paper - 7

Cytology, Genetics, Evolution & plant Breeding.

"Kishor publications."

" failure is just practice for success -

Success is SUM of All of your failures "

- Kishor

[m.R. kuy]

Cell & Chromosome Biology

Cell as a fundamental unit of life & organism.

The cell is the str & fun unit of life. It may be also regarded as the basic unit of biological activity. the cells of the living kingdom may be divided into 2 categories.

prokaryotes lack a well-defined nucleus & posses relatively simple str. these includes the various Bacteria.

Eukaryotes posses a well defined nucleus & are more complex in their str & fun. the higher organisms are composed of eukaryotic cells.

Str of Eukaryotic chromosome.

chromosomes are thread like deeply stained compact DNA protein complex that carry genetic information in a linear sequence of genes

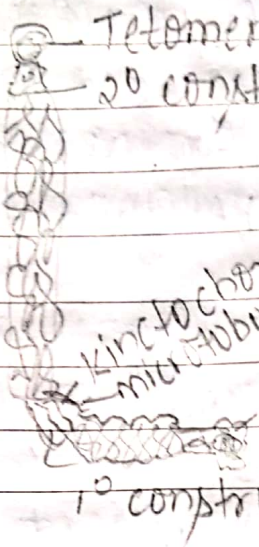
They are the physical basis of heridity as they store, replicate, transcribe & transmit the genetic information.

A typical chromosome has following parts

a) centromere (1° constriction)

A metaphase chr has 2 identical sister chromatids which are attached to each other at a point called centromere. At anaphase the centromere splits the sister chromatids sepearate to become two

anaphasic chromosomes. Either sides of centromere called arms.



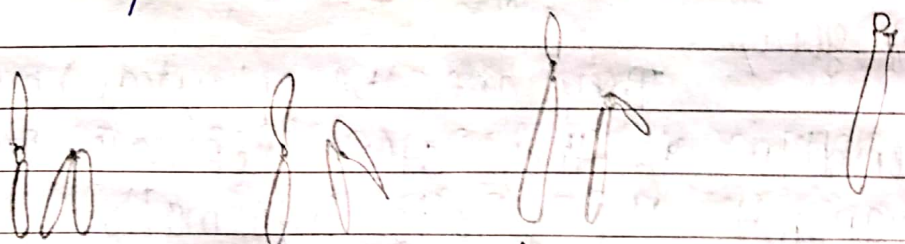
1° constriction with centrome.

Telocentric: centromere is at one end of the chromosomes

Acrocentric: centromere occupies a sub-terminal position.

Submetacentric: centromere is located away from the centre of the chromosomes

metacentric: centromere at the middle of the chromosomal length



meta sub-meta Acro Telocentric

b) kinetochore: These are complex str found in centromeric region of ch. the centromere has 2 kinetochores present syd by syd in line with chromosomal arms Each kinetochore is a complex system of fibres & C-shaped commisural cap. these cups are made of protins from the outer part of each cup fine hairy

outgrowth called coronary hair develop.

c) Secondary constrictions: It have 2 parts NOR (Nuclear organizer region) & joint. They are always const in their positions & often used as markers. The NOR are specialised to produce nucleous & rRNA. The joints sometime develop due to breaking & fusion of chromosom segments.

d) Telomeres: Terminal ends of chromosomes are called Telomers.
If telomers are damaged the chromosomal ends may stick together resulting in abnormality Telomers provide stability by preventing end fusions of chromosomes. It causes senescense & aging.

e) Chromomeres: Sometimes along the entire length of interphase chromosomes appear beaded due to accumulation of chromatin these bead-like str called chromomeres.

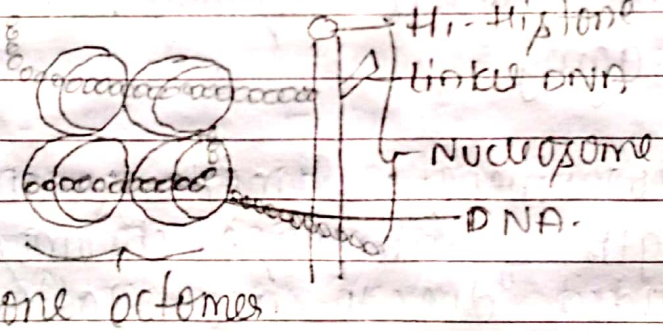
Functions of Chromosomes.
* They contain heriditary information in the form of genes & acts as heriditary vehicle.
* They control division, growth, metabolism & diff of cell.
* The ploidy of chr determines the expression of gametophyte.
* Sex chromosomes determines sex of individuals
* crossing over & aberations of chromosomes

introduce variation in population.
* They transmit heriditary information from generation to generation.

Nucleosome & its importance in the orgindsation of eukaryotic chromosomes.

The length of DNA is much greater than the dimension of nucleus.

In eukaryotes the DNA organisation is much more complex than prokaryotes. The basic unit of DNA packaging in eukaryotes called Nucleosome. The nucleosome consists of -ve charged DNA wrapped up with +vely charged histone proteins.



Histone proteins are +vely charge due to abudance of amino ā namely, lysine & Arginine in their side. there are 5 types of histone namely. H_1, H_{2A}, H_{2B}, H_3 & H_4.
A small amount of DNA called Linker DNA runs blw adjacent chromosome core.
Nucleosomes constitue the repeating units of str in the nucleus called chromatin.
Euchromatin represents regions of chromosata that are highly uncoiled at interphase & highly coiled at metaphase whereas

heterochromatic zones have permently coiled parts of chromonemata.
Heterochromatin stain deeply with specific DNA stain & it also contains genes but genetically less active whereas euchromatin is generally more active than hetero-chromatin.

Types of chromosomes.

1. monocentric :- It has only one centromere.
2. polycentric: It has many chromosomes present at centromere.
3. Holocentric: chromosomes centromeres are not clearly seen. But entire surface of chromosomes shows diffused centric activity.
4. Acentric chromosomes: segement of chromosomes without centromere. Such chromosomes are incapable of anaphase movement

Kinds of chromosomes.

1. Lampbrush chromosomes: largest chromosome found in yolk rich oocyte nuclei of certain vertebrates: they can be seen with naked Eye are classified by fine lateral loops, arising from the chromosomes. these loops gives it a brush like appearance. first discovered by flemming (1882).
It consist of longitudinal axis formed by a singe DNA molecule along which several hundred bead-like chromosomes are

distributed in a linear fusion.

Functions:

* lampbrush chromosomes involve synthesis of RNA & protein by their Loops.
* They also help in the formation of certain amt of yolk material for the egg.

2. polytene chromosomes.

First observed by Balbani in 1881 in the salivary gland cells of chromosomes. They get their name from the fact that they are formed by many parallel chromatids often more than a thousand chromatin are highly coiled & other regions are less coiled with the result that polytene ch^{n} appear to consist of light & dark bands

Functions:

* It carry genes which ultimately control physiology of our organisms.
* Helps in protein synthesis indirectly.

Cell division.

New cells arise from division of pre existing cell

walter flemming (1882) coined the term mitosis & former & moore (1905) coined term meiosis.

The cell division is controlled by mitogen.

The plant mitogen is cytokinin.

Cell cycle: The series of changes in a newly formed cell which involve in growth & division to form two daughter cells.

phase of cell cycle.

The cell cycle consist of 2 stages a non-dividing growing Interphase a short dividing mitotic phase.

