

Plant Morphology

- deals with the external forms of the plant.

The life cycle of higher plants including two stages:

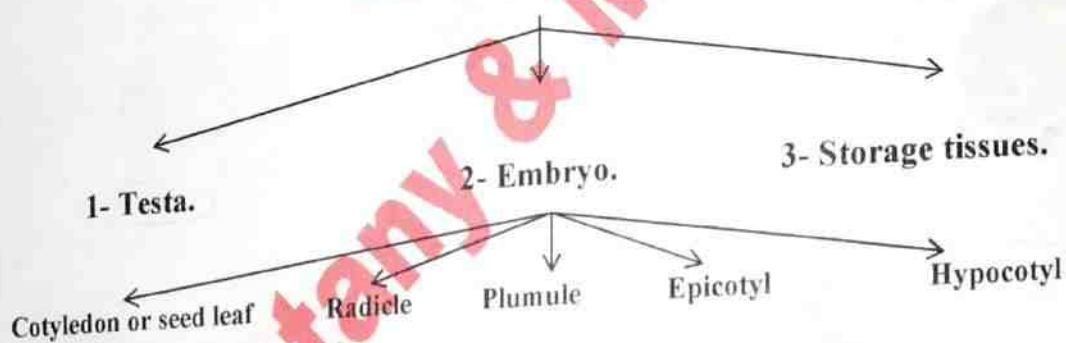
A: Dormice stage (Seed)

B: Active stage (vegetative body)

1- Seeds

- are mature fertilized ovule.
- A seed is a small embryonic plant enclosed in a covering called the seed coat, usually with some stored food.

Seed structure (parts)



1. The seed coat (testa):

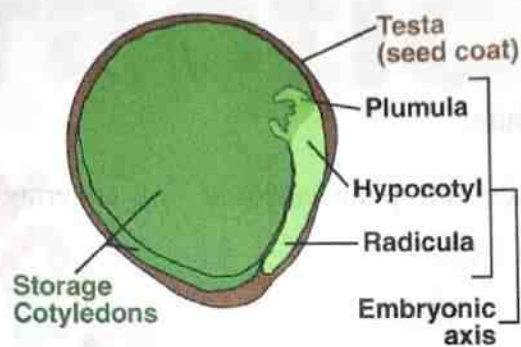
- ☐ It is protective wall surrounding the embryo and storage tissue. It develops from the integument, originally surrounding the ovule.

2. The embryo is immature plant, it have:

- ☐ Cotyledon or seed leaf, one in monocot, two cotyledons in dicot and two or more in gymnosperms.
- ☐ Radicle is the embryonic root.
- ☐ Plumule is the embryonic shoot.
- ☐ Epicotyl is embryonic stem above attachment of the cotyledon(s)
- ☐ Hypocotyl is embryonic stem below attachment of the cotyledon(s)

3. **Store of nutrients**, it may be:

- In angiosperms, in a tissue called the endosperm, via double fertilization, usually triploid ($3n$) endosperm rich in oil or starch and protein.
- In gymnosperms, the food storage tissue is part of the female gametophyte, a haploid tissue (n) contain different materials.



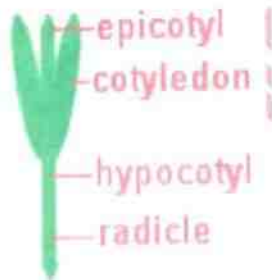
Pisum sativum

Kinds of seeds

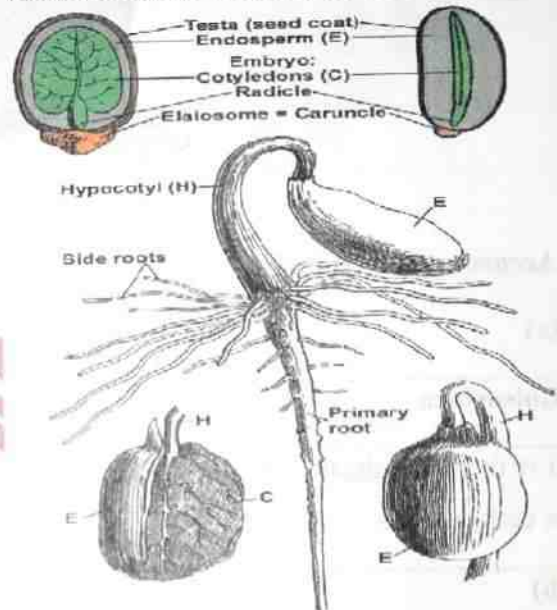
According to storage foods

1. Endospermic seeds

- Cotyledons thin and the endosperm is the major storage tissue. The cotyledons absorb the nutrients from endosperm.

