K. T. S. P. Mandal's

Hutatma Rajguru Mahavidyalaya

Rajgurunagar 410 505.

Department of Zoology

T. Y. B. Sc.

ZO 354: Genetics

Semester V

By

Prof. D. N. Birhade.

Exception to Mendelian Inheritance

Incomplete dominance

Codominance

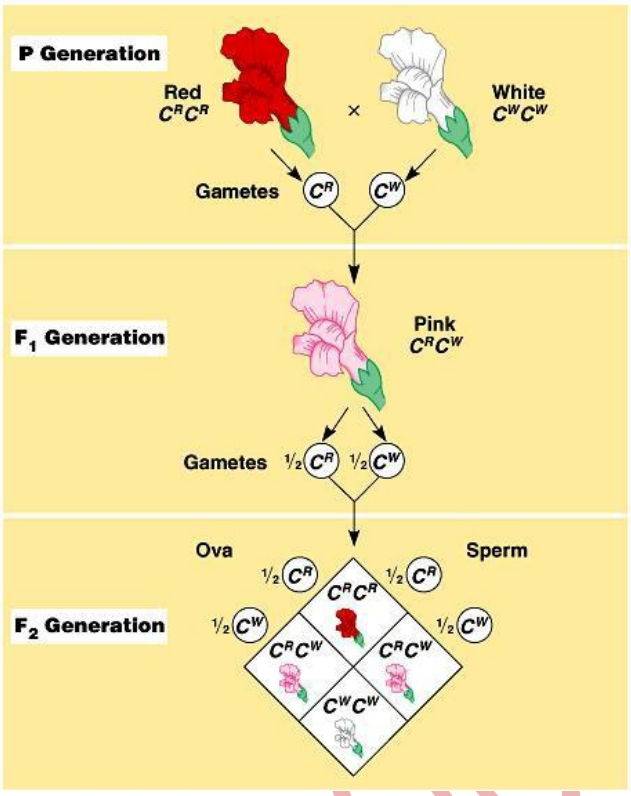
Lethal genes

Incompletedominance

Mendel always observed complete dominance of one allele over the other for all the seven characters, which he studied, in garden pea. Later on cases of incomplete dominance were reported. For example, in four ëoí clock plant (*Mirabilis jalapa*) there are two types of flower viz. red and white. A cross between red and white flowered plants produced plants with intermediate flower colour i.e. pink colourinF1andamodifiedratioof1red:2pink:1Whitein F2.

Parents Red flower x White flower RR x rr

F1 Rr pink flower

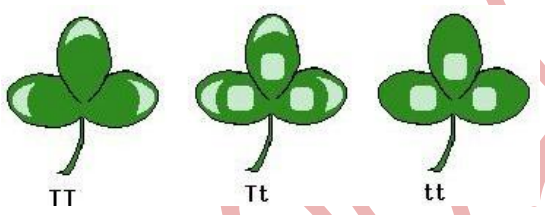


F2 1Red (Rr) : 2Pink (RR) :1White (rr)

Incomplete dominance in flowers of *Mirabilis jalapa*

Codominance

Incaseofcodominancebothallelesexpresstheirphenotypesinheterozygotegreaterthananinterm ediateone.TheexampleisABbloodgroupinhuman.Thepeoplewhohaveblood type AB are heterozygous exhibiting phenotypes for both the IA and IB alleles. In otherwords, heterozygotes for codominant alleles are phenotypically similar to both parental types.The main difference between codominance andincomplete dominance lies in the way in whichgenesact.Incaseofcodominancebothallelesareactivewhileincaseofincompletedominanceboth alleles blend tomakean intermediate one.