Interphase	G_1 phase
Telophase	G_2 phase
metaphase	S-phase
Anaphase	I-phase.
cytokinesis	

Interphase:- The period blw 2 mitotic division called Interphase. it is also called resting phase.

further it divisible into 3-stages.

a) G_1 phase: It is first growth phase takes place at the end of cell division

b) S phase: It is synthesis phase. duplication of DNA & centriole takes place

c) G_2 phase: It is premitotic gap phase.

The formation of macromolecules for spindle formation

Mitosis:

It is a process of cell division where the chromosomes are duplicated & are equally distributed blw daughter cells. It is also called equational division. bcoz chromosomes replicate & equally distributed into 2 daughter cells.
It is also called somatic division because It is a division of somatic cells

Mitosis involves karyokinesis & cytokinesis simultaneously.

→ karyokinesis: It is continous process & for convenience is ÷ u stages. they are pro, meta, Ana & Telophase.

1) Interphase: Here NO divisions occors but in the nucleus & cytoplasm active metabolic activites occor & also increase in the volume of the cytoplasmic & nuclear substances takes place.

2. prophase: Due to DNA replication in interphase, each chromosomes now posses 2 chromatids consist of single DNA molecule wrapped in nucleoproteins
* Nucleous starts to disappear

3. pro-metaphase:

* Nuclear membrane completely disintegeates.
* chromosomes moves towards the equator.

4. metaphase.

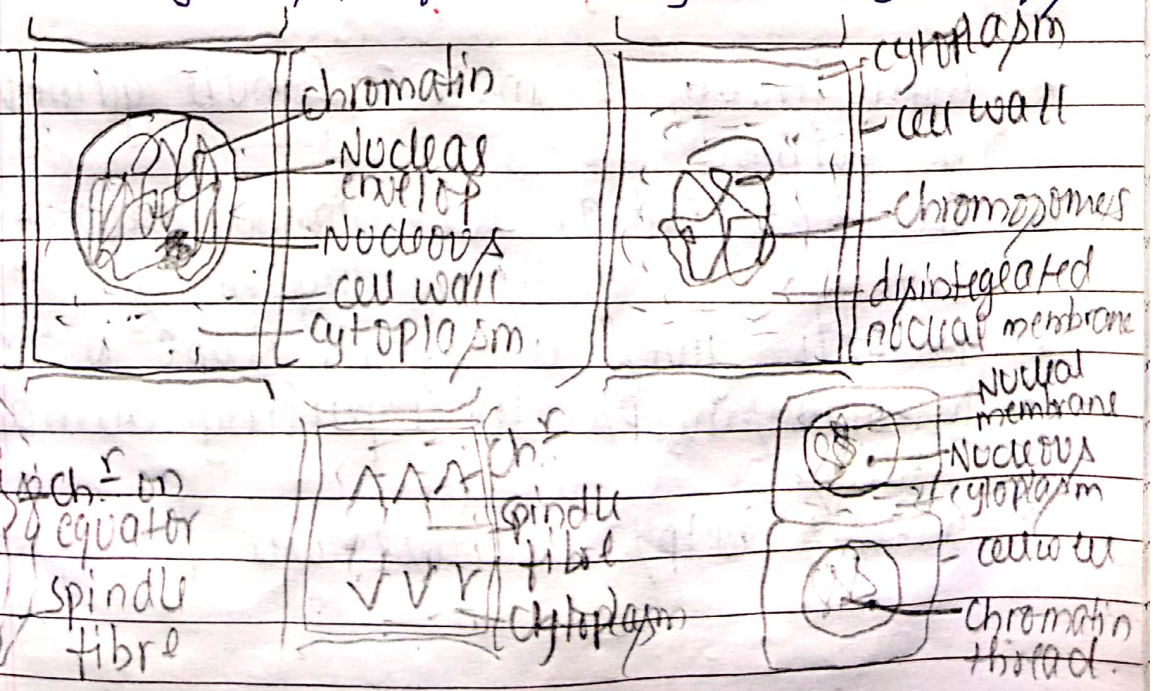
* Each chromosomes reaches to the equator & all orange themselves radially at the periphery of the spindle

5. Anaphase.

* The chromatids of the each chromosomes are seperated & form two chromosomes
* The chromosomes become shorter & thicker & migrates towards the opposite poles of the cell.

6. Telophase.

* The nucleous reappears
* Thus after the telophase, two daughter nuclei are formed due to karyokinesis, the karyokinesis followed by the cytokinesis



cytokinesis:
The final cellular division to form two new cells. In plants a cell plate forms along the line of the metaphase plate; In the cell that enters interphase the interval b/w mitotic division.

Mitotic Inhibitors:

These are drugs derived from plant sources. They inhibit cell division, where a single cell divides into 2 genetically identical daughter cells.
Mitotic inhibitors bind to tubulin & inhibit its polymerisation into microtubules
Mitotic inhibitor affect cancer cells more than normal cells because cancer cells r more rapidly therefore are more susceptible to mitotic inhibition
Ex: vinblastine, vincristine, vinorelbine etc

Significance of mitosis.

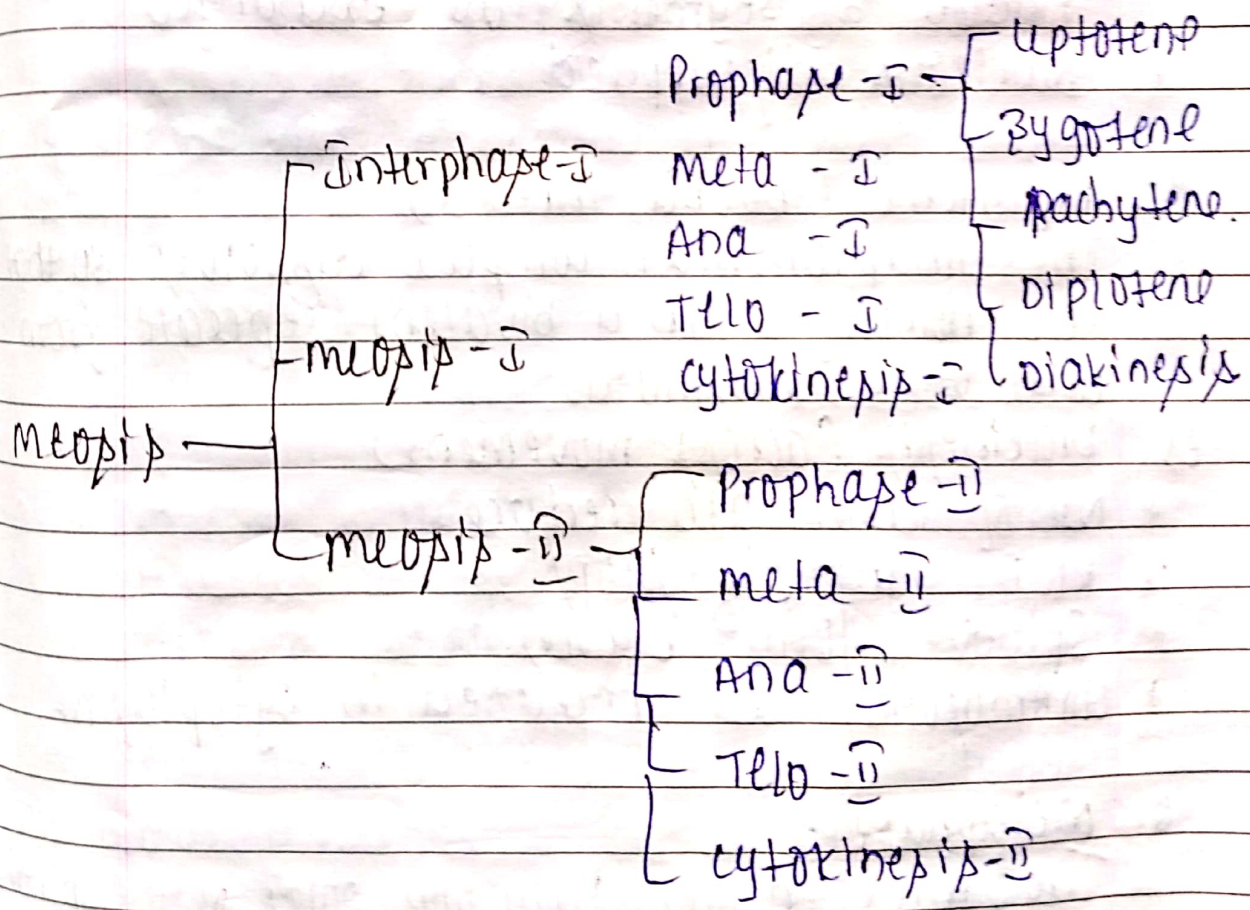
* After fusion of male & female gamete zygote is formed.
* It is essential for normal growth & development of living organisms.
* mitosis gives a definite shape of organisms.
* Mitosis helps in repairing damaged parts.
* mitosis helps in asexual propogation.