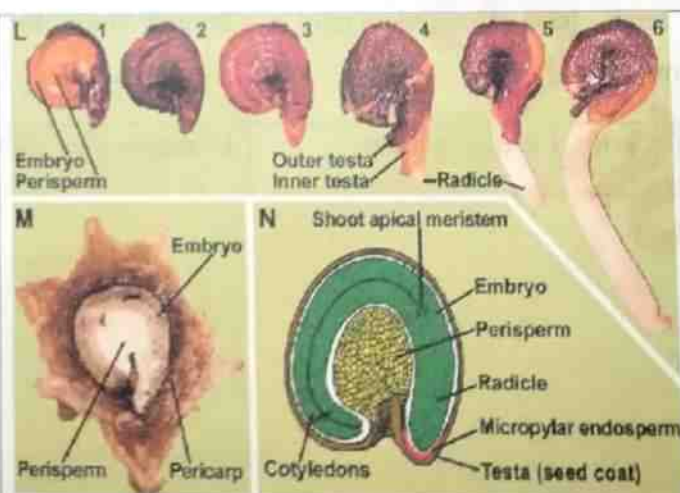


Ricinus communis - castor bean (Euphorbiaceae)



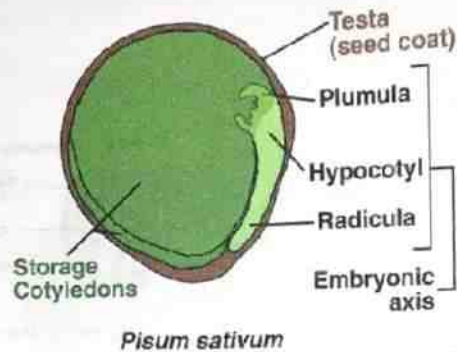
2. Perispermic seeds Sugar beet

- Stored food in pericarp, a fruit tissue, and then uptake by the cotyledons.



3. Non-endospermic seeds (legume, pea)

□ Stored food in cotyledons. During embryo development the cotyledons absorb the food reserves from the endosperm.



According to germination

(a)

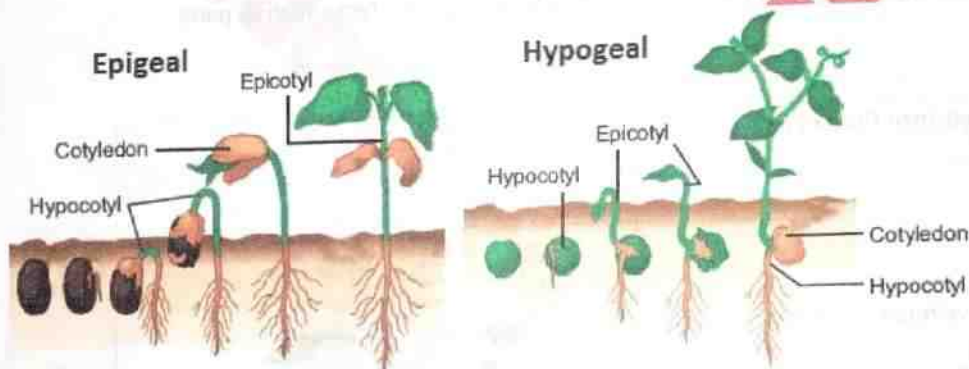
Goleorrhiza	Coleoptile
It is the outer sheath covering the radicle in certain seeds.	It is the outer sheath covering the plumule in certain seeds.

(b)

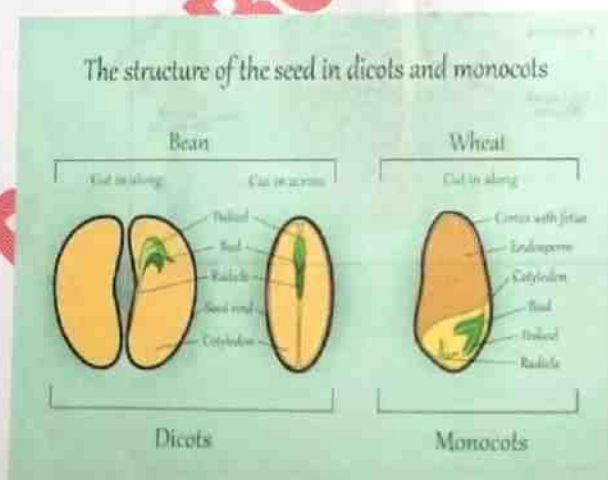
Albuminous seed	Exalbuminous seed
These seeds have endosperm.	These seeds lack endosperm.
In such seeds, food is stored mainly in endosperm.	In such seeds, food is stored only in the cotyledons.
Example- Castor, Cereals, grasses.	Example- Pea, gram, Lentil.