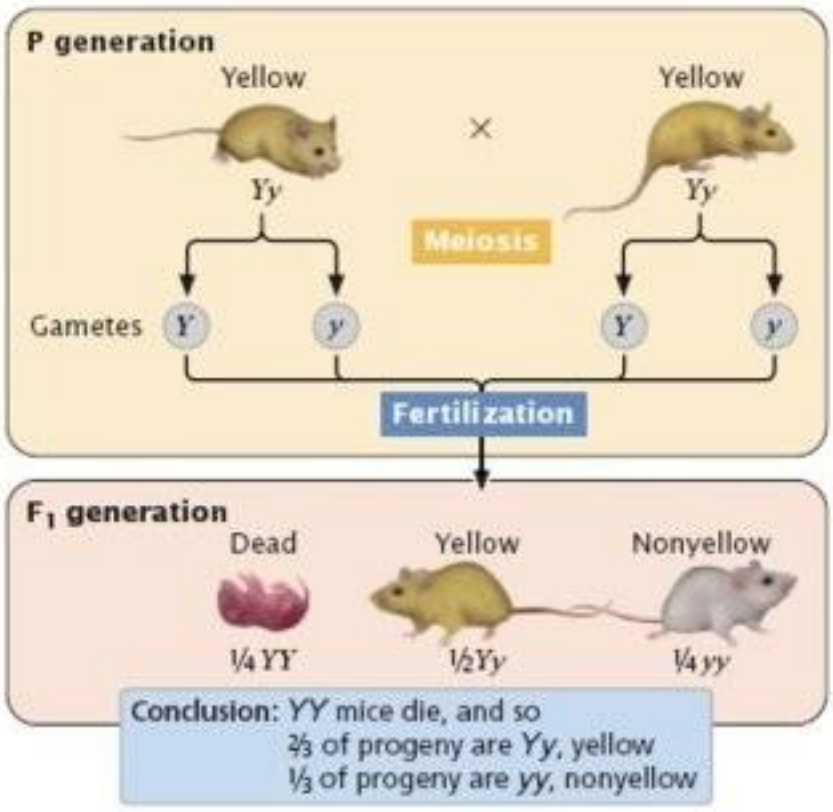


Codominance-both genes fully expressed

Lethal genes

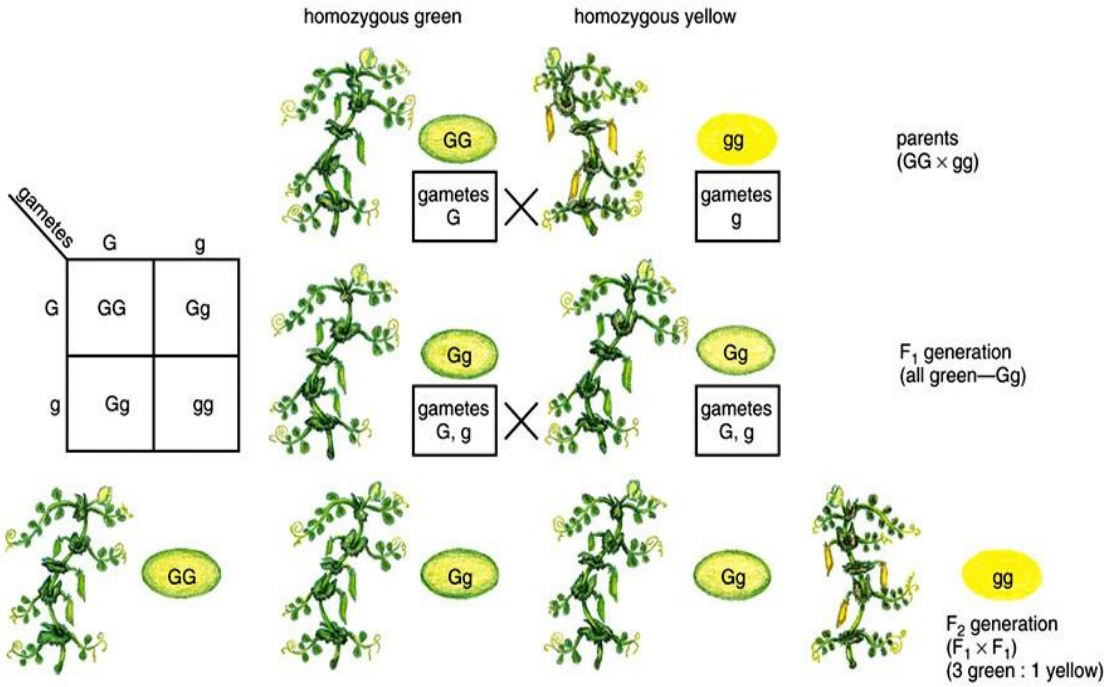
Gene, which causes the death of its carrier when in homozygous condition is called lethal gene. Mendel's findings were based on equal survival of all genotypes. In normal segregation ratio of 3:1 is modified into 2:1 ratio. Lethal genes have been reported in both animals as well as plants. In mice allele for yellow coat colour is dominant over grey. When a cross is made between yellow and grey a ratio of 1:1 for yellow and gray mice was observed. This indicated that yellow mice a real ways heterozygous. Because yellow homozygotes are never born because of homozygous lethality. Such genes were not observed by Mendel. He always got 3:1 ratio in F2 for single gene characters.