Meosis (Reductional division)

In this process of meosis the chromosomy divides once in the nucleus & cytoplasm divide twice. due to meosis 4 haplid cells are formed from single diplid cell. Meosis is a double divison in which a diplod cell divide twice to form 4 haploid daughter cell.

Interphase:

* physiologically most active stage
* Nuclear envelop remain intact
* Nuclei is prominent
* chromosomes appeas in the chromatin reticulum



1. prophase-I : It is typically longer & more complex phases.
It ÷ 5 substages:

a) Leptotene (Thin thread)
Chromosomes appears thin thread like str with series of beads called chromomas also called Bouquet formation

b) Zygotene (pairing)
pairing (or) synapsis of homologous chr takes place in a zipper-like manner.
* During synapsis a ladder like proteinous str appears called synaptonemal complex.

c) Pachytene (Thick thread)
* Coiling takes place blw non-sister chromatid with the appearance of recombination nodule & segments are exchanged.
* Nucleous disappeared.

d) Diplotene (Double thread)
The synaptonemal complex dissolves so that the homologus in a bivalent seperate from each other chiasmata.

e) Diakinesis (Across movement)
* No of chiasmata reduce.
* RNA synthesis stops
* Spindle formation occurs.
* chromosomes are released in cytoplasm

2. Metaphase-I
The microtubules from opp poles of the spindle attach to the bivalents.

3. Anaphase-I

Half of the homologous chromosomes seperate & move to opposite pole. this process is known as disjunction.

4. Telophase - I.
* Each pole possess a group of dyad chromosomes
* Spindle fibres disappears.
* Nucleoli reappears & nuclear membrane reformed

Interkinesis.
It is a very brief interphase blw meosis I & II
There is NO DNA rep^{n} i.e, s-phase absent

Meosis - II Equational (or) Homotypic division

1. prophase - II :
* chromosomes shorten & thicken
* Nucleoli disappears & nucleas envelope breaks down.
* spindle fibres appears at right angle to the spindle of meiosis - I

2. Metaphase - II :
* Spindle fibres attached to kinetochores of Sister chromatids.
* centromeres remains on the metophasic plate while the chromatids are extended towards the pole.

3. Anaphase - II
* centromeres divides & chromatids of each

chromosomes seperate & pulled towards opposite poles.
* seperated chromatids called daughter ch=

4. Telophase - II
* daughter chromosomes reach opp poles
* chromosomes uncoiled to form chromatin.
* nuclei & nuclear envelope reappear.
* spindle fibres disappear.

Cytokinesis.
a) Successive type: cytokinesis occurs after both meosis I & II. As a result four haploid cells are formed. In plants are arranged in form of Isobilateral tetrad.
b) Simultaneous type: cytokinesis occurs have twice only after meosis - II. The four haploid cells arranged in form of a tetrahedeal tetrad.

Significance of meosis:

* Meosis essentially maintains constancy in chromosomes generation to generation
* Meosis causes segregation & random assortment of genes.

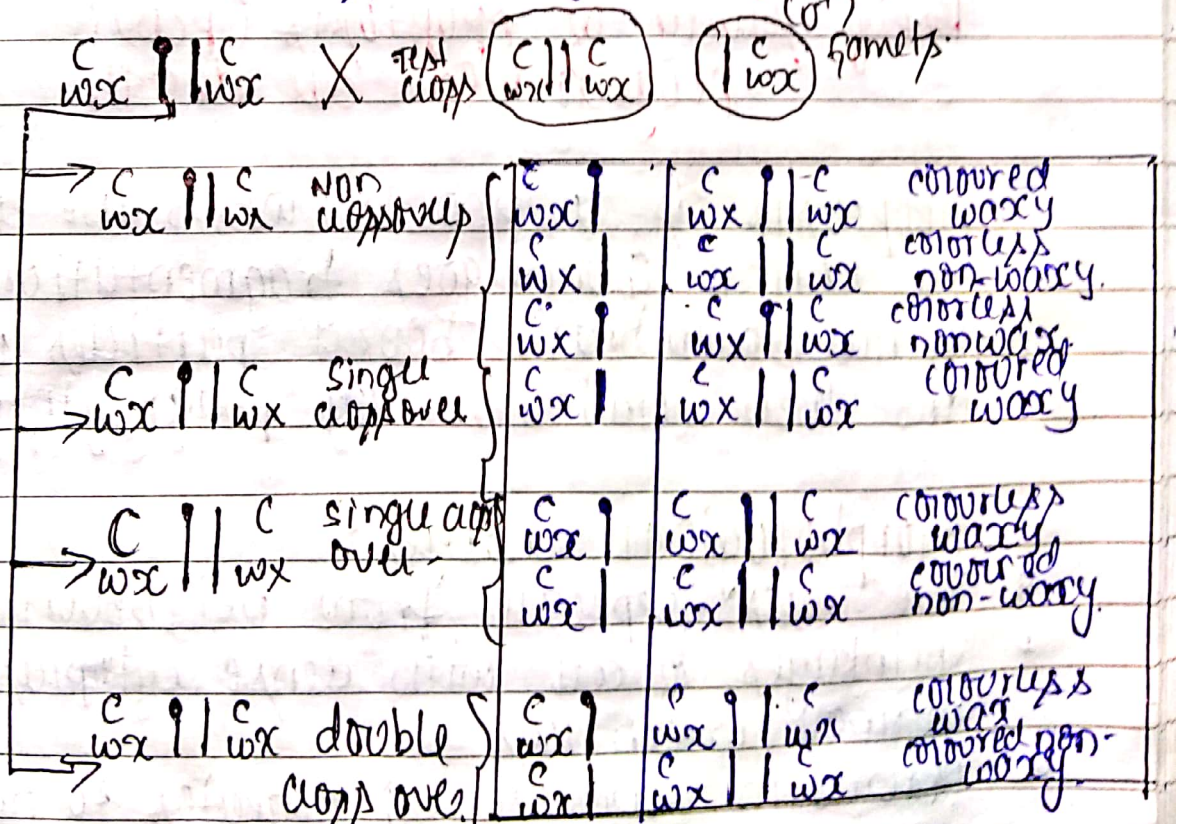
Cytological proof of crossing over.