(c)

Epigeal germination	Hypogeal germination
Here cotyledons are pushed above the soil.	Here, cotyledons remain inside the soil.
Here hypocotyl grows and elongates faster than epicotyl.	Here epicotyl grows and elongates faster than hypocotyl.
Example – Bean, cotton, castor, papaya	Example – Wheat, rice, groundnut, mango



According to number of cotyledons



B: Vegetative Body (2 parts)

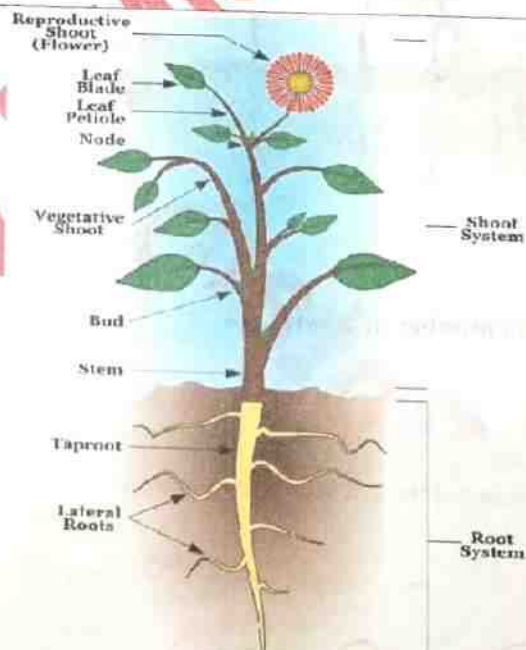
Root system	Shoot system
- grows beneath the soil surface - consists of primary root, lateral roots & rootlets. - its function fixation, absorption & some roots perform special functions as storage, climbing,	grows above the soil surface consists of the stem (main axis) of the plant. It carries the leaves the flowers and fruits. A normal stem is divided into nodes and internodes. its function bearing, conduction & Metamorphosed for special functions as storage, perennation, climbing

and the shoot system which usually

grows above the soil surface and carries the foliage leaves and the reproductive parts.

Plant is divided into four organs:

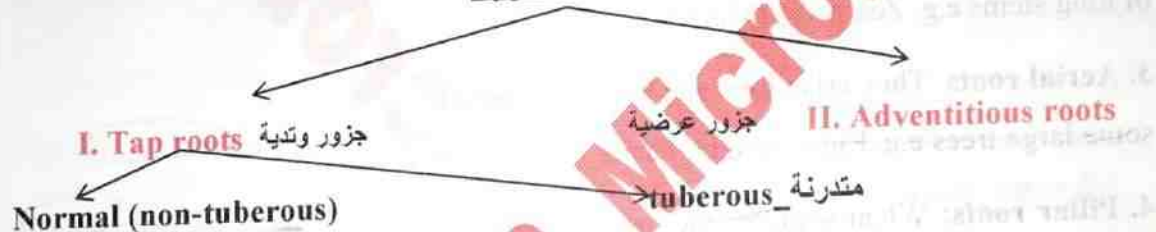
1. Root
2. Stem
3. Leaves and vegetative organs.
4. Flower and fruits.



The root is usually differentiated into the following zones:

1. **Growing apex:** active promeristem at tip, consists of meristematic tissues, covered by calyptra.
2. **Zone of elongation:** rapid elongation zone helps root to grow.
3. **Zone of absorption (root hairs):** fine white hairs at all sides for absorption of water and solutes.
4. **Bare zone:** oldest root hairs fall leaving region bare.
5. **Permanent zone (lateral roots):** Lateral roots arise endogenously from the vascular cylinder branch into smaller rootlets.

Types of Roots



- store normal amounts of food.
 - The root is cylindrical in shape with broad base and a tapering apex.
- e.g. Cotton root or Ricinus root.



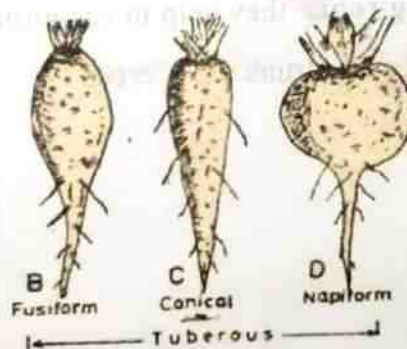
- store excessive amounts of food.

