DOMINANCE RELATIONSHIP

'ONE SMALL POSITIVE THOUGHT IN THE MORNING CAN CHANGE YOUR WHOLE DAY'

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INTRODUCTION

DOMINANCE: The phenomenon of a F1 hybrid which are identical to one of its parents for a character.

DOMINANT: A character which is express in F1 hybrid.

RECESSIVE: A character which is supress in F1 hybrid.

DOMINANT ALLELE: In the F1 hybrid, dominant and recessive alleles of a gene are present together in heterozygous state, only one of the two alleles of a gene is able to express itself and produce a character.

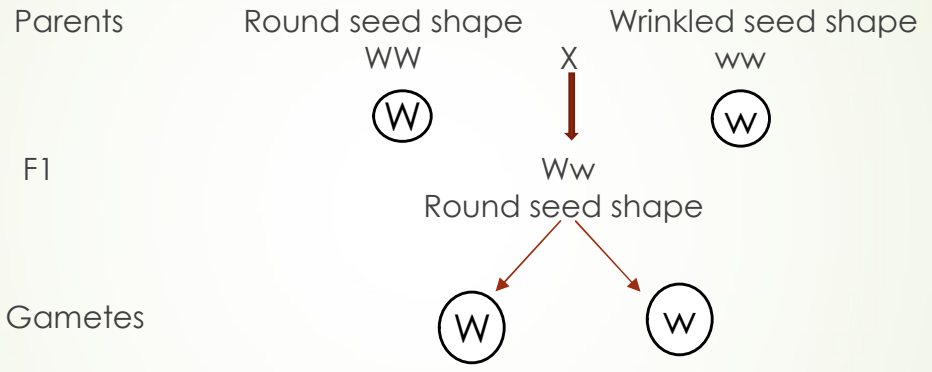
RECESSIVE ALLELE: In the F1 hybrid, dominant and recessive alleles of a gene are present together in heterozygous state but recessive allele of that gene is enable to express itself.

In the terms of dominant and recessive, its was first used by Mendel himself. Later Mendel was discovered that F1 is not identical with one of the parents, it may either intermediate between two parents. These phenomenon have been classified into the following groups: complete dominance, incomplete or partial dominance, codominance and overdominance.

A. COMPLETE DOMINANCE

A phenomenon produce by heterozygotes which is identical with that produces by homozygotes for a concerned dominant allele. In an other words, a allele is express themselves in F1 hybrid, because dominant allele is completely dominant over recessive allele.

For example: Seed shape in pea



F2

♂	W	W
W	WW	Ww
w	Ww	ww

Phenotypic ratio: 3 Round : 1 Wrinkled

Genotypic ratio: 1WW : 2 Ww : 1 ww

B. INCOMPLETE DOMINANCE

The phenomenon which appear between dominant and recessive phenotypes in F1 hybrid. Therefore, the phenotype of heterozygotes expressed intermediate.

For example: Flower colour of four 'O' clock plant (*Mirabilis jalapa*)

Parents — Red flower — White flower

RR X rr

Gametes: R and r

F1: Rr

Pink flower

Gamete: R and r

F2

♂	R	r
R	RR	Rr
r	Rr	rr

Phenotypic ratio: 1 Red : 2 Pink : 1 White

Genotypic ratio: 1RR : 2Rr : 1rr

D. CODOMINANCE

The equal intensity of both the alleles of a gene of heterozygotes expressed itself, and both the genes expressed own phenotypes separately in the heterozygotes.

For examples: Blood group antigen in human (Blood group ABO in man)

A dominant allele of gene I^A produces antigen A which give rise to blood group A, and dominant allele I^B produces antigen B which give rise to blood group B, while heterozygotes $I^A I^B$, both alleles I^A and I^B produce their respective antigen A and antigen B.

If marriage between two heterozygotes $I^A I^B$ produce three types of progenies

Parents Blood group AB X Blood group AB

$I^A I^B$ X $I^A I^B$

Gametes

Progeny

♂	I^A	I^B
I^A	$I^A I^A$	$I^A I^B$
I^B	$I^A I^B$	$I^B I^B$

Phenotypic ratio: 1A : 2AB : 1B Blood group

Genotypic ratio: 1 $I^A I^A$: 2 $I^A I^B$: 1 $I^B I^B$

E. OVERDOMINANCE

The intensity of phenotype produce by the heterozygotes is more than that produced by the homozygotes for the concerned dominant allele. This may be due to repulsion phase linkages or epistasis.