The phenomenon of complete linkage occurs rarely since the linked genes tend to seperate during meotic division. this mechanism of genes as a result of

interchange of chromosomal segments called crossing over.

cytological crossing over was demonstrate in maize by creighton & mcclintock. They observed a corn plant which had a pair of chromosomes whose two members could be held apart cytologically. Among them one was normal & other chromosome had a translocated piece of another ch^{n} at one end. the other end was like a knob (hard round protoberance)

The normal ch^{r} carried 'c' for colorless endosperm & 'w' for starchy endosperm. other knobbed ch^{n} had alleles 'c' & colored & 'w' for waxy endosperm. creighton & mcclintacks crossed this plant with a plant having homologous chromosomes with recessive genes that is colorless waxy 'ccww'.



Significance of crossing over.

* It provides direct evidence of the linear arrangement of genes.
* It increases the frequency of variation which are vital.

Synaptonemal Complex.

During zygotene & pachytene substages of meosis in there occur a highly organised ~~st~~ of filament blw the paired ch=

Fun of Synaptonemal Complex.

* It maintaince of synapsis in fixed state for extended period for crossing over
* It provide a structural framework
* To segregate recombinant DNA from the rest of other chromosomal DNA.

Breif Study of Apoptosis (PCD): progeammed cell death

Apoptosis is a PCD in which the during cell shrink & undergoes fragmentation into Smaller membrane bound particles which are then eliminated by phagocytosis.

Morphological changes:

* The cells seperate from neighbouring cells
* Shrinkages of cell with dense cytoplasm with normal organelles
* chromatin condenses & migeates to nuclear membrane.

* convolution of cell membrane & Nuclear membrane

Numerical changes.

chromosomes are the vehicle of hereditary material (or) genes. Any alteration addition (or) deletion of chromosomal part leads to alteration of no, position (or) sequence of genes in the chromosomes. Numerical changes in chromosomes can be 2 types Namely:

1) Aneuploidy: It involves addition (or) deletion of one (or) few chromosomes. to the diploid set of chromosomes.

Aneuploids are of following types.

a) Monosomies: They arise by the loss of one chromosome from the diploid set i.e. 2n-1. they can form two,

Ex: Tobacco & wheat

b) Nullisomies: Loss of particular pair of chromosomes i.e 2n-2. they arise fusion of 2 (n-1) type of gametes.

c) Trisomies: Addition of an extra chromosomes in the normal diploid 2n+1 Such individuals are formed.

Ex: Datura & Zea mays

d) Tetrasomies: addition of extra chromosome of the diploid set of chromosomes - 2n+2. By partical chromosome is represented in 4 doses instead of two.

2) Euploidy: The change in the whole set of chromosome in the cells.

a) Haploidy: out of 2 sets of chr of a normal plant when one set is lost.
b) diploidy: presence of 2 sets of chr
c) polyploidy: occurence of more than 2 haploid sets of chromosomes

Then polyploidy ÷ into 2 types.

- Autopolyploid :- These are polyploids which have some basic sets of chromosomes multiplied.
for instance if a diploid spp has 2 similiar set of chr (AA) an autotriploid will have 3 similiar sets (AAA), an autotetraploid will have four such sets (AAAA).
Ex: bood geass.

- Alloployploidy: polyploidy may also result from doubling of chr no in a F1 hybrid which is deelved from 2 distinctly spp called alloployploidy.
Ex: wheat, Radish & cabbage.

Significance of polyploidy.
* polyploids generally have large flowers, seeds & fruits.
* polyploids acts as a conservative process & stabilizes interspecific hybrids.
* polyploids facilites gene exchange blw distant releated spp
* polyploidy plants prodoced in some spp are dse resistant.

→ Duplication: A str change resulting in doubling genes in a section of chr

* Intra chr duplication: In a segment of one chr is incorporated in another homologus chr.
* Inter chr duplication: In a segment either incorporated into a nono-homologus chr

→ Translocation: A part of chr is transfered to another non-homologus chr within the chromopome Compliment.

Types of Translocation.

1) Non-reciprocal translocation: A piece of one chr is transfered to a non-homologous chr
2) Reciprocal translocation A type of chr rearrangement involving exchange of chr segments blw 2 chr that do not belong to the same pair of chromosomes

Mendelian Genetics.

Biogeaphy of mendel

G.J mendel (1822-1884) for his discovery of the book laws of heridity is called father of Genetics.

He was born on july 22 1821. He was worked as a substitute teacher in the school attached to the monastrey.
In 1857, he began to conduct hybridization experiments with garden pea. He presented the results of his works at two meetings of annual proceedings of the natural history of the year 1865
Mendel died in 1884, long before the significance of his work was rediscovered his works remained unrecognized for 16 years.

Reasons for mendel's sucess.

* Selection of garden pea as a material for hybridization experiments as it had several advantage like.
* The plants were easy to cultivate & maintain.
* The plants have well defined contrasting features
* The features are bisexual & self-pollinating that maintain pure lines
* pure lines: organisms showing genetic purity because of continous interbreeding.
* Selected only pure breeding varities for his expt

* He carries out his Expt upto F_2 & F_3 Gen.

Genetic terms:

1) Gene: It determines a biological character of an organisms.
2) Allele one of a pair of gene that occur at a given locus in a chromosome.
3) Locus: fixed location of gene on chromosomes
4) Trait: Difference feature of a character & its detectable variant.
5) F_1 generation: Hybrid produced from a cross blw the genetically dif pure breeding parental.
6) F_2 generation: Individual produced as a result of inbreeding among individual of F_1 gen
7) Reciprocal cross: crops blw dif strain with Sexes reserved.
8) Back cross: crops of F_1 hybrids to one of the parental types
9) Test cross: The crops blw F_1 hybrid with its fully recessive parent.

Significance of Test cross.

* Test cross helps to verify the genotype of F_1 hybrid
* It helps to determine the genotype of unknown for a given trait.
* It used test for a linkage.

10) Homozygous: An organism with the same allele forms of a gene for a specific trait.
TT - Tall tt - dwarf.

11) Heterozygous: An organism with 2 different forms of a gene for a specific trait
Ex: Tt (tall).

12) phenotype: physical appearance.

13) Genotype: It is a genetic make-up of an organisms.

Mendel's Experiment.

Stem Length	Tall (T)	Dwarf (t)
flower position	Axial (A)	Terminal (a)
pod color	Green (G)	yellow (g)
pod shape	Inflated (I)	constricted (i)
Seed shape	Round (R)	wrinkled (r)
flower color	violet (v)	white (v)
cotyledon color	yellow (Y)	green (y).

Mendlian laws:

a) Law of Dominance: When two contrasting characters are present in a single individual, only one characte is considered as dominant & other is as recessive.

b) Law of segregation: whenever a pair of factors for a characte brought together in a hybrid they seperate during the formation of gametes.

c) Law of independent assortment: factor for 2 (or) more pairs of contrasting characters are distrobuted independently of one another at the time of gamete formation.

Monohybrid cross

It explains mendels law of dominance & segregation.

It is a crossing involving 2 homozygous individuals differing in one contrasting characte is called monohybrid cross.

Example:

parental phenotype: Homozygous Tall × Homozygous dwarf.

Genotype: TT × tt

Gamets: T × t.