- According its shape they are:

1-fusiform e.g. Raphanus sativus (Radish).

2- conical e.g. Daucus carota (Carrot).

3-napiform e.g. Brassica rapa (Turnip).



II. Adventitious roots

They do not arise from the radicle but they usually arise from other parts such as the base of the stem or lower surface of leaves.

Types of adventitious roots:

1. **Fibrous roots:** They are fine thread-like roots common in the family Gramineae

e.g. *Cynodon dactylon*.

2. **Prop roots:** They develop from the lower nodes of long stems e.g. *Zea mays* (Maize).

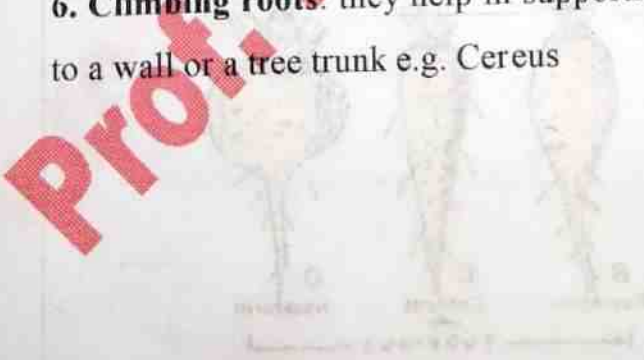
3. **Aerial roots:** They arise from the lower surface of some large trees e.g. *Ficus benghalensis*.

4. **Pillar roots:** When some of the prop roots reach the soil surface and penetrate inside the soil

e.g. *Ficus benghalensis*.

5. **Tuberous roots:** store excessive amounts of food e.g. *Ipomoea batatas* (Sweet potato).

6. **Climbing roots:** they help in supporting the plant to a wall or a tree trunk e.g. *Cereus*



The Shoot System

Description of Stem

1. Habit

1. Herb عشبي

كمية قليلة من الانسجة اللجنين
مثل نبات البرسيم
e.g. Trifolium (clover).

2. Shrub شجيرة

كمية كبيرة من الانسجة اللجنين
ولكن الشجيرة ليس لها جذع
رئيسي والافرع قريبة من سطح
التربة واقل في الطول من الشجرة
مثل الورد
Rosa

3. Tree شجري

كمية كبيرة من الانسجة اللجنين و
لها جذع رئيسي يسمى
Trunk
مثل شجر الكافور
Eucalyptus.

2. Nature

1. Erect stems ساق قائمة

لها القدرة على حمل الاوراق والفروع والازهار
والثمار لانها تحتوى على كمية كافية من الانسجة
الخشبية التدعيمية

e.g. Gossypium, Vicia faba.

مثل القطن والفاول

2. Weak stems ساق ضعيفة

غير قادرة على حمل الاوراق والفروع والازهار
والثمار لانها لا تحتوى على كمية كافية من الانسجة
الخشبية التدعيمية

Weak stems

a. Climbing stems متسلقة

1- by twining الالتفاف e.g. Convolvulus

2- by tendrils المحاليق e.g. Vitis or e.g. Pisum

3- by prickles بالاشواك e.g. Rosa

4- by adventitious roots الجذور العرضية
e.g. Cereus.

b. Creeping stems زاحفة

1- Prostrate منبطحة

2- Running جاري

3. Shape الشكل

Cylindrical إسطواني angular مضلع flattened مسطح

4. Surface السطح

Smooth (glabrous) ناعم Rough خشن Hairy شعري prickly شوكي

5. Internal structure التركيب الداخلي

Solid مصمت hollow أجوف
with a pith e.g. Salvia without a pith e.g. Vicia faba.

6. Dwarfness (القزم) (القصير)

Normal ساق طبيعية
divided into nodes and internodes Dwarf (discoid stem) ساق متقزمة قرصية
not differentiated into nodes and internodes
مثل البصل والفجل

