

9. His knowledge on mathematics was a definite asset for the interpretation of his findings after subjecting the results to more refined mathematical analysis.
10. He maintained particulars of pedigree records, which gave him the exact ancestry of any given plant.

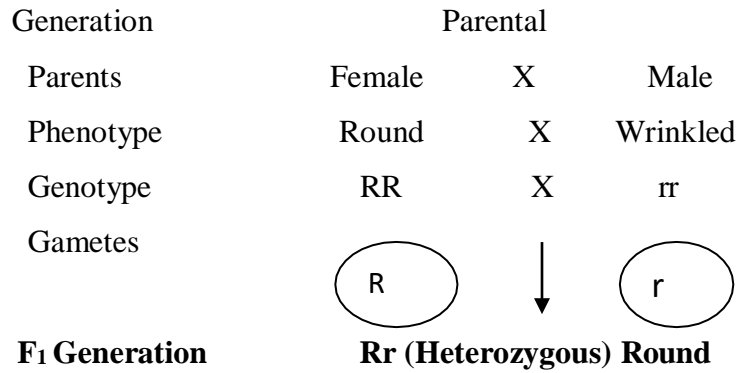
### **Mendelism / Laws of Mendel:**

Mendel's cross breeding experiments with garden peas showed certain numerical relations among the progeny. The relationship between the character pairs and the kinds and the ratio of the progeny is known as Mendelism. Mendelism was not a theory of hereditary origin, but it was a theory of the manner in which inheritance had taken place. Mendelism can be summarized in the following laws and principals which are called Mendel's laws of inheritance.

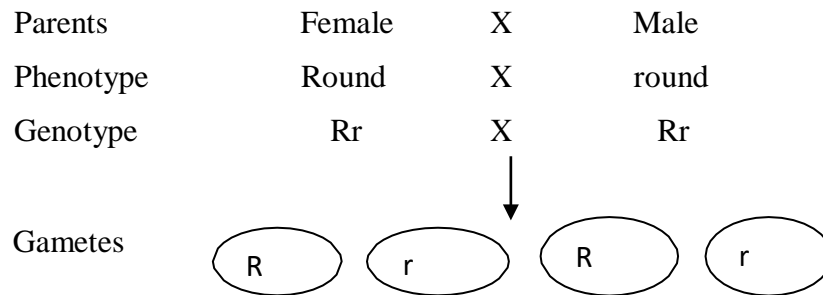
- 1. The law of segregation or the law of purity of gametes:** It states that when a pair of alleles / allelomorphs is brought together in a hybrid (F<sub>1</sub>) they remain together without contaminating each other and they separate or segregate from each other into a gamete in a complete and pure form during the formation of gametes. The law is universal in its application and it has been found to occur in plants as well as animals.
- 2. Law of independent assortment:** The factors in an allelomorphic pair separates independently to the separation of factors in the other allelomorphic pair.
- 3. Principal of Dominance:** States that in a hybrid one factor of the allelomorphic pair expresses itself completely over the other.
- 4. Principal of unit characters:** State that each factor (gene) controls the inheritance of single character occurs in pairs in each diploid organism.

### **Explanation of Laws of Mendel:**

**Monohybrid ratio:** The Mendel's first law i.e. Law of segregation or purity of gametes can be explained by considering the monohybrid ratio i.e. by studying inheritance of only one character. For example: In pea, round seed shape is dominant over wrinkled seed shape.



**On selfing:**



**F<sub>2</sub> Generation**

	<b>R</b>	<b>r</b>
<b>R</b>	RR Round	Rr Round
<b>r</b>	Rr Round	rr Wrinkled

Phenotype ratio: 3 round: 1 wrinkled

Genotypic ratio: 1 RR : 2Rr : 1rr

Two different alleles of the same gene i.e. 'R' and 'r' were brought together in the hybrid (F<sub>1</sub>). Even though the hybrid was round seeded in the next generation (F<sub>2</sub>) it produced both round and wrinkled seeded progeny. Thus, both the alleles for round shape (R) and wrinkled shape (r) remained together in the hybrid without contaminating each other. In F<sub>2</sub> generation (selfing of (F<sub>1</sub>) hybrid), the different phenotypes could be recovered because the two alleles in F<sub>1</sub> remained pure and did not contaminate each other thus producing two types of gametes from F<sub>1</sub> i.e. (R)

and (r). The separation of homologous chromosomes during anaphase I of meiosis may be regarded as the reason for segregation of the two alleles of a gene. This is because the alleles of a gene are located in an identical position in the two homologous chromosomes.