For example: White eye gene in Drosophila.

White eye gene show overdominance due to some of the pigment such as sepiapteridine and himmelblaus.

The homozygote gene ww produce white eye in Drosophila, if they are present in low concentration, while dominant allele W produce normal dull eye colour in both homozygotes as well as heterozygotes condition, because the eye pigment are present relatively high concentration in both the conditions.

White eye gene in Drosophila is a sex limited gene which would not show the typical ratio 3:1 in F2, while autosome gene which is not located on the X-chromosome, showing overdominance, and give rise to 1:2:1 ratio in F2 generation.

LETHAL GENE ACTION

During inheritance, every trait have equal survival in the gametes during zygote formation in F2 generation while some genes are affects the survival of those individuals, if they are present in the appropriate genotypes. This affects may increase or decrease the survival of all the individuals carrying the gene. All such genes may be classified into following groups:

A. LETHAL GENE:

An allele of a gene which causes the death of all those individuals which carry it in the appropriate genotype, death occurs any time before the individuals reach adulthood. The lethal action of all the alleles would depend on it dominance relationship with it other alleles. Lethal gene may be classifying into the following categories:

1. **RECESSIVE LETHAL:**

Mostly lethal gene are recessive lethal, and its effects is expressed if it is present in the homozygous condition. While in heterozygous condition its has no effects for death of individual.

According to Cuenot (1905) French scientist was discovered a recessive lethal effect on yellow coat colour in mice. This lethal effect is produce by a dominant allele Y, while recessive allele y determines the normal gray coat colour, and has no lethal effect.

All the yellow mice are heterozygous Yy. The mating between yellow females with yellow males would produce one fourth YY, one half Yy and one fourth yy. Homozygote YY embryos will die at a very early stage, heterozygotes Yy embryos give rise to yellow mice and homozygote yy embryos produce gray individuals. So the progeny obtained by mating in mice produce 2:1 ratio in the place of 3:1 ratio.

All the yellow coat colour mice were heterozygotes Yy. But Cuenot was enable to find a mice homozygous for the YY gene.

Later, Castle and Little was suggested that the dominant allele Y is a recessive lethal which cause death of homozygous YY embryos at an early stage of development, so that YY embryos do not survive.

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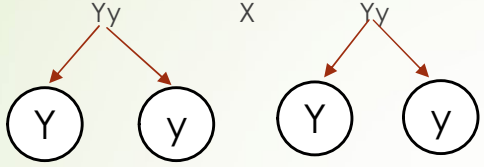
Inheritance of yellow colour in mice

Parents Yellow mice Yy X Yellow mice Yy

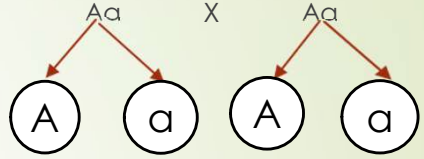


Progeny

♂	Y	y
Y	YY (dies)	Yy (Yellow)
y	Yy (Yellow)	Yy (Grey)

Phenotypic ratio: 2 Yellow mice : 1 Gray mice
Genotypic ratio: 2 YY : 1 yy

Parents Green Aa X Green Aa



Progeny

	A♂	A
A	AA (Green)	Aa (Green)
a	Aa (Green)	aa (dies)

Phenotypic ratio: 3 green : 1 albino
Genotypic ratio: 1 AA : 2 Aa : ! aa

So there are many genes which have dominant phenotypic effect while they are recessive lethal. For examples:

- Aurea gene which producing yellow leave in the heterozygous state in *Antirrhinum majus.*
- *Dexter* gene in cattle and *Achondroplastic* dwarfness in man, both the genes are produce a dwarf condition in the heterozygotes.
- *Xeroderma pigmentosum* which producing Heavy freckling in the heterozygotes in man.
- Albino seedling in barley, character of albino seedling is controlled by recessive allele. If these alleles is in homozygotes stage then seedling produce white, and totally devoid of chlorophyll. In this condition, photosynthesis is not done.

2. DOMINANT LETHAL:

- Such gene reduce viability in heterozygotes condition. For example: Epiloia gene in human.
- Epiloia gene causes abnormal skin growth, several mental defects and multiple tumours in heterozygotes condition, and they are die before reaching adulthood. Dominant lethal produce every generation through mutation, so it can not maintained in the population. While recessive lethals are maintained in the heterozygous condition.

