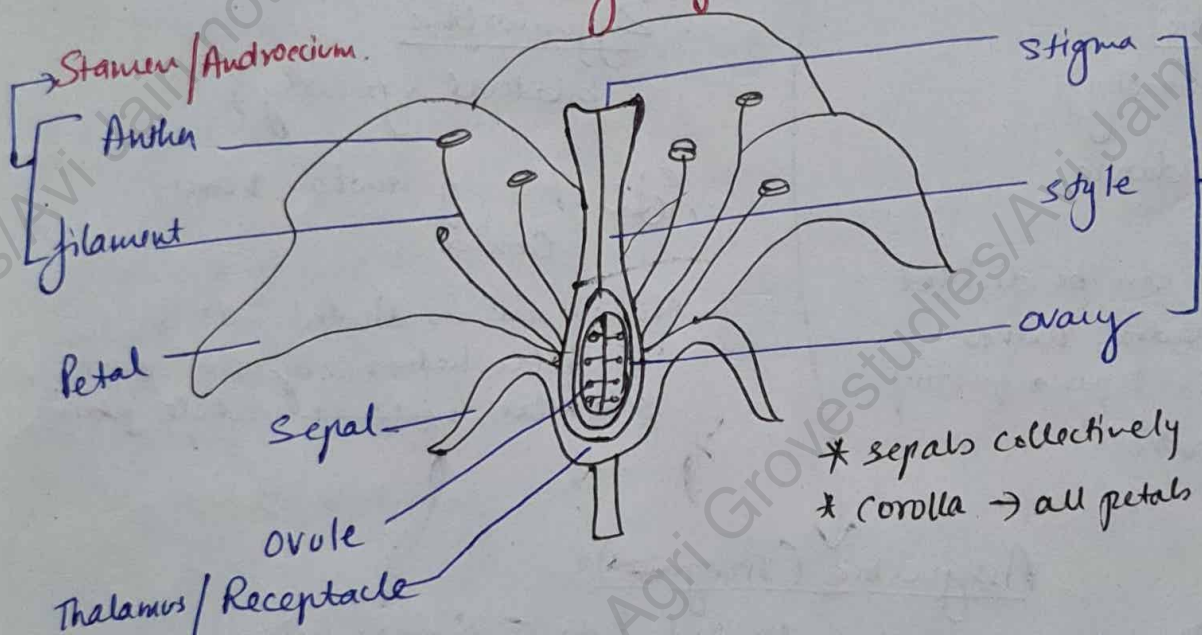
FLORAL BIOLOGY

Flower:- Flower is a reproductive unit in angiosperms. (flowering plant)
↳ It is meant for sex. reproduction.

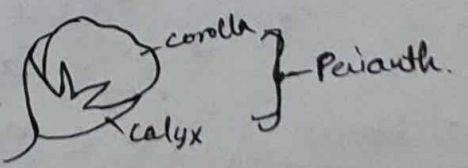
Thalamus / Receptacle:- A typical flower has four different kinds of whorls arranged successfully on the swollen end of the stalk / pedicel called Thalamus / receptacle.

4 different whorls → Calyx, corolla, Androecium, Gynoecium.
accessory organs — reproductive organs.



* sepals collectively called → calyx
* corolla → all petals of flower.

Perianth:- When calyx and corolla cannot be differentiated from each other is called as Perianth.
eg- lily.



Bisexual / hermaphrodite / Androgynous flowers:- have both pistil and stamen in one flower.
eg- rose, lily, tomato, hibiscus, brinjal, mango, sunflower.

~~Unisexual flowers.~~

Unisexual flowers – flowers which contain either pistil or stamen is called as unisexual flower.

eg- papaya, watermelon, coconut flower etc.

→ flowers having only stamen → Staminate / male flower. (cucumber, eggplant)

→ " " only pistil → Pistillate / female flower. (cucumber, eggplant)

These are also called as Incomplete flowers.

These flowers unable cross pollination.

On the basis of Symmetry :-

Actinomorphic
(Radial symmetry)

eg- mustard, datura, chilli.

• when a flower can be divided into 2 equal radial halves in any radial plane passing through the centre.

Zygomorphic
(bilateral symmetry)

eg- pea, gulmohar, bean, cassia.

• When it is divided into 2 similar halves only in one particular ~~vertical~~ vertical plane

Assymetric (Irregular) :

If it cannot be divided into 2 similar halves ~~in~~ by any ~~vertical~~ vertical plane passing through the centre.

eg- Canna.

