Genetics and it's Aspects: An Overview

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Abstract

After the rediscovery of Mendel's work, inheritance of qualitative and quantitative traits was studied. In the later period of time, Mendelian exception were discovered which included incomplete dominance, multiple alleles and so on. It has expanded itself from gene to molecular level leading to identifying and curing of major biological problems.

Keywords: Genetics, interaction, traits, dominance, alleles

Genetics

Branch of science which describes the heredity and variation of characters is known as genetics. Term 'Genetics' was given by Bateson in 1905. Transmission of characters from parents to the progeny was explained by Gregor John Mendel who is also known as 'Father of Genetics'.

- Mendel was born in 1822 in Brno (Czechoslovakia). He joined St. Augustinian monastery in 1843.
- In 1851 went to university of Vienna to study Physics and Mathematics.
- In 1857 he started his research in Pea.
- In 1865 he published his paper "Experiments in Plant Hybridization" in the annual proceedings of the society.
- He died in the year 1884 at an age of 62 yrs (Iltis 1932).

All the seven characters which is studied by Gregor John Mendel are inherited qualitatively no one with quantitatively (fig1).

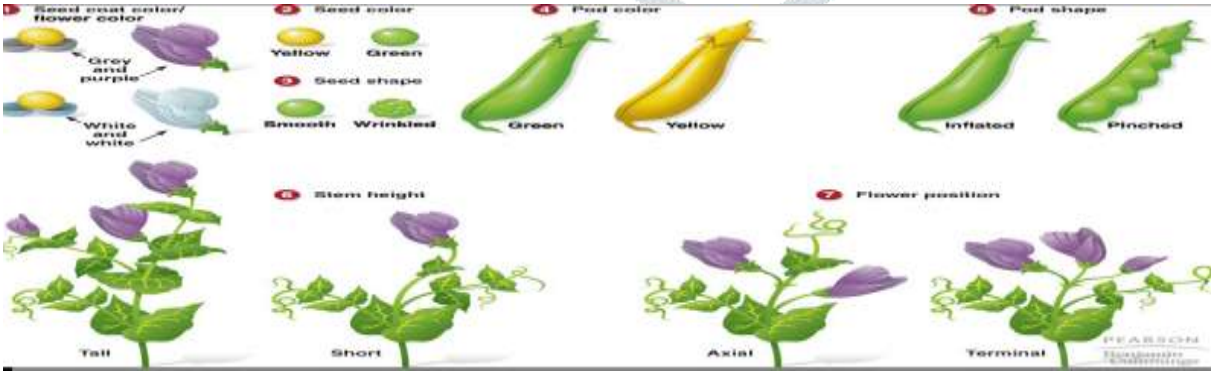
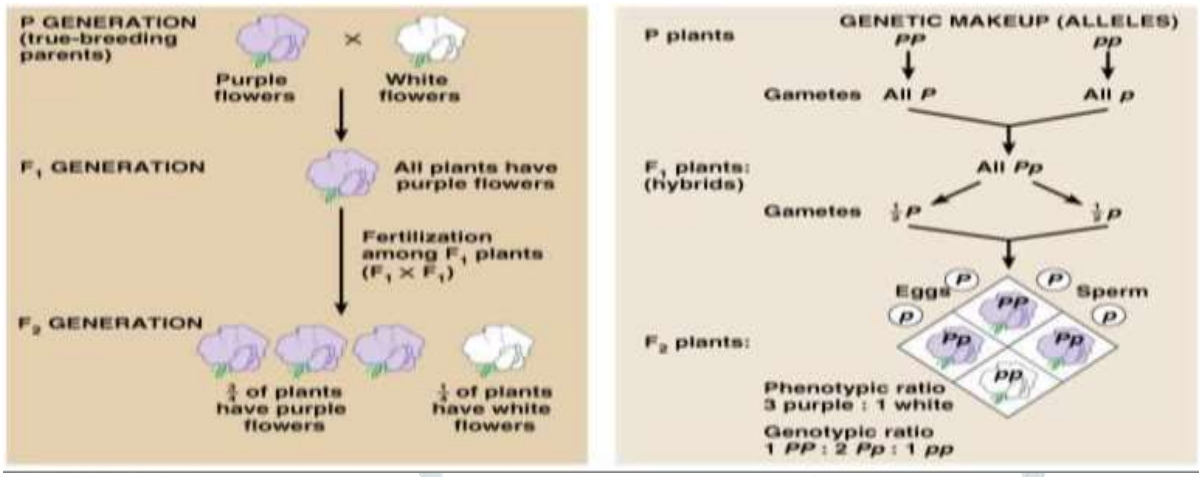