3. CONDITIONAL LATHALS:

- The lethal action of such gene require a specific environmental condition. For example: The mutants in Drosophila, Neurospora, barley, maize etc.
- Some individuals are temperature sensitive mutations which requires a specific elevated temperature for lethal action. Example, kidney-eyed mutant of the wasp *Bracon hebetor* (*Hebrobracon juglandis*). This gene survive at low temperature, and it have lethal effects on 30^0 C and above.
- A chlorophyll mutant of barley require a temperature of 19^0 C and above, while albino seedlings produce below the temperature of 8^0 C, it has lethal effect at low temperature.
- *Xeroderma pigmentosumin* humans, this mutant require light for development.

4. BLANCED LETHALS:

- A progeny produced by mating between heterozygotes for a lethal gene, that progeny exhibits 1/3 individuals for the normal gene in homozygous and 2/3 individuals for lethal gene in heterozygotes condition. All the heterozygotes progeny for lethal gene are survival, but homozygotes progeny for normal gene are not survive. Because two non allelic recessive lethal are linked in the repulson phase in such a system.

Parents Gametes Progeny

$\frac{l_1L_2}{L_1l_2}$ l_1L_2 L_1l_2

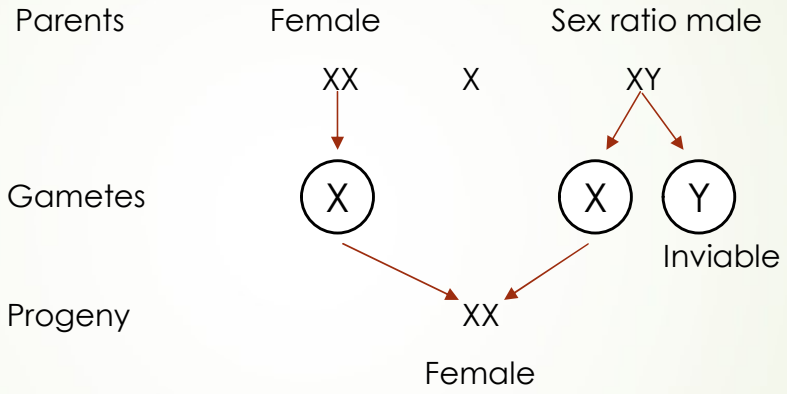
X

$\frac{l_1L_2}{L_1l_2}$ l_1L_2 L_1l_2

	l_1L_2	L_1l_2
l_1L_2	$\frac{l_1L_2}{l_1L_2}$ Dies	$\frac{l_1L_2}{L_1l_2}$ Parental
L_1l_2	$\frac{l_1L_2}{L_1l_2}$ Parental	$\frac{L_1l_2}{L_1l_2}$ Dies

5. GAMETIC LETHALS:

- 'Some genes are incompatible with other genes/gametes, and make them incompatible of fertilization'. Gametic lethal are split away from the typical ratio which are expected in segregating generations, this condition is called *segregating distortion*, it is also known as *meiotic drive*.
- In 'sex ratio' males of *Drosophila pseudoobscura*, it produce only half sperm than normal males. If these males are mated to normal females it produce almost all the females progeny, because male have X chromosome only, and their Y chromosome are non functional.



6. SEMILETHAL GENES:

- This types of lethal gene do not death of all the individuals if they are present in appropriate genotype. The individuals are death more than 90%, and only less than10% of individuals survive. *Xanth* mutants of some plants are semi lethal in the homozygous condition.

B. SUBVITAL LETHAL:

- Mostly mutants gene reduce viability of the individual, if the gene present in the appropriate genotype as compare to normal individuals. In such condition, these lethal gene kill less than 90% individual, and more than 10% individual are survive. For example, Miniature wings in Drosophila, and Viridis chlorophyll mutants in barley.

c. VITAL GENE:

- Some gene do not affect the individual, if these genes present in the appropriate genotype. In such condition, that gene neither enhance and nor reduce the viability of the individual. For example, seed shape in pea, and wild allele of all the genes of an individual.

D. SUPERVITAL GENES:

- Mutant alleles which enhance the survival of individual, if that genes are present in the appropriate genotype. For example, disease resistance genes protect the individual against the concerned disease, so these disease resistance genes may be regarded as supervital genes.
- Similarly, genes of the various abiotic stresses such as salinity, alkalinity, high temperature, drought may also be regarded as supervital genes, which enhance the fitness of the plants.

HAVE A NICE DAY

THANK YOU