Tt – Hetrozygous tall

f_1 hybrid

$f_1 \times f_1$ (selfing): T t × T t.

f_2 hybrids: TT Tt Tt tt

Tall Tall Tall dwarf.

monohybrid cross :- phenotype :- 3:1

Genotype :- 1:2:1

Conclusion: f_1 plant is tall trait is dominant & dwarf trait recessive. dwarf trait disappeared in f_1 generation. was not lost made its appearance again in F_2 generation. for dwarf trait that remained hidden. In a hetrozygous hybrid one allele supressed the expression of another allele - Law of dominance.

The apperance of both tall & dwarf plants in f_2 generation clearly signify that during gamete

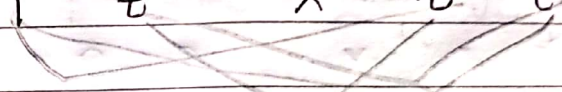
These factor retain their individuality from generation to generation without getting contaminated when they are present in hybrid called law of segregation.

Monohybrid test cross:

parental phenotype: F1 hybrid x recessive plant

parental genotype: Tt x tt

Gametes: T t x t t



F2 generation: Tt Tt tt tt

monohybrid ~~test~~ cross: 1:1

Dihybrid cross: It explains mendel's law of independent assortment.
It is a cross involving 2 parental varities differing in two characters: the hybrid obtained from such a cross is called dihybrid.

parental phenotype: Homozygous x Homozygous
Round yellow wrinkled green

parental genotype: RRYY rryy

Gametes RY RX ry ry.

F1 generation RrYy x RrYy.
Selfing F1 hybrid x F2 hybrid.
Genotype: RrYy x RrYy

Gametes: RY, Ry, rY, ry X RY, Ry, rY, ry
f_2 generation:

Gametes.	RY	Ry	rY	ry
R Y	RRYY Round yellow	RRYy Round yellow	RrYY Round yellow	RrYy Round yellow
R y	RRYy Round yellow	RRyy Round green	RrYy Round yellow	Rryy Round green
r Y	RrYY Round yellow	RrYy Round yellow	rrYY wrinkled yellow	rrYy wrinkled yellow
r y	RrYy Round yellow	Rryy Round green	rrYy wrinkled yellow	rryy wrinkled green.

Dihybrid phenotypic ratio: 9:3:3:1
Dihybrid genotypic ratio: 1:2:2:4:1:2:1:2:1
Conclusion: The form of wrinkled green & round green in addⁿ to parental combination in f_2 generation clearly shows seed color & seed shape are independent unit characters that are control dif genes. this expt proves that heriditary traits are independent units & the genes controlling them assort independtly i/s the law of independent assortment.

Dihybrid test cross.
parental phenotype f1 hybrid x recessive plant
↓ Genotype RrYy x rryy
Gametes: (RY) (Ry) (rY) (ry) x (ry)

f_2 gen.	RrYy	Rryy	rrYy	rryy
	RY	RG	WY	WG

Ratio = 1:1:1:1

Incomplete dominance:

A phenomenon where both alleles of a character express incompletely & a producing new intermediate phenotype in the heterozygous condition.

Ex: Antirrhicum (snapdragon)
mirabilis Jalapa (u'o' clock plant)

Snapdragon

parental phenotype: Redflowerplant x white.
parent genotype: RR x rr
Gamets: R R x r r

f_1 generation. Rr — rr - pink color flowe plant

selfing: f_1 hybrid x f_1 hybrid
Genotypes: Rr Rr
Gamets: R r R r

f_2 generation: RR Rr Rr rr
red pink pink white

phenotypic & genotypic ratio: 1:2:1

Conclusion: Reappeara of pure parental traits shows there is no mixing of genefactor of red colour & not completely supress the factor for white colour. the cross also shows there is no specific gene for pink color trait
- This shows that the concept of dominance is not of universal application

Modification of mendlian ratio:

- Interaction of Genes - Epistasis

The effect of one gene being dependent on the presence of one (or) more modifies gene.

Epastatic gene: The gene (or) LOCUS which Supress (or) masks the action of a gene at another LOCUS.

Hypostatic gene: The gene (or) LOCUS whose express is supressed by an epistatic gene.

1) Dominant Epistasis: When a dominant allele at one LOCUS can mask the expression of both alleles at another LOCUS is known as Dominant Epistasis.

Ex: fruit colour in summer squash.

parental phenotype	white fruit	x yellow fruit
→ Genotype	WWyy	WWYY
Gametes	Wy	WY

F1 generation — WwYy

Selfing — F1 hybrid x F2 hybrid

Genotypes — WwYy x WwYy

Gametes - WY, Wy, wY, wy x WY, Wy, wY, wy.

P.T.O

F2 generation:

Gametes	WY	Wy	wY	wy
W	WWYY	WWYy	WwYY	WwYy
Y	White	White	White	White
W	WWYy	WWyy	WwYy	Wwyy
y	White	White	White	White
w	WwYY	WwYy	wwYY	wwYy
Y	White	White	yellow	yellow
w	WwYy	Wwyy	wwYy	wwyy
y	White	White	yellow	Green

The normal dybrid modified to 12:3:1 in F2 generation

W-Y (9/16), W-yy (3/16) ww-Y (3/16) wwyy (1/16).

2) Recessive Epistasis: When recessive alleles at one locus mask the expression of both alleles at another locus.

Ex:- Grain colour in maize.

Parental phenotype: purple grains x white grains

—||— Genotype: PPRR pprr

Gametes: PR pr

F1 generation: PpRr - purple grain

Selfing: F1 hybrid x F1 hybrid

Genotype: PpRr PpRr

Gametes: PR, Pr, pR, pr x PR, Pr, pR, pr

F_2 generation:

Gametes	PR	Pr	pR	pr
P R	PPRR purple	PPRr purple	PpRR purple	PpRr purple
P r	PPRr purple	PPrr white	PpRr purple	Pprr white
p R	PpRR purple	PpRr purple	ppRR Red	ppRr Red
p r	PpRr purple	Pprr white	ppRr purple	pprr Red.

The normal dihybrid segregation ratio of 9:3:3:1 is modified to 9:3:4 in F_2 generation. R-P (9/16), R-pp (3/16), rrp (3/16) & rrpp (1/16).

Complementary factors

Certain characters are produced by the interaction b/w 2 (or) more genes identified from diff parents. these genes are complementary to one another that is if present alone these gene remain unexpressed. but are expressed only when they are combined in F_1 generation through suitable crossing Ex white flowered varities of sweet pea.

parents : white flowered sweet pea x white color pea
Genotype : CCrr x RRCC
F_1 hybrid : CCRr Red flowered plant
Genotypes : CCRr x CCRr
Gametes : CR, Cr, cR, cr x CR, Cr, cR, cr.

F_2 generation.

Gametes	CR	Cr	cR	cr
CR	CCRR Red	CCRr Red	CcRR Red	CcRr Red
Cr	CCRr Red	CCrr White	CcRr Red	Ccrr White
cR	CcRR Red	CcRr Red	ccRR White	ccRr White
cr	CcRr Red	Ccrr White	ccRr White	ccrr White

The ratio 9:7 obtained in F_2 generation is actually a normal dihybrid ratio 9:3:3:1

Supplementary factors:

These are a pair of non-allelic genes of which produces its effect independtly in the dominant state while the dominant allele of the second gene needs the presence of the other gene for its expression.

In supplementary genes are a pair of non allelic gene is essential for the development of the concerned phenotype, while the other gene modifies the expression of the first gene.

Ex:- Grain colour in maize.

NOTE: Checker board of supplementary factor as in Recessive Epistasis.

Polygenic Inheritance in Maize.

