 - WwYy



F2 hybrids

	WY	wY	Wy	wy
WY	WWYY	WwYY	WWYy	WwYy
wY	WwYY	wwYY	WwYy	wwYy
Wy	WWYy	WwYy	WWyy	Wwyy
wy	WwYy	wwYy	Wwyy	wwyy

white : dark brown : light brown
12: 3 : 1

Results and Discussion:-

From the given seed sample, the following data can be obtained.

WWYY = white
WwYY = white
WWYy = white
WwYy = white
wwyy = light brown
wwYY = dark brown
wwYy = dark brown
WWyy = white
Wwyy = white

white : dark brown : light brown
12: 3 : 1

It is a derivation from Mendel's normal dihybrid ratio 9:3:3:1. It is a case of Dominant epistasis:-

- Non-allelic interaction between two dominant non-allelic factors.
- A type of epistasis where a dominant factor masks the expression of another dominant factor.
- If together, F1 progeny is like dominant parent
- Selfing F1 yield intermediate variety.

The best example of this interaction is fruit color in *Cucurbita pepo*. Three different colors of fruit can exist – green, white and yellow. White color 'W'; yellow color 'Y'. 'W' does not allow 'Y' to be expressed. Therefore, 'W' is epistatic to 'Y'. as a result, white fruit color is expressed. In WW condition, 'Y' is expressed and yellow color is formed. Homozygous recessive condition of 'W' and 'Y' produces green color.

Therefore, W is epistatic to Y.

Exercise.....

1. Determine the seed ratio from the given seed sample and correlate it with the particular gene interaction involved.

	No. of white seeds	No. of dark brown seeds	No. of light brown seeds
Observed no. of seeds			
Expected no. of seeds			
Deviation			