On the basis of floral appendage –

trimerous
floral appendage is in multiple of 3

eg- onion, wheat, rice, maize

tetramerous
in 4

eg- mustard

pentamerous
in 5

eg- Dicots (hibiscus)

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On the basis of presence of bracts

Bracteate

→ have reduced leaves at base of pedicel

eg - tulip, china rose

→ Floral symbol → Br

Ebracteate

They do not have reduced leaf.

eg - mustard.

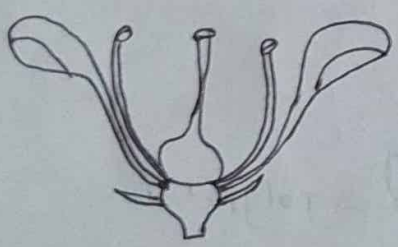
→ Ebr → symbol

On the basis of position of calyx, corolla, and androecium in respect of the ovary on thalamus

Hypogynous

eg - mustard, china rose, brinjal.

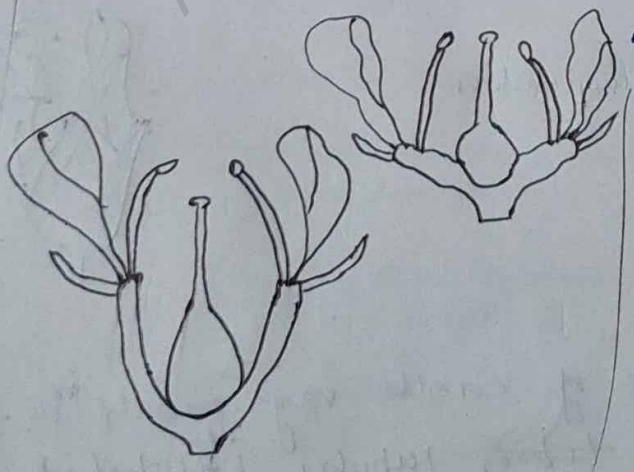
- gynoecium occupies the highest position while other parts are situated below it.
- also called Superior ovary.



Perigynous

eg - plum, rose, peach

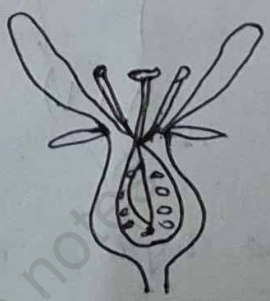
- gynoecium is situated in the centre & other parts of flower are located on the rim of thalamus almost at the same level.
- also called half-inferior ovary.



Epigynous

eg - guava, cucumber, ray floret of sunflower.

- the margin of the thalamus grows upwards enclosing the ovary completely and getting fused with it., the other parts of flower arise above ovary.
- also called inferior ovary.



Parts of a flower :-

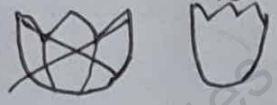
Each flower normally has 4 floral whorls. → calyx, corolla, androecium and gynoecium.

also called complete flower. → hibiscus, rose, lily, sweet pea.

1) Calyx :-

- The calyx is the outer whorl of flower and the members are called sepals.
- Sepals are → green, leaf like, & protect flower in bud stage.

Gamosepalous – flowers in which sepals united/fused.
eg – hibiscus, china rose.



Polysepalous :- sepals are free
eg – rose.

2) Corolla – is composed of petals.

↓

are brightly colored to attract insects for pollination.

Gamopetalous
eg – bindweed, elderberry

- petals fused / united

Polypetalous
eg – rose

- petals free.

→ The shape & colour of corolla vary greatly in plants
→ Corolla may be → ~~tubar~~, tubular, bell shaped, funnel shape or wheel shaped.

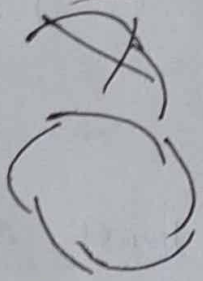
the parts of Aestivation :-

Aestivation - The mode of arrangement of sepals or petals in floral bud with respect to other members of the same whorl is called aestivation.

Valvate
eg - Calotropis

- When sepals or petals in a whorl just touch one another at margin without overlapping.

Twisted
eg - china rose, lady finger, cotton



- If one margin of appendage overlaps that of the next one and so on.