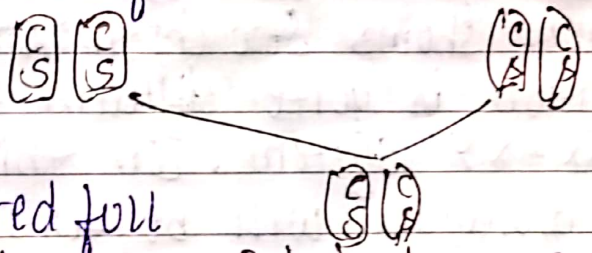
Inheritance of characters controlled by 2 (or) more genes is called polygenic inheritance. This genes involved in polygenic inheritance are called polygenes.

Ex:- Colour of grain in wheat.

Kernel colour in wheat is determined by 2 pairs of genes Aa & Bb genes 'A' & 'B' are dominant genes which determine the red colour where as 'a' & 'b' are recessive alleles.

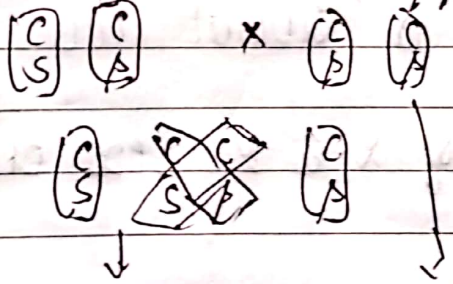
Ex: Maize.

Colored full x colorless shrunken.

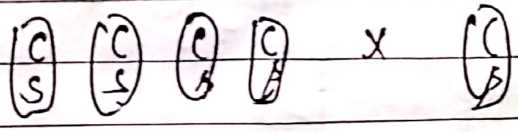


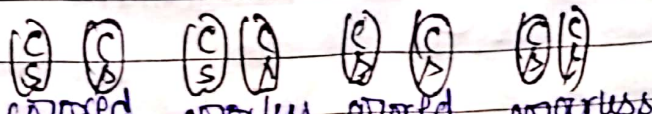
Colored full

Test cross F1 hybrid x Recessive parent.



Gametes





Colored full 4,032

Colorless Shrunken 4,035

Colored Shrunken 149

Colorless shrunken 154

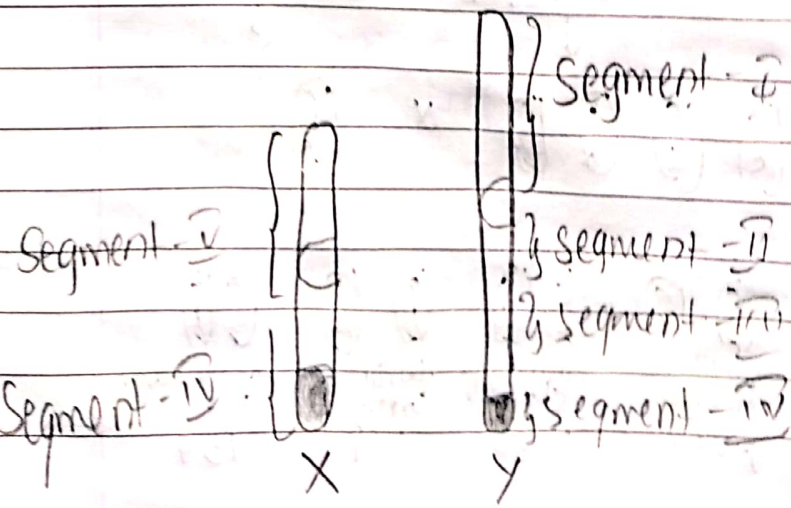
parental combination = 96.4%.
New combination = 3.6%.
From above stated result it is clear that the parental combination are more common than new combination. their genes are located in the same chromosome & only in 3.6% individual these genes are seperated by crossing cover

Sex determination.

1) XX - XY type:

Melandrium album is a dioclious model plant in genetics belongs to family Carophyllaceae. the diplod chromosomes no of Melandrium is 24 (n=12).
melandrium shows sex chromosomes sex determination is quite different from the usual XX-XY system. In this plant the AAXX individuals will be females & AnXX individuals will be males. the Y chromosome plays a crucial role of sex determination

str of X & Y Sex ch



Y-chr segments & its functions.
Segment - I :- Suppress femaleness: it inhibit the development of female str
Segment - II : Initiate anther development.
Segment - III : Control the late stage of anther development.
Segment - IV : It used for pairing with x-chr during meotic phophase.

X - chr segments & its functions.
Segment - IV : It used for pairing with Y-chr during meotic prophase.
Segment - V : It promote femaleness in the absence of segment - I on Y - chr

2) ZZ - ZW type (strawberry)
Here, the females are heterogametic & males are Homogametic. the female carries 2 dif types of sex chr - ZW while male carries chr - ZZ. the egg will be 2 types : AZ type & AW-type will all sperm will be only AZ type & AW type will all sperm will the zygote with AAZZ chr formed by fusion of A-Z type sperm. A-Z type ovem develops into a male. A zygote with AAZW chr formed by a fusion of AZ-type sperm with A-W type ovum results formation of a female.

3) XX - XO type (vallisnaria)
Here, the females have 2 identical sex chr designated as xx & Hence they have Homo-

genetic. All the eggs produced carry haploid set of autosome. with one x-chr (Ax)

The males have one x-chr are represented as xo & Hence they heterogametic 50% of sperm are Ax type & the other 50% are Ao type.

If the ovum fertilized by Ax carrying sperm. the zygote AAxx will develop into the female. If the ovum is fertilized by an ovum Ao carring sperm. the zygote AAxo will develop into a male.

Evolution

origin of life:

origin of life refers to origin of the living organisms on the earth surface. To explain origin of life many theories are formulated.

1) Theory of special creation.

It was proposed by Hebrew et. al & supported by father Suarez. According to theory God created life by his divine act of creation. this theory have 3 connations:

* All organism that we see today are created such as.
* Diversity was always the same since creation & will be the same in future also.
* Earth is about 4000 years old.

2) Cosmozoa / panspermia theory:

Richer in 1865 proposed this theory, Acc? to this theory life came to earth from other heavily bodies in the form of resistant spores called panspermia through meteorites still some astronomers belive in this theory.

3) ABiogenesis (or) Spontaneous generation.

According to this theory life arose Spontaneously from non-living matter like decaying straw, mud etc.... the elements such as air, water, fire & earth have vital force.

Louis pasteur disaproved the theory of spontaneous generation & gave the scientific explanation that life originates from pre-existing life. His expt are popularly called Swan Necked flask expt

- He showed in pre-sterilized flask life did not come from killed yeast while in another flask open to air, new living organisms arose from killed yeast.

4) Theory of Biogenesis:

Franisco Redi proposed this theory. According to this theory, living organisms are always produced from pre-existing living & not from non-living.

5) Theory of chemical evolution (or) physico-chemical theory.

This theory was proposed by A.I. Oparin & Haldane.