### **Dihybrid Ratio:**

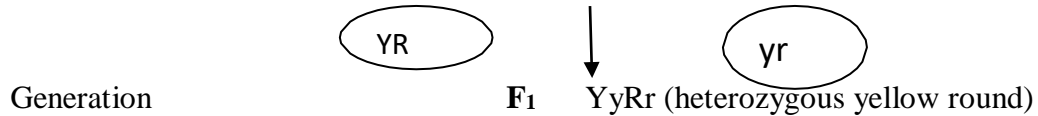
Mendel's second law i.e. Law of independent assortment can be explained by studying the inheritance of two characters at a time, simultaneously.

Independent segregation for two genes can be explained by assuming that the two genes are located in two different chromosomes. The two alleles of a gene will be located in the two homologues of the concerned chromosome. Independent separation of these two pairs of chromosomes at anaphase I of meiosis will lead to the independent segregation of the genes located in them. Thus, any allele of one gene is equally likely to combine with any allele of the other gene and pass into the same gamete. Independent segregation of two genes produces four different types of gametes in equal proportion. A random union among these gametes gives rise to sixteen possible zygotes. These zygotes yield a 9:3:3:1 phenotypic ratio, which is known as the typical dihybrid ratio.

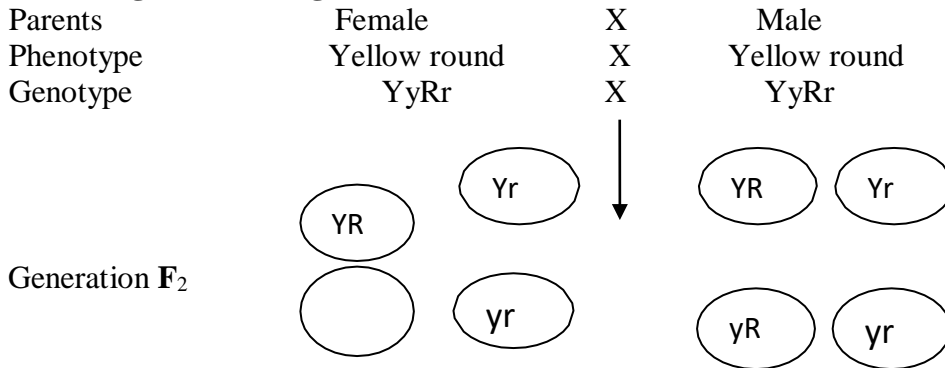
When two pairs of independent alleles enter into F1 combination, both of them have their independent dominant effect. These alleles segregate when gametes are formed but the assortment occurs independently at random and quite freely. Example: when plants of garden pea with yellow round seeds (Y Y RR) were crossed with plants having green wrinkled seeds (yyrr), yellow round seed plants (YyRr) were obtained in F1. Thus, yellow colour of seed exhibited dominance over green and round seed shape over wrinkled seed shape independently. The F1 produces four types of gametes YR, Yr, yR and yr. Selfing of F1 gives rise to yellow round, yellow wrinkled, green round and green wrinkled individuals in 9:3:3:1 ratio. This is possible only when the alleles of two genes controlling the two characters assort independently to one another.

Parents	Female	X	Male
Phenotype	Yellow round	X	Green wrinkled
Genotype	YYRR	X	yyrr

Gametes



**On selfing/ intermating:**



♀♂	YR	Yr	yR	yr
YR	YYRR Yellow round	YYRr Yellow round	YyRR Yellow round	YyRr Yellow round
Yr	YYRr Yellow round	YYrr Yellow wrinkled	YyRr Yellow round	Yyrr Yellow wrinkled
yR	YyRR Yellow round	YyRr Yellow round	yyRR green round	yyRr green round
yr	YyRr Yellow round	Yyrr Yellow wrinkled	yyRr green round	yyrr green wrinkled

**Phenotypic ratio:**

9 Yellow round: 3 Yellow wrinkled: 3 green round: 1 green wrinkled

**Genotypic ratio:**

1 YYRR: 2 YYRr: 1 YYrr: 2 YyRR: 4 YyRr: 2 Yyrr: 1 yyRR: 2 yyRr: 1 yyrr

**Exceptions to Mendel's laws:**

1. Paramutations and polyploidy are exceptions to the law of segregation or law of purity of gametes.
2. Linkage is an exception to Mendel's second law i.e. law of independent assortment.
3. Incomplete dominance is an exception to the principle of dominance.
4. Pleiotropism is an exception to the principle of unit characters.
5. Modification of F<sub>2</sub> ratios due to incomplete -dominance, co-dominance, lethal factors, interaction of factors, epistatic factors are all exceptions.

However, Mendel failed to confirm his results when he worked with hawk weed, (*Hieraceum* sp.) because of the formation of embryo from the ovule without fertilization (diploid parthenogenesis) in this plant.