Lethal genes can be recessive, as in the aforementioned mouse experiments. Lethal genes can also be dominant, conditional, semi lethal, or synthetic, depending on the gene or genes involved.



MONOHYBRID CROSS

Across is made between two true-breeding parents differing for a single trait, producing an F1generation.These plants are inter crossed to produce an F2generation.



Dihybrid Crosses

The following legends were described for peas by Mendel:

TT-Tall

tt - dwarf

G - green (pod)

gg -yellow

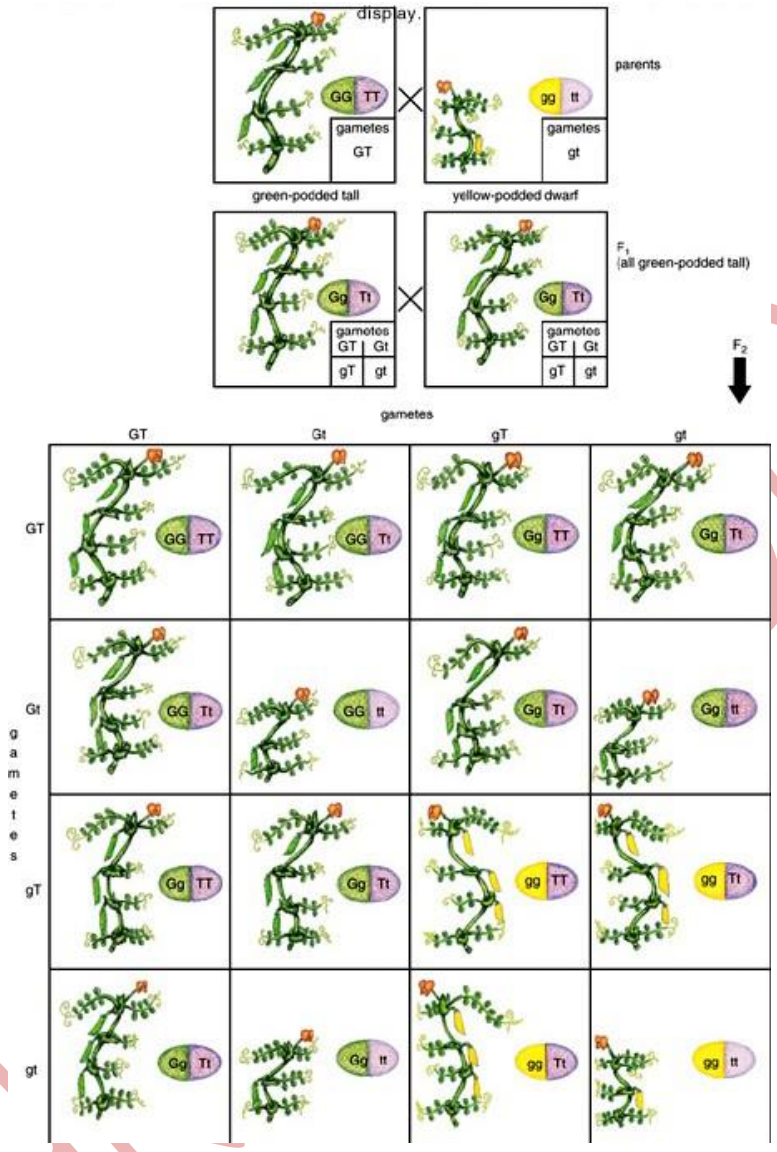
Pure breeding parents can be crossed to produce a dihybrid meaning that 2 genes affecting different traits are heterozygous(segregating)inallthef1progeny.

Examples: TT, GG X tt, gg —— Tt, Gg

TT, gg X tt, GG —— Tt, Gg

When the F1 is self fertilized (plants) or crossed with another Tt, Gg individual, theprogenywillshowtheexpected3dominant:1recessivephenotypicratioforeachtrait.Ifthetwotraitsar eindependent,the two 3:1ratios will interact to give a ratio based on16ths.

