MENDELS LAWS OF INHERITANCE

Mendelism

Mendel's experiments in genetics, where he described the mechanisms of hereditary processes and formulated principles, are collectively known as Mendelism.

Gregor Johann Mendel (1822 – 1884): Mendel was born on July 22, 1822, in Heinzendorf, a Silesian village in Austria. He worked as a monk in the Augustinian Monastery in Brunn city, Austria.

In 1856-57, Mendel initiated his groundbreaking experiments on heredity using pea plants (Pisum sativum). His work with pea plants continued until 1865 in the 19th century.

The results of Mendel's experiments were published in the science journal "Nature For schender varien" in 1866. The journal was in German, titled "Verschue uber Pflangen Hybridan," and published by the 'Natural History Society of Bruno.' Mendel's paper, "Experiments in Plant Hybridization," was part of this publication. Unfortunately, Mendel did not gain recognition during his lifetime and passed away in 1884 due to kidney disease (Bright disease).

Sixteen years after Mendel's death, in 1900, his postulates were independently rediscovered by three scientists.

- Carl Correns : Germany (Experiment on Maize)
- Hugo deVries (Holland) (Experiment on Evening Primerose)
  He republished the Mendel's results in 1901 in Flora magazine
- Erich von Tschermak Seysenegg - (Austria) (Experiment on different flowering plants)
  The credit of rediscovery of Mendelism goes to three scientists.
  Correns given two laws OF Mendelism

Mendel Results Remain Hidden Due To

- During that period, Darwin's book "Origin of Species" was published, and scientists were engrossed in discussions about it.
- Mendel's ideas were ahead of their time.
- Mendel employed advanced statistical calculations in his experiments, making the results complex to comprehend.
- At the suggestion of Karl Nageli, Mendel also conducted experiments on Hawkweed (Hieracium) and beans (Lablab) plants. However, he did not achieve success with Hawkweed, as it exhibits Parthenogenesis.

Reasons For Mendel's Success

- Mendel focused on studying the inheritance of one or two traits at a time, unlike his predecessors who considered multiple traits simultaneously (e.g., Kolreuter-Tobacco plant, John Goss & Knight-Pea plant).
- Mendel chose the pea plant (Pisum sativum) for his studies, which offered several advantages.
- The garden pea is an annual plant with a short life cycle of 2-3 months, allowing for the analysis of a large number of offspring within a brief period.
- It exhibits many distinct traits.
- The pea plant naturally self-pollinates, maintaining the purity of its characteristics.
- Artificial cross-pollination can be performed, facilitating hybridization.
- Pea plants are easy to cultivate.
- Mendel also worked on rajma (beans) in addition to peas.
- Mendel conducted a quantitative analysis of the inheritance of qualitative traits.
- He meticulously maintained statistical records of all his experiments.

Mendel's work : Mendel studied 7 characters or 7 pairs of contrasting traits.

Actual data obtained by Mendel in F_2 progenies in garden pea				
S.No.	**Character (Chromosomal position)**	**Dominant**	**Recessive**	**Ratio**
1	Length of plant (4)	787 (tall)	277 (dwarf)	2.84:1
2	Colour of flower (1)	705 (violet)	224 (white)	3.15:1
3	Pod or flower position (4)	651 (axial)	207 (terminal)	3.14:1
4	Shape of pod (4)	882 (inflated)	299 (constricted)	2.94:1
5	Colour of pod (5)	428 (green)	152 (yellow)	2.82:1
6	Shape of seed (7)	5,474 (round)	1850 (wrinkled)	2.96:1
7	Colour of cotyledon (1)	6,022 (yellow)	2,001 (green)	3.01:1
Average of all traits studied				2.98:(=3:1)

Technique Of Mendel

- Mendel devised a technique known as Emasculation and Bagging for hybridization in plants.
- The flowers of the pea plant are bisexual, with one acting as male and the other as female.
- In the case of the female plant, its stamens are removed at an early stage, a process called Emasculation, which prevents self-pollination.
- Emasculated flowers are then covered with bags, a practice referred to as Bagging.
- Bagging is employed solely to avoid undesirable cross-pollination.
- Mature pollen grains are collected from male plants and spread over the emasculated flowers.
- Seeds are produced in the female flower after pollination.
- The plants resulting from these seeds are termed the First Filial generation or F1 generation according to Mendel.
- Mendel was a remarkable plant breeder, often referred to as a true breeder.