7. Buds البراعم: محور قصير لا يتميز الى عقد وبين عقد

1. Terminal (apical) bud قمي أو طرفي

2. Lateral (axillary) buds جانبي

3. Adventitious buds عرضي

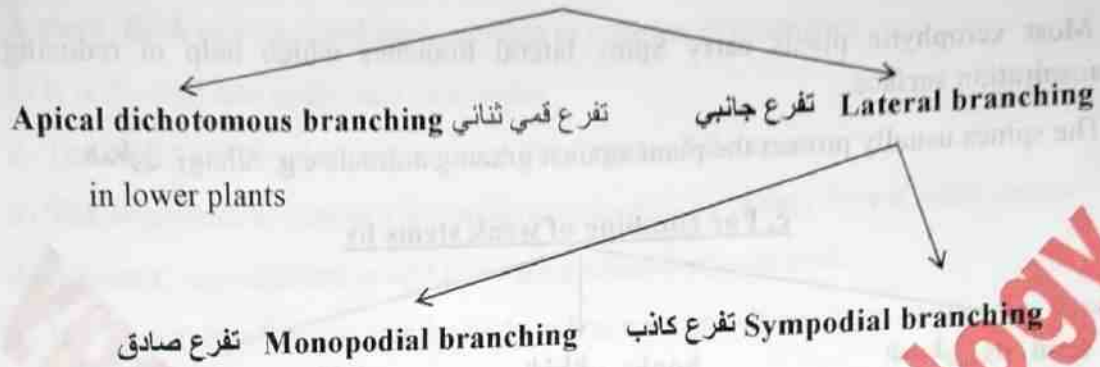
Classification

1. Position المكان 2. development التطور 3. duration فترة الوجود

Leafy or branch bud برعم وريفي Flower bud برعم زهري Mixed bud برعم خليط

Summer bud Winter bud

8. Branching (due to activity of buds)



9. Metamorphosis التحورات

- Stems metamorphosed to perform functions other than their normal functions as

a. For assimilation التمثيل الضوئي

- | | |
|---|---|
| <p>Phylloclades ساق عديد السلمييات</p> <ul style="list-style-type: none"> The stem is flattened. with several internodes. green and leaf-like. e.g. <i>Ruscus</i> السفندر | <p>Cladode ساق وحيد السلية</p> <ul style="list-style-type: none"> flattened. with a single internode. green and each cladode is represented by a single internode |
|---|---|

Succulent stems: ساق عصارية

Phylloclades of are flattened, green and fleshy being photosynthetic and store water and food.

- The lateral buds are metamorphosed to spines.

e.g. *Opuntia* التين الشوكي

e.g. *Asparagus*. الكشك الماظ

b. For reduction of the transpiring surface and protection

- Most xerophytic plants carry Spiny lateral branches which help in reducing transpiration surface.
- The spines usually protect the plant against grazing animals e.g. Alhagi. العاقول

c. For climbing of weak stems by



d. For perennation التعمير, storage التخزين and vegetative reproduction التكاثري الخضري

1• Rhizome:

A horizontal underground stem growing horizontally beneath the soil surface.

e.g. Cynodon dactylon.

- 1- It is usually branched and divided into nodes and internodes.
- 2- Scale leaves and adventitious roots arise from the nodes.
- 3- Aerial green shoots arise from the upper surface of the rhizome at the nodes.
- 4- Branching of the rhizome is mostly sympodial.

2• Tuber:

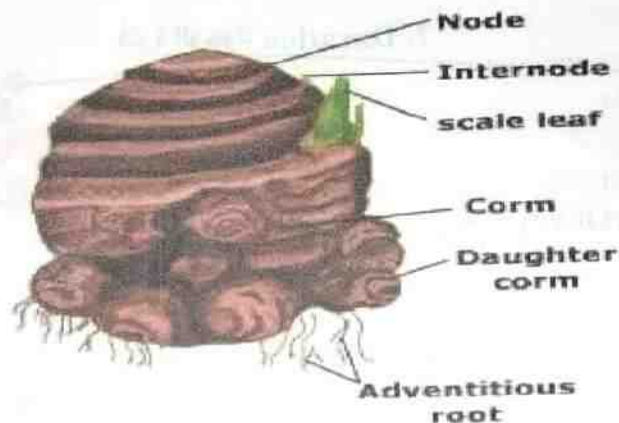
It is an enlarged portion of an underground perennial stem e.g. potato.

- 1- The surface of the tuber is full of shallow depressions known the eyes.
- 2- The eyes represent nodes of the underground stem.
- 3- The eye is surrounded by very small scale leaves & axillary buds found in center.

3• Corm:

A short, thick underground stem, upright in position (Colocasia).