Imbricate
eg - Cassia, gulmohar

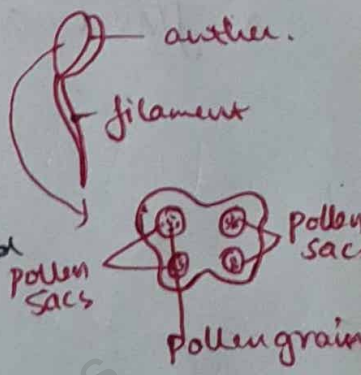
- If margin of sepals or petals overlaps one another but not in any particular direction.

Vexillary
eg - pea, bean

- There are 5 petals.
  → the largest (standard) overlaps the 2 lateral petals (wings) which in turn overlap the two smallest anterior petals (keel).

3) Androecium :-

- composed of stamens (male reproductive organ)
  ↓ consists of
  stalk/filament and anther.
  ↓
  each anther is bilobed (2 lobes)
  ↓
  each lobe has 2 chambers called (pollen sacs)
  ↓
  where pollen grains are produced.

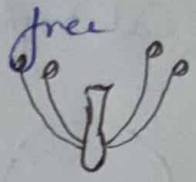


Staminode → Sterile stamen

Epipetallous – when stamens are attatched to petals.
eg – brinjal.

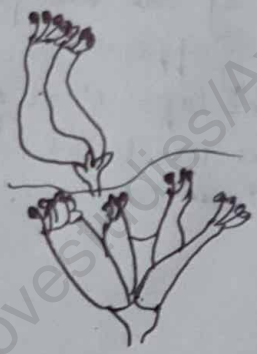
Epiphyllous – ~~attat~~ stamens attatched to Perianth.
eg – lily.

Polyandrous – stamens in flower may either remain free or may be united in varying degrees.
eg – rose & lotus.



Monadelphous – eg – china rose
Stamens may be united in one bunch or one bundle

diadelphous – in 2 bundles.
eg – pea.



Polyadelphous – eg – citrus.
in more than 2 bundles

→ There may be a variation in length of filaments within a flower as in eg – Salvia and mustard

Gynoecium :- female reproductive part of flower
↳ made of one or more carpels.

Carpel / pistil / gynoecium. consist of 3 parts → Stigma, style and ovary

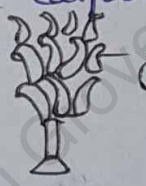
Ovary :- enlarged basal part on which lies the elongated duct called style.

Style - connects ovary & stigma.

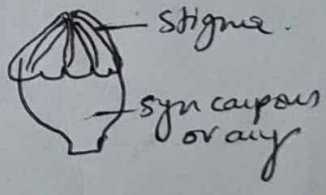
Stigma - at the tip of the style and its receptive surface for pollen grains.

→ Each ovary → has one or more ovules attached to a flattened cushion like placenta.

Apocarpous :- eg- rose & lotus.
when more than one carpel is present, and may be free.



Syncarpous :- eg- mustard and tomato.
when carpels are fused.



→ After fertilization → ovules → seed (into)
ovary → fruit (into)

Mendelian Traits Vs Polygenic Traits

→ History of Plant breeding is about → 12000 yrs old. when it started with the cultivation of useful crop plants in captivity of human beings.

• **Plant Breeding:-**

It is defined as an art and science and technology of improving genetic makeup of crop plants in relation to their economic use for mankind

OR

• Plant breeding is a science based on principles of genetics & cytogenetics. It aims at improving the genetic makeup of the crop plants.

Objective of plant breeding -

1) production
2) tolerance
3) agronomical → height, maturation time, photosynthetic variety.
4) nutritive content.

• **Qualitative traits -**

• The rediscovery of Mendelian principles in the beginning of 20th century totally revolutionized the manipulation of crop plants.

→ Mendel → was the 1st to offer simple and reasonable explanation for the process of heredity.

→ Mendel → observed 7 traits in garden pea (Pisum sativum) & postulated laws of inheritance of characters.

character	dominant form	recessive form
1) seed shape	round	wrinkled
2) cotyledon colour	yellow	green
3) seed coat colour	grey	brown white
4) pod shape	inflated	constricted
5) ~~ur~~ unripe pod colour	green	yellow
6) flower position	axial	terminal
7) stem length.	long	short.

Allele :- different forms of genes that are found at the same place in chromosome

→ Allelic differences $\xrightarrow{\text{cause the}}$ morphology, physiology or behaviour of organisms to alter in such a way to catch the eye of experimenter

→ Allelic differences $\xrightarrow{\text{produce}}$ phenotypic differences which are not greatly influenced by environment.