#	Genotypes	Phenotypes
9	T_,G_	Tall, Green
3	T_,gg	Tall, yellow
3	tt,G_	Dwarf, Green
1	tt,gg	Dwarf, Yellow



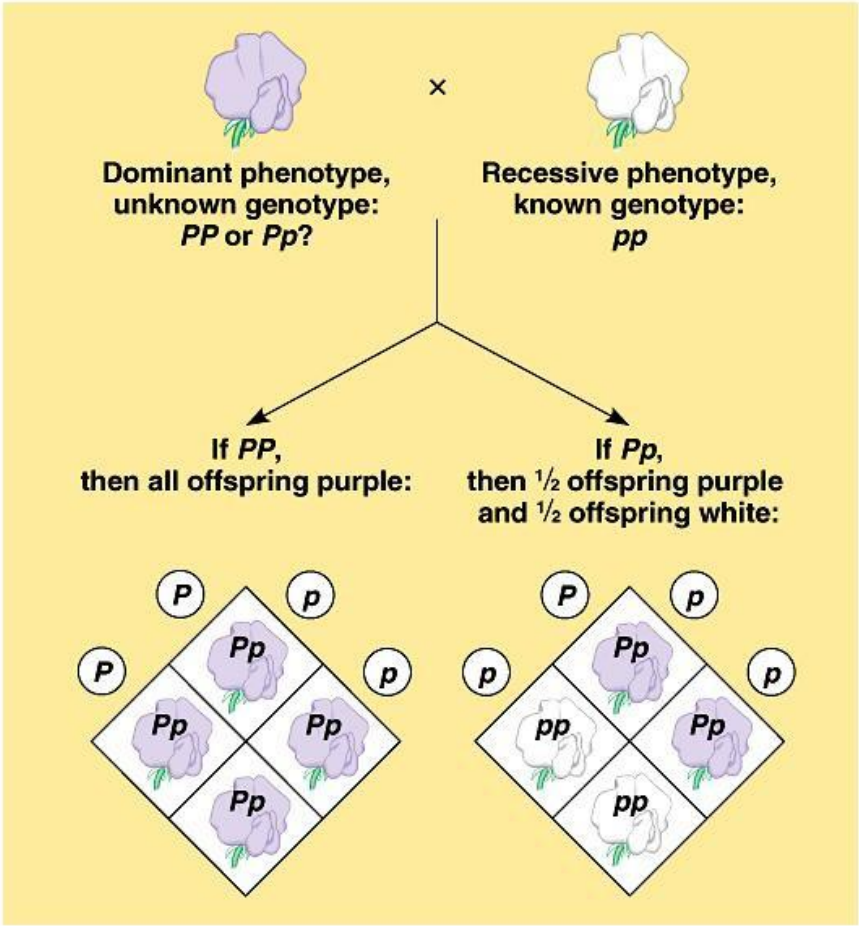
Backcross

Backcrossing is a crossing of a hybrid with one of its parents or an individual genetically similar to its parent, in order to achieve offspring with a genetic identity which is closer to that of the parent.

The Test cross

Because some alleles are dominant over others, the phenotype of an organism does not always reflect its genotype. A recessive phenotype (yellow) is only expressed with the organismishomozygousrecessive(gg).Apeaplantwithgreenpodsmaybeeitherhomozygousdominant(GG)orheterozygous(Gg).Todeterminewhetheranorganismwithadominace phenotype(e.g.greenpodcolor)ishomozygousdominantorheterozygous,youusea*testcross*.

The breeding of an organism of unknown genotype with a homozygous recessive. If alltheprogenyofthetestcrosshavegreenpods,thenthegreenpodparentwasprobablyhomozygous dominant since a GG x gg cross produces Gg progeny. If the progeny of thetestcrosscontainsbothgreenandyellowphenotypes,thenthegreenpodparentwasheterozygous since a Gg x gg cross produces Gg and gg progeny in a 1:1 ratio. The test cross was devised by Mendel and is still an important too genetic studies.


×
Dominant phenotype, unknown genotype: PP or Pp?
Recessive phenotype, known genotype: pp
If PP, then all offspring purple:
If Pp, then ½ offspring purple and ½ offspring white:
P
p
Pp
pp