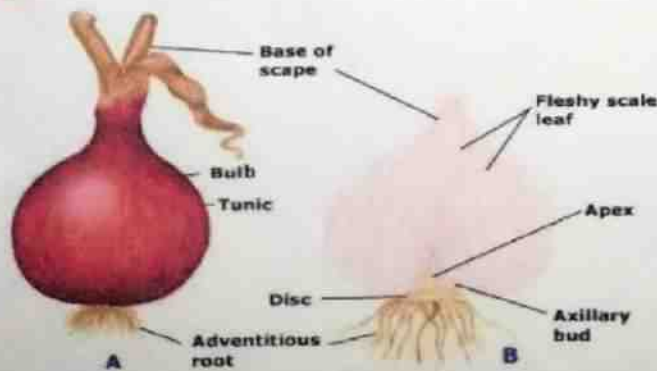
- 1- It is divided into nodes and internodes.
- 2- The nodes are circular rings around the surface of the corm.
- 3- The internodes in between the nodes are covered by papery brown scale leaves.
- 4- Adventitious roots and lateral buds are produced at each node.
- 5- If the corm is left in the soil the buds will grow to produce corms of the next year.



4• Bulb:

It is an underground short discoid stem composed of enlarged and fleshy leaf bases which are termed the scales.

- 1- Food is stored in the scales e.g. onion.
- 2- The discoid stem carries a terminal bud on its upper surface which is surrounded by the scales.
- 3- axillary buds present in the axile of the scales.
- 4- The bulb of garlic is divided into small **bulbils**.



A. Tunicated bulb of onion B. L.S. of bulb

II. The Leaf

1. Insertion المنشأ

Radical جزرية

arise from discoid stem (Onion and radish).

Cauline ساقية

arise along main axis of stem at nodes

2. Duration فترة الوجود

Evergreen دائمة الخضرة

Leaves remain through the whole year green (Olive). الزيتون

Deciduous متساقطة

Leaves fall down in autumn or winter العنب (Vitis).

3. Arrangement الترتيب

1. **Alternate**

متبادلة

one leaf at each node

2. **Opposite** متقابلة

Two leaves at each node

• **Superposed** فوق بعضه

Successive pairs of leaves over each other

Decussate متصالب

Successive pairs of leaves at right angles to each other

3. **Whorled (Verticillate)**

محيطية

more than 2 leaves at each node.

4. Leaf base is the part of the leaf which is attached to the stem at the node.

a. **Exstipulate** عديمة الاذينات no appendages

b. **Stipulate** ذات اذينات

with two lateral appendages.

1. **Normal**

no swollen
than petiole.

2. **Pulvinate** منتفخة

swollen than petiole.