Fig.1. Seven characters studied by Mendel

For explaining transmissions of characters from parents to the progeny he gave two laws of inheritance i.e. principle of segregation and principle of independent assortment which can be studied using monohybrid and dihybrid cross respectively (Carlson 1973).

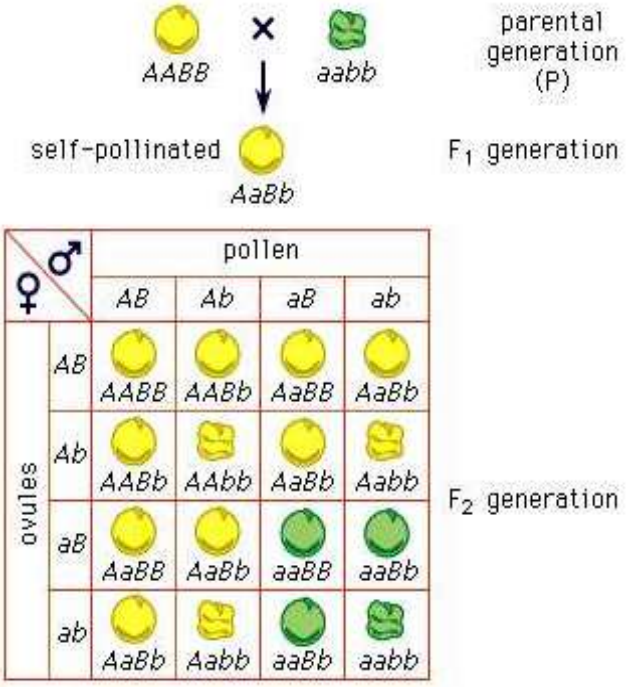
Principle of Segregation

When a cross is made between the plants for one character, the F1 produced show phenotypic expression of the dominant parent. That means the dominant phenotype is expressed in F1 and recessive phenotype is suppressed however it again reappears in the F2 generation indicating that the alleles when they stay together in F1 without mixing with each other. The phenotypic and genotypic ratio for this cross is 3:1 and 1:2:1 respectively. Since the gamete consists of only one type of allele therefore it is also known as law of purity of gametes (Singh 1990; Singh 2009 and Strickberger 1985).



Principle of Independent Assortment

When a cross is made between the plants differing in two characters, the F1 produced express the dominant allelic expression for both the characters studied. F2 generation obtained through selfing of F1 produces the phenotypic classes in the ration of 9:3:3:1 out of which the class having ratio 9 and 1 are the parental characters while class having ratio 3 and 3 are the new class possessing new phenotypic expressions. This suggests that the formation of new phenotypic class in F2 is due to random and free segregation of alleles in gametes. Therefore it is also known as 'Principle of Independent Assortment'(Singh 1990; Singh 2009 and Strickberger 1985).



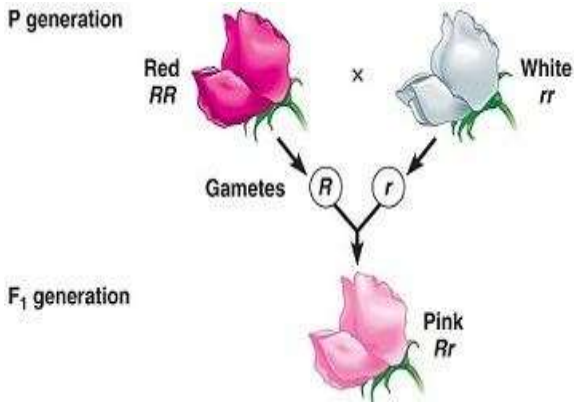
Various factors are responsible for Mendal success like proper maintenance of records, choice of material, study of individual character, mathematical background etc. (Singh 2009).