→ Such differences are called qualitative differences. and arise from major allelic differences at one or two genes. → called major genes.

Vavilov's centres of origin of cultivated crop plants

→ a crop is generally confined to one place.

Centre of origin :- It is a geographical area where the particular group of organisms (either domesticated or wild) 1st originated on earth.

→ centre of origin are also centre of diversity

but.

centre of diversity may not represent the centre of origin

Centre of diversity - found at more than one place.

↳ refers to a location where vast genetic variability for a crop and its wild species is found.

* Thus centre of origin and centre of diversity of a crop may be same or may be different.

Why information on origin of crop is important?

1) To locate wild relatives, related species and new genes.

2.) to avoid genetic erosion.

3) To avoid loss of germplasm due to the loss of ecotypes and habitat

The Russian scientist Nikolai Ivanovich Vavilov considered that great centres of origin were always located in Lower mountains, & hills of tropical and subtropical regions.

→ He recognised some secondary centre of origin where

- 2 or more species crossed together.
- where natural and artificial selection occured one after another

He stated that plants were not domesticated at random but it was a continuous process.

Vavilov's centres of origin :-

In 1926, and developed a theory on centres of origin of cultivated plants. He proposed 8 centres of origin of crop plants.

1) Chinese centre - • earliest and largest independent centres of origin of cultivated plants.
• includes mountain region of central & western China.
• Peach, pear, plum, buckwheat, china tea, Colocasia, brinjal, apricot, opium poppy, orange, radish, turnip, soya bean., etc.

2) Himalayan centre :- • also called Indian centre of origin.
• includes region of Assam, Burma, Indo-china, and Malayan-archipelago.
• rice, red gram, chick pea, cowpea, mung dal, cucumber, sugarcane, black pepper, cotton, turmeric, millets, indigo, brinjal, rice bean. etc.

3) Mediterranean centre :- borders of mediterranean sea.
• most of the cultivated vegetables.
eg- A. → durum wheat, common wheat, oat, barley, lentil, pea, gram pea, cabbage, peppermint, asparagus etc.

4) Abyssinian centre - include Ethiopia & parts of Somalia.
→ wheat, sorghum, bajra, safflower, okra, coffee, Castor, etc.

Central asian centre - north-west India, Afghanistan, West China, Uzbekistan.

- bread wheat, club wheat, sesame, linseed, carrot, onion, garlic, grape, cotton etc.

6) Asia minor centre - near East-asian region like Iran, and Turkmenistan.

- almond, fig, walnut, wheat, rye, cherry, alfa-alfa, pomegranate etc

7) Central american centre :- southern parts of Mexico, Costa Rica, Guatemala and Honduras region.

→ maize, rajma, sweet potato, pumpkin, chilli, cotton, papaya, guava, avocado.

8.) South american centre - Peruvian regions, Brazil, Paraguay region, island of southern Chile.

- potato, sweet potato, rubber, tobacco, tomato, cassava, cocoa, pineapple, etc.

Limitations of Vavilov's views :-

1) Vavilov's considered regions with greatest genetic diversity of a species as the centre of origin of that species. But now, many species due ~~to~~ known who's centre of origin & genetic diversity is different. eg - maize & tomato.

2) Acc to vavilov centre of origin was limited to low mountain & hills of tropical & subtropical regions, But recent evidences show plains as the centre of origin of many cultivated plants.

3) Today, several crops are known who's centres of origin are different from the one suggested by Vavilov. moreover, there is more than one centre of origin

Also origin of many species cannot be traced due to lack of sufficient evidence.

4) According to Vavilov primary centre is marked by high frequency of dominant alleles towards the centre & recessive towards periphery.

But this view is not accepted as perfect ~~fact~~ knowledge

Origin & Introduction of plants

Humans → Heterotroph., they derive their nutrition from plants & animals.

→ evolve from herbivorous ancestors.

→ About 2 million yrs ago. the early Palaeolithic man started using weapons for hunting.

Later he began eating fruits & roots of wild plants.
Much later, man started cultivating plants & raising animals and started a settled life.

→ Earliest settlement ⟶ river valleys & northern India plains.

Soil fertile, plenty of H_2O, so it was easy to cultivate crops.

→ Agriculture originated about 7000 - 13000 yrs ago. Subsequence in the well watered highlands ~~islands~~ of Indus, Euphrates, and Nile and Tigris river.