3. **Sheathed** غمدية

a broad flattened base

Stipules may be ordinary,
leafy, spiny, tendral, hairy

5. Leaf petiole عنق الورقة a cylindrical portion between the leaf base and the blade

1- **Petiolate** or stalked leaves معنقة

leaves with a petiole

2- **Sessile** جالسة

with no petiole

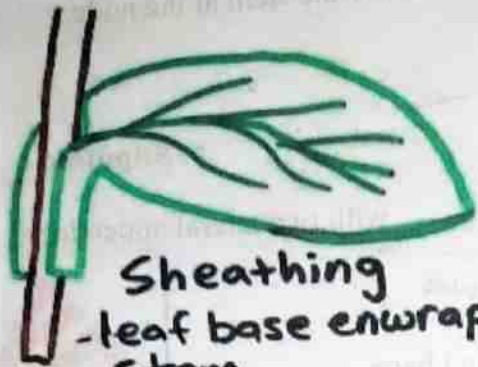


Petiolate

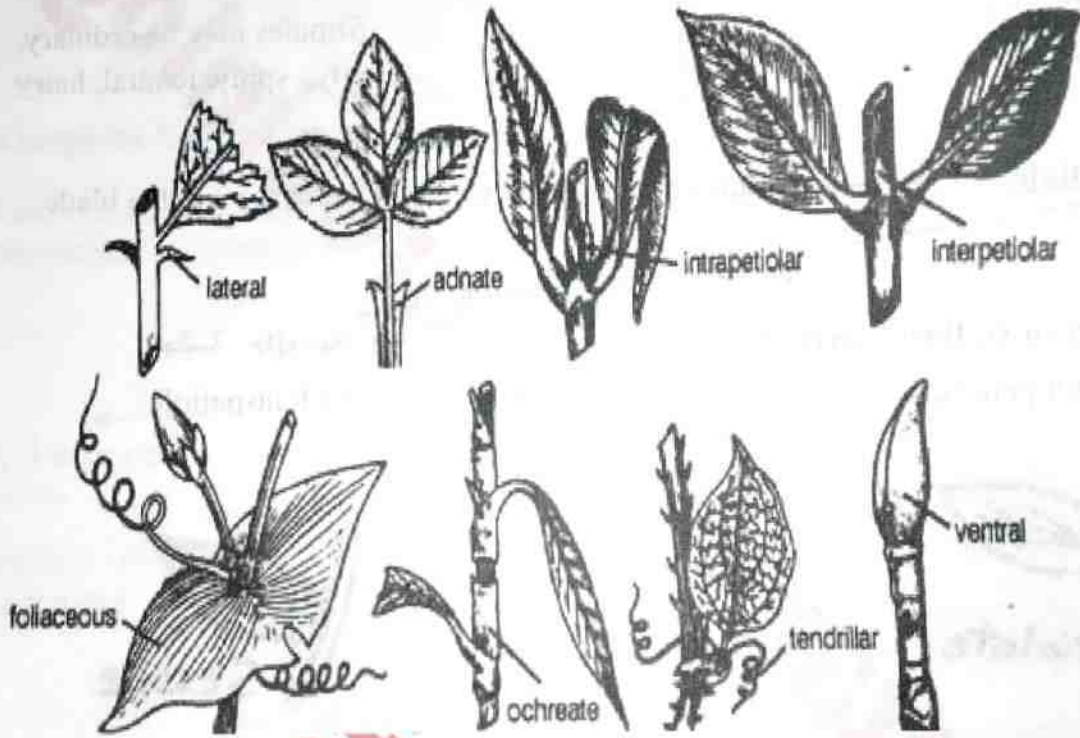
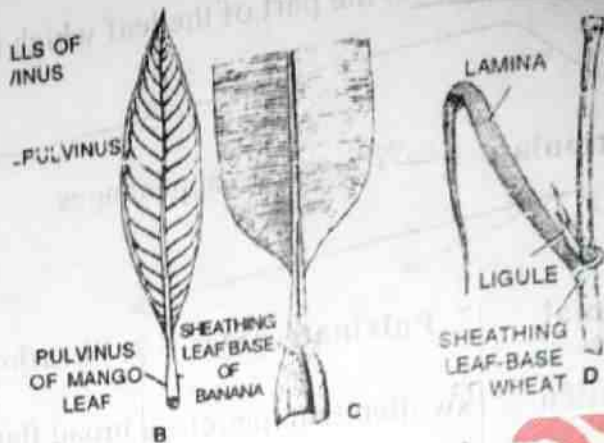