According to this theory life orginiated from chemical through geadual progressive changes over a long period of their time life originated from inorganic substances It were transformated into organic substance which is turn were transformed into collidal systems to produce first form of life

6) Big-Bang theory:

It was proposed by Immanuel Kant in 1755. the universe originated by a singular huge

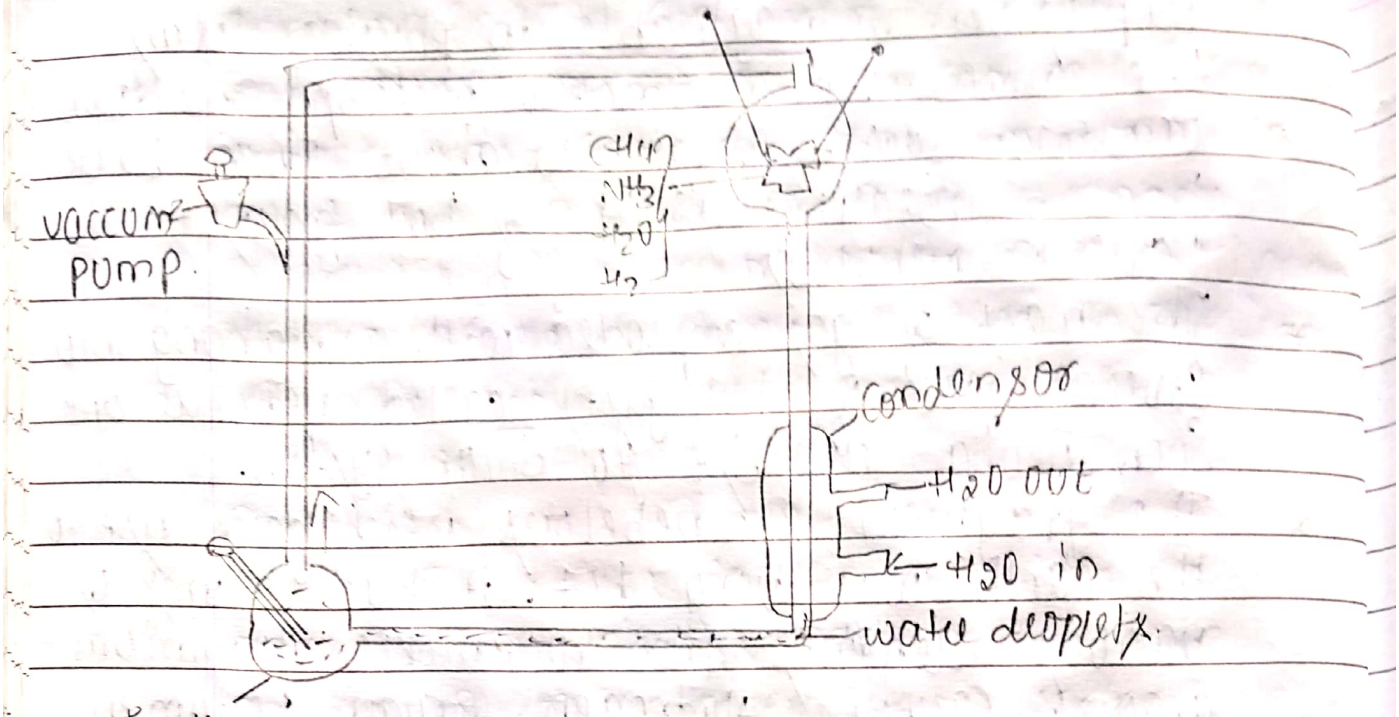
explosion, unimaginable in physical terms, the universe, unimaginable in temp. Come down

* our solar system originated about 5 BYA. back from a rotating cloud of hot gases called Nebulous.
* The mass of gas exploded with a big bang into several piece of hot gases called nebulae. one such neoba gave rise to solar system.
* The fragment of nebelous which gave rise to the earth was very hot. it had atoms of vaeious elements like ion, nickel, aluminium, argon, carbon, hydrogen, oxygen, heliom etc,
* As the nebulous cooled the heavier & less volatile metals like iron & nickel condensend rapidly due to geavity & formed. while lighter silicates & Aluminium came to the surface & formed earth's crust. while the lightest atoms like H, He, N, O & Ar escaped the geavitational field & formed the atm

Stanley milleps Expeeiment.

Stanley miller & harold urey were first to put to test oparin - haldane theory in 1953. they conducted the expt simulting prebiotic earth condition using spark discharge appaeatus. the spark discharge appaeatus is made up of closed system of glass except tungsten electrode.

p.T.O



Steps

* Evacuated the Appaeatus.
* A mixture of CH_4, H_2 & NH_3 were passed into appaeatus
* The mixture of gases were circulated & exposed to high electrical charge of 75,000 volts that produced temp ≅ at 800°C
* The product formed were cooled & liquified
* The liquid of U-trap analysed.

Result:

A no of organic compounds related to life like several amino ā, fatty ā, & urea were synthesized only four amino ā were not found. Aspaeatic ā, Glycine & Glutamic ā.

Control experiment Conducted without using energy showed no organic compounds

Conclusion:
It proves that in pre-biotic earth sample organic compounds could be formed from the primitive gases. In similar expt by others observed the formation of sugars, N2 bases, pigments & fats. with limited evidence, the chemical evolution was more/less accepted.

Theories of Evolution.

following are the important theories related to organic evolution.

1) **Lamarkism:** It refers to the theory of inheritance of acquired characters. It proposed by John Baptise de Lamark.

Salient features.

* All organisms posses an innate tendency to evolve
* changes in environment of an org create new needs. In response to new needs of the organisms.
* use & disuse of organs:- variations in org arise through effects to use & disuse organs, the organ used conciously & continously develops well while the organs that remain unused for long time get reduced & in course of time degeneated & disappear.
* Inheritance of acquired characters: The variation acquired by an organisms in its life time is transmitted to the next generation. Require characters remain unchanged due to

environmental condition.

* Speciation :- form of new spp called speciation lamark was convinced that environmental effect are main causes of evolutionary changes. the accumulation of such changes over a period of time resulted in the form of new spp

Darwinism

It refers to the evolutionary theory proposed by Charles Darwin. He is called father of organic evolution. He undertook a voyage for 5 years in ship HMS Beagle as a Naturalist & visited Galapagos Islands where he made many interesting observations on living organisms & collected data.

In 1859 Alfred Russel explained the theory of organic evolution in his book "origin of spp" by Natural Selection.

Based on observation made during voyage Darwin drawn the following conclusions:

* Existing living forms share similarities to varying degrees themselves & also the extinct forms.
* Different type forms have been extinct over a period of time.
* There has been a gradual evolution of life forms with new forms arising at dif periods of history.

* The individuals showing favorable adaptive variation survive & outbreed others with unfavorable variations. is called as survival of fitness.

Natural selection Based on 5 Imp Observation

* All spp have a great reproductive potential
* Natural resource like food, shelter are limited
* Most populations are stable in size except for seasonal fluctuations.
* Individuals of population vary in char
* Most variations are heritable.

Survival fittest.
In the struggle for existence the individuals showing unfavorable adaptive variations survive & reproduce while organisms with unfavorable variation will be eliminated.

- The organism which adopt well in the environment will survive more in nature is called Natural selection

Example of support of Natural selection

DDT [Resistance in musquito].
DDT was used indiscriminately as an insectiside to eradicate musquitoes. use of DDT has eliminated sensitive varities where as mutant forms having resistance to DDT survived & reproduced. As a result in due

course of time the dominant musquito population consisted of DDT resistant strain.

Mutation theory:

Hugo de vries proposed mutation theory in 1901 to explain process of organic evolution

Main features of mutation theory.

* Mutations are large discontinuous variation arising suddenly in a population.
* Mutation cause speciation & called it saltation (or) single step large mutation
* Mutations are random & without any direction.
* Mutations appear full fledged, hence there are no intermediate stages blw the new spp & the pre-existing one.
* Mutations can take place in any direction & are subjected to natural selection. harmful mutants are eliminated by natural selection.