Terminology :

1. **Factor (Gene):** Mendelian factor, known as a gene in modern genetics, is an inheritance unit passing through gametes, controlling the expression of a trait. Genes consist of DNA and play a role in inheritance.
2. **Allele or Allelomorph:** Alleles are contrasting forms of a gene found at the same locus in homologous chromosomes. They control the expression of a trait, such as tallness (T) and dwarfness (t).
3. **Phenotype:** The external appearance, like color or shape, is represented by phenotype. Examples include red color, tallness, or dwarfness.
4. **Genotype:** It indicates the genetic constitution of an individual. For instance, the genotype of hybrid tall pea plants is Tt, pure tall TT, and dwarf tt. The terms 'Phenotype' and 'Genotype' were first used by Johannson in 1911.
5. **Homozygous:** An individual with identical alleles of a gene, like TT or tt.
6. **Heterozygous:** An individual with two contrasting factors or different alleles, like Tt.
7. **Hybrid:** Offspring produced by crossing genetically different individuals.
8. **Hybridization:** The process of obtaining hybrids.
9. **Reciprocal Cross:** Crossing individuals 'A' and 'B' as male and female alternately.
10. **Homologous Pair:** Zygotic pairs are termed homologous pairs.
11. **Back Cross:** A cross between F_1 hybrid and one of its parents, including test cross.
12. **Test Cross:** A cross between F_1 hybrid and a recessive parent to determine genetic makeup.

13. **Out Cross:** Cross between F_1 hybrid and a dominant parent, producing offspring with dominant characters.
14. **Genome:** The complete set of chromosomes in a nucleus; haploid cells contain a single genome.
15. **Gene Pool:** The sum of all genes and their alleles in an interbreeding population.
16. **Phenocopy:** When different genotypes produce the same phenotype due to varied environments test cross. It is not inheritable.
17. **Pure Line:** Coined by Johannson, it refers to a strain of genetically pure, true-breeding individuals.
18. **Checkerboard:** A representation of genetic analysis using squares, with female and male gametes arranged vertically. Introduced by C. Punnett.

Technique Of Mendel :

Monohybrid cross :

A monohybrid cross involves mating two organisms of the same species that differ in one pair of contrasting traits, such as plant height.

To demonstrate this, Mendel chose tall and dwarf plants in the garden pea. He performed "emasculation" by removing stamens from tall plants in bud condition, and then he covered their flowers with a bag to prevent cross-pollination, a process known as "bagging." The dwarf plants were considered male, and their flowers were covered similarly.

Upon maturity, pollen grains from dwarf plants were sprayed over the stigma of tall plants, which were again covered with a bag. Seeds were collected from the tall plants, leading to the formation of the F_1 generation through hybridization.

In the F_1 generation, Mendel observed only tall plants. Reciprocal crosses were performed, but they didn't alter the results. Subsequently, Mendel obtained the F_2 generation through self-pollination of F_1 plants, revealing a 3:1 ratio of tall to dwarf plants. This demonstrated that the tallness trait in the F_1 generation was not pure.

Mendel applied this technique to six other characters, obtaining consistent results. In a monohybrid cross, the phenotypic ratio in the F_2 generation is 3:1, while the genotypic ratio is 1:2:1. Mendel termed the hereditary units as "factors," a concept initially introduced by Correns and referred to as determinor or element by Mendel.