→ Some other prehistoric ancient agricultural activity are - Tehuacan valley in modern Mexico & banks of yellow river in modern china

→ S.E asia → Ideal for ~~beginning~~ agri beginning → diverse vegetation to support a stable human population.

→ planting of vegetative parts, rhizomes, tubers, bulbs was simpler in these areas.

1st act of civilization → based on finding seeds & throwing stuff into the ground

→ Cereals were originally → weeds → which grew in mountain areas of Asia, Europe and Africa (old world). and North & South America (new world).

Domestication of plants – is the starting step in the direction of a full-fledged agricultural economy.

→ When a plant is called domestic? when its natural characteristics are so much improved and it cannot grow & reproduce without human involvement.

→ Domestication is thought to be the result of the development of a symbiotic relationship b/w the plants and humans, called, co-evolution because plant & human behaviour evolve to suite one another.

Eg- Plant	Domesticated at	Domesticated in
egg plant	Asia.	1st century BC
vanilla.	central america.	14th century AD.
chocolate	Mexico	1600 BC
rice	east asia	9000 BC
barley, emmer wheat, einkorn wheat	near east	8500 BC

Basis of plant domestication-

- plants cultivated was 1st cultivated → historical times & have poor evidence
- palentological data → unavailable for cultivated plants, &
- archaeological data → very poor & fragmented.
- In beginning of 19th century → origin of most cultivated sp. were unknown.
- No species were common to northern regions of the 2 hemispheres before cultivation
- great no. of sp. originated in → Europe, India, Brazil, Colombia, West asia
- In short, the original distribution of cultivate sp. was unequal.
- There was no proportion with the needs of man & ~~no. of plants~~ number of plants cultivated.

Cultivated wild species of rice →

1) Asian wild sp – Oryza rufipogon
2) African wild sp – Oryza glaberrima

Asian rice → 3 races → 1) indica – cultivated in tropical region
2) japonica – temperate
3) javanica – intermediate b/w indica & japonica.

→ There are total 22 wild species of rice found in tropics. In which 8 of them are tetraploid (4n) → use for breeding programme for developing new varieties.

CROP IMPROVEMENT

CEREALS (Poaceae / Gramineae).

Crop	Bot. name	Chr. no.	Centre of origin	distribution of species	wild relatives
1.) Rice. Poaceae	Oryza sativa	2n = 24	S.E Asia.	China, India, Japan, Pakistan, Korea, Bangladesh.	O. nivara O. officinalis.
2) Maize. Poaceae	Zea mays	2n = 20	Central America	USA, china, Russia, Canada, & many South Asian countries.	Zea mexicana. Zea perennis.
3) Sorghum Poaceae	Sorghum bicolor	2n = 20	S.E Africa, Ethiopia.	South & central India, Africa, China, Argentina, Australia, and South & central plains of USA.	S. halepense, S. drummondii.
4.) Pearl millet. Poaceae	Pennisetum americanum	2n = 14	W. Africa.	India, Africa, Pakistan, USA, Europe and S.E Asia.	P. purpureum P. squamulatum
5.) Finger millet. Poaceae	Eleusine coracana	2n = 36.	Vavilov – Africa Decandolle – India.	India. Africa. Pakistan	E. indica E. oligostachya

PULSES (fabaceae / leguminaceae

Crop	bot. name	Chromosome no.	Centre of origin	distribution of species	wild relatives
1) Red gram Fabaceae	Cajanus cajan	2n = 22	Africa & India	India, Uganda, Kenya, West Indies, Burma etc.	C. scarabaeoides
2) Soyabean fabaceae	Glycine max	2n = 40	China.	India, USA, China, Brazil and Argentina.	Glycine soja
3) Green gram Fabaceae	Vigna radiata	2n = 22	India	India, Pakistan, Philippines, Taiwan, Thailand, Srilanka, Bangladesh, Nepal and South Asian countries.	V. radiata variety sublobata
4) Black gram Fabaceae	Vigna mungo	2n = 22	India	India, Pakistan, Srilanka & South Asian countries	V. mungo var. silvestris.
5) Cowpea Fabaceae	Vigna unguiculata	2n = 22.	Africa	Nigeria, Niger, Burkina faso, Ghana, Kenya, Uganda, Malawi, Tanzania (all in Africa) and India, Srilanka, Burma, Bangladesh, Indonesia, Thailand, Philippines.	V. unguiculata var spontanea.