Modern Concept of Evolution (or) Neo darwinism

Darwin was unable to explain the causes of variation. But the discovery of mutation by de vries principle of inheritance of mendel & the germ plasm.

In light of modern development evolutionists like Huxley, Haldane, Goldsmith, fischer, muller & other purth of this theory supported Darwinism. So this theory

called NEO-Darwinism.
According to this theory
* change in gene frequency is evolution
* diff: Somatic & germinal variations & has understood the principle of inheritance
* Believes that evolution operates on a gene pool.
* Believes that evolution operates trough differentials reproduction & comparitive reproductive success
* It explains the arrival of the fittest.

PLANT BREEDING.

Objectives of plant breeding.
* Higher yeild
* Pest resistance
* flood resistance
* Early to mature
* Adoptable to wide range of habits
* Better quality
* Drought resistance
* Response to manuring
* Insect & pest resistance.

Vegatative propogation.

It is a form of Asexual reproduction
The plant parts used in vegetative progation is called vegatative propugules
Ex: Runner, sucker, rhizome, offset.

Vegatative propogation by stem

1) Bulbs:- These are the undergeound stems made up of a short axis with thick leaves which store food.
   Exr onion.

2) Runners: Runners are modified stems which grow along the geound & produce roots & a new plant at the apex.
   Ex:- Lawn grass.

3) Rhizome:- It modified stem which geows along unde the geound bearing buds which produce shoots
   Exr Ginger.

4) Corm:- It usually a thincked stem base with buds in its axis of dead leaf base
   Ex: Colocasia.

5) Tuber: It is thickned undergeound stem in which food is stored. tube have buds in modified leaf axis from new plants.
   Ex: potato.

6) Offset: It looks like a modification of runner in being more (or) less thickned, prostate branch with a tuft of leaves at the apex. Exr Eichornia.

7) Aerial shoots: A stem segment of opuntia & other cacti develops into a new plant after falling on the soil.

8) Bulbils. They are fleshy buds which develop into new plants after falling on the soil.
   Exr Agave, oxalis.

Artificial methods of vegetative propogation.

These are man made special techniques in which a part of somatic body of a plant & it develops into a new independent plant.

further classifications :-

1) Cutting : It is a simple method in which a suitable part of stem (or) root is cut & it is planted in the soil along with some nutrients & this cut parts develops a new plant.

a) Root cutting : Lemon & orange.
b) Stem cutting : Grapes, coffee, tea, mulberry.
c) Leaves cutting : Bryophylum.

2) Layering : In this method, a twig of a plant is bent down, below the level of soil, this bend is called layering.

* Soon this covered portion develops new roots & become seperated from main body.

a) Tip layering : Tip current seasonal shoot is bent into the soil by digging a slop hole soom bent parts develops root.
   Exr Blackberry, Raspberry.
b) Serpentine layering : Basal branch is pegged down in the soil at several places to form a number of new plants from single branch
   Exr clematis.
c) Mound layering : Basal part of lower branch is bent down & covered with soil.
   Exr Gropsberry.
d) Trench layering : it consist of pegging o

branch (or) young plant in horizontal position in a trench. Af. soon shoots came out their bases are covered to belson rooting
Ex: walnut.

3) Grafting: It is the technique of joining parts of 2 dif plants to form a composite plant.
* It can be done efficiently in those plants which has a strong closely related & have vascular cambium.

Types of Grafting:
a) Tongue grafting: In this case stock & scion have almost same diameter. they are given oblique (or) sloping cuts.

NOTE: The plant of which the root system into be taken is called stock.
The other plant in which shoot system is taken is called scion.

b) wedge grafting: Here also stock & scion have same dm. But V-shaped notch is given the stock while stem is cut like a wedge.

c) crown grafting: Stock have larger dm than scion. many scions are selected & all of them are grafted on a single stock.

d) Side grafting: lateral cuts are made in stock. one scion is fitted in each lateral cut of stock.

4) Gootee:-
* It is also called air layering. it is commonly employed for propogation of litchi, lemon etc.
* In this method a healthy, leaf bearing branch of main plant is selected.
* A ring of bark is removed. the open part is covered with moist grafting clay. the graft is enriched with root promoting chemical
* This area is wrapped with a polythene paper to prevent desication & infection
* The branch is cut down is planted to a new location.

5) clones: It also called micropropogation It refers to process of asexual rep^{n} by multiplication of genetically identical copies of individual plants. the term clone used to represent a plant population derived from a single individual by asexual rep^{n}

Advantages of vegatative propogation
* It is easiest method of rep^{n} in plants
* It is a quick method of multiplication.
* It helps in cloning of plants which turns helps in standing a uniform population in plants.

* It helps to remove common infections through pruning, micro-grafting & micro propogation.

Disadvantages of vegetative propogation.

* DSC's contacted by a parent spreads to all daughter plants.
* vegetative organs useful for propogation cannot be preserved for long.

Hybridisation:- It is crossing of 2 plants differing from each other in one (or) more characters to get offsprings with new desirable characters.

Types:-

a) Intra-varietal:- The crosses are made blw the plants of the same variety but with dlf genotypes.

b) Intra-Specific:- The crosses are made blw the plants belonging to dlf varities.

c) Inter generic hybridization.
crops are made blw 2 plants of dlf genera belonging to same family
Hybrid produced in this method both Specifically and agriculturely.
Ex:- Wheat x Rice.
Raphonbracia: Rabbage - Raphanus (radish)
Brassica (cabbage)

Bromato - Bringal x Tomato.

d) Inter specific (or) Intra generic.
Crosses made blw 2 dij spp of the same genus. hybrid by repeated crossing blw local spp & wild spp
Ex: cotton - Gossypium hirsutum x G. arborium
potato = Lycopersicum esculentum x S. tuberosum
Tomato = Lycopersicum esculentum x L. pimpinellifolium.

2marks:-

- Emasculation: It is the removal of stamens from female parent by the help of forceps before they brust & sheid their pollens.

- Bagging: The emasculated flower is immediately bagged to avoid population by any foreign pollen. the bag made up of paper, butter paper etc.

- Tagging: The emasculated flowers are tagged just after bagging. the tags are attached to the base of flower with the help of thread.

- Crossing: Artificial cross pollination blw the genitically unlike plants. In this method imature, futile & viable pollens from the male parent placed on the receptive stigma of emasculated flowers to bring about futilization.

Maintenance of Germplasm

* Germplasm broadly refers to hereditary material transmitted to offspring through Germ cells.
* It provides raw materials for the breeds to develop various crops that conservation of germplasm assumes.
* As the primitive man learnt about the utility of plant for food & shelter he cultivated the habits of saving selected seeds
* The imp objective of germplasm conservation is to preserve genetic diversity of a particular plant.
* In the recent years many new plant spp with desired & improved characteristics have started replacing the primitive used agricultural plants.
* It is important to conserve the endangered plant.

Pollen Banks:

A collection of all types of pollen containing the male genetic materials of flowering plants. It is used for plant ex-situ conservation pollen bank supplies pollen to commercial growers of fruit & nut tree crops.

Quarantine method.

plant quarantine is defined as legal enforcement of measures aimed to proved pests from spreading on to proved them from multiplying further. in case they have already gained entry & have established new restricted areas.

* To prevent the intro of pests & weeds from foreign countries.
* legislation to prevent the spread of already established pests, dpc & weeds. from one part of country to another.
* legislation to enforce formers to apply effective control measures to prevent the damage by established pests.
* legislation to prevent adulteration & mis-branding of insecticide in food stuffs.