After rediscovery of Mendel's work by Correns, Tschermak and deVries in the year 1900. Several other scientists discovered some new concepts which are said as Mendelian exceptions. Some of them will be discussed in this overview.

1. Incomplete Dominance:

The characters which were studied by Mendel showed complete dominance. But in some cases in the F1 intermediate phenotypic expression was observed. Such type of dominance is defined as **'incomplete dominance'**.

In *Mirabilis jalapa*, when the cross is made between plant having red flower with the plant having white flower colour, the F1 expresses pink flower colour and when F2 is produced from such generation it produces three phenotypic classes i.e. red, pink, white bearing same phenotypic and genotypic ratio i.e. 1:2:1.



2. Co-dominance:

When both the alleles express themselves in the heterozygote it is defined as 'Co dominance'. The ABO blood group in humans is the perfect example of the same.

If a cross is made between the male having AB blood group with the female having AB blood group, then 25 % chances are that the progeny will have A or B blood group and 50 % chances are that the progeny will have AB blood group. This concluded that when both I^A and I^B allele come together in a genotype both of them express themselves in the genotype indicating Co dominance.

	I^A	I^B	i
I^A	I^AI^A A	I^AI^B AB	I^Ai A
I^B	I^BI^A AB	I^BI^B B	I^Bi B
i	iI^A A	iI^B B	ii O

3. Multiple Alleles

Mendel studied two allelic forms for each character. In the later period of time, some characters were observed which were governed by the gene having more than two alleles. Such types of alleles are known as 'Multiple Alleles'. They share the same locus on chromosomes, govern the same character but with different phenotypic expressions. Fur colours of rabbit (Agouti, Chinchilla, Himalayan & Albino), wing type of drosophila (Normal, Nicked, Notched, Strap, Vestigial) are some examples of multiple alleles (fig 2&3).

Phenotype	Allele	Possible Genotypes	Order of Dominance
Full color (brown)	C (capital C)	C^CC^{ch} C^CC^h C^CC	Dominant over all others
Chinchilla	C^{ch} (lowercase c with ch superscript)	$C^{ch}C^{ch}$ $C^{ch}C^h$ $C^{ch}C$	Dominant over Himalayan and albino
Himalayan	C^h (lowercase c with h superscript)	C^hC^h C^hC	Dominant over albino
Albino	c (lowercase c)	cc	Recessive to all others

Fig.2. Fur colours of rabbit

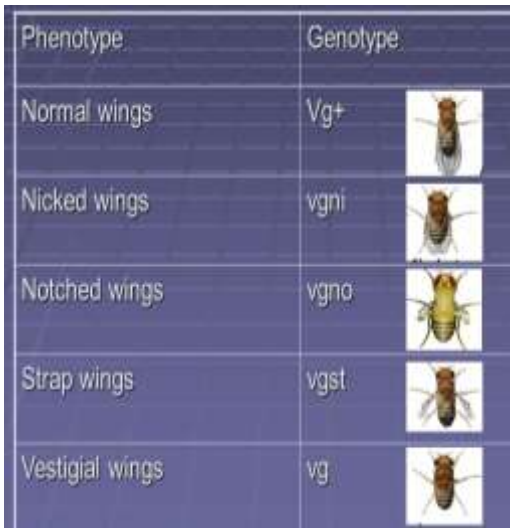


Fig.3. Wing type of drosophila

4. Gene Interaction

   In some cases the characters are governed by two genes which may or may not have same phenotypic expression. Such types of interactions are known as 'epistatic gene interactions'. In these interactions the phenotypic ratio of dihybrid is 9:3:3:1 in which class 9 and 1 are your new classes and classes 3 and 3 are your parental classes. There are six types of gene interactions i.e. duplicate gene interaction, complementary gene interaction, supplementary gene interaction, inhibitory gene interaction, masking gene interaction and polymeric gene interaction. All of them are modification of normal dihybrid ratio (Singh 1990; Singh 2009 and Strickberger 1985).

It can be concluded that genetics came into proper existence in the 1900s with the rediscovery of Mendel's work. In the beginning the inheritance of traits was studied, later on it went on a paradigm shift from phenotypic level to the molecular and evolutionary level. It helps in detection of hereditary diseases to curing such diseases by measuring the response of medicine on different individuals.

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