Sessile

Prof. Botany & Microbiology

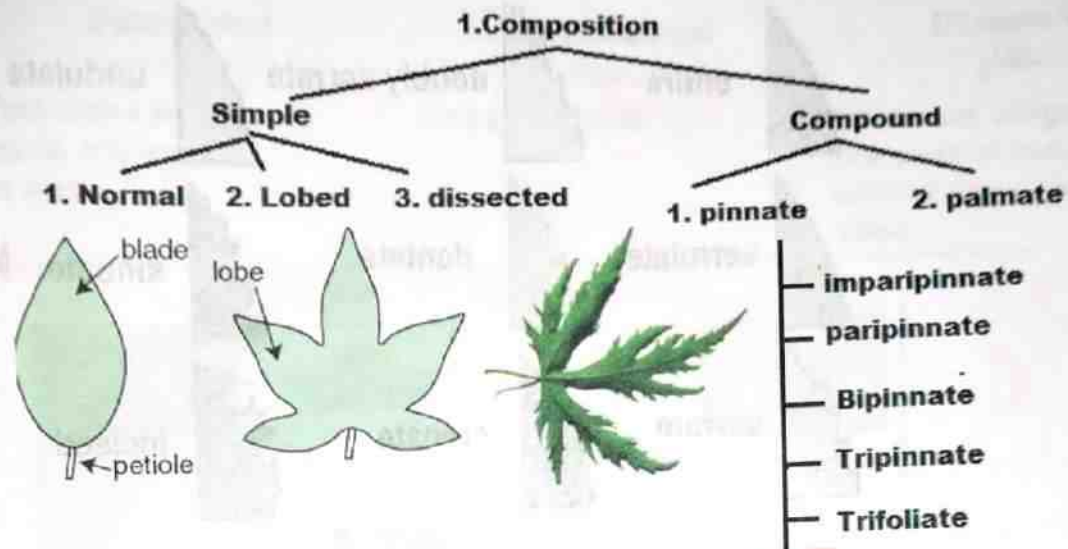


**Sheathing
-leaf base enwraps
stem**

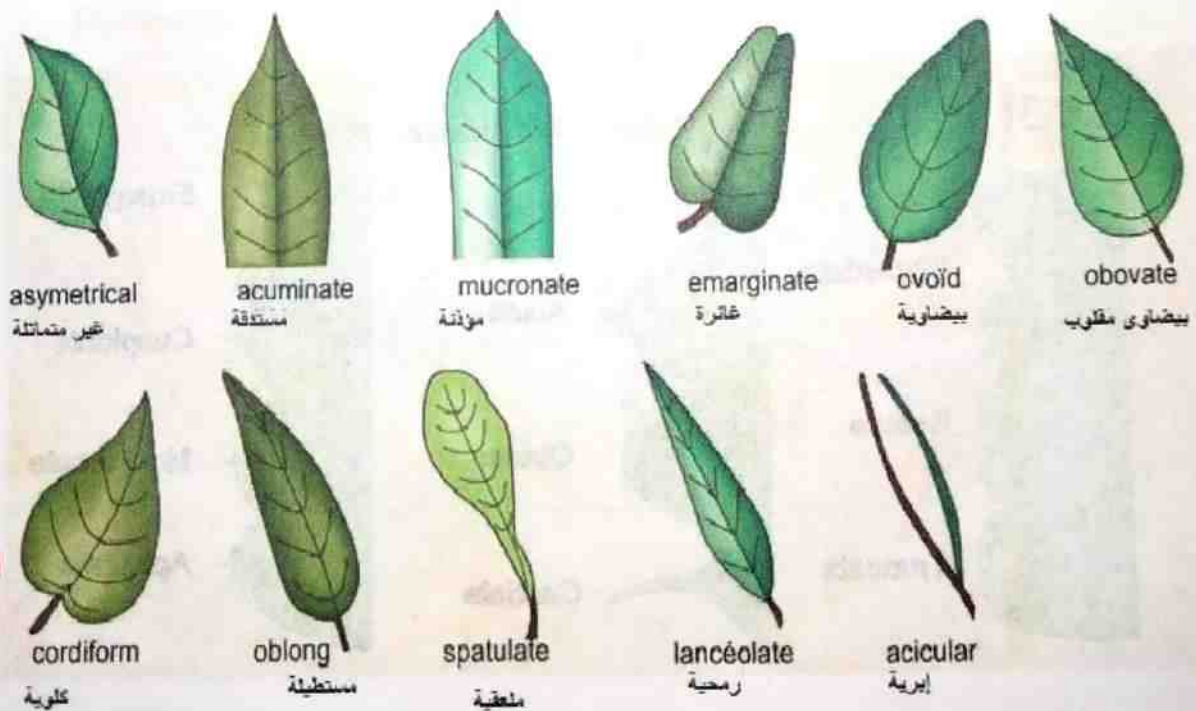


Prof. Box

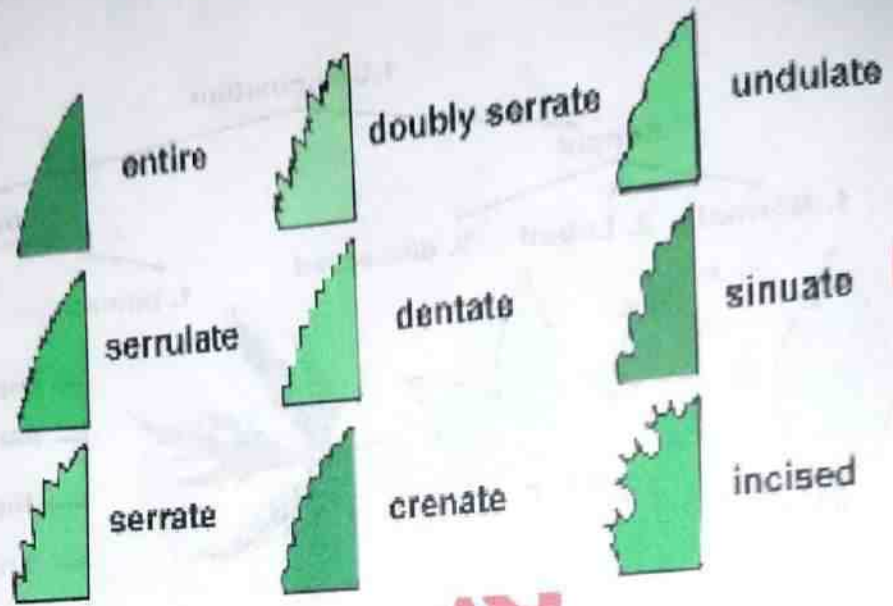
6. Leaf blade: green photosynthetic flattened part of the leaf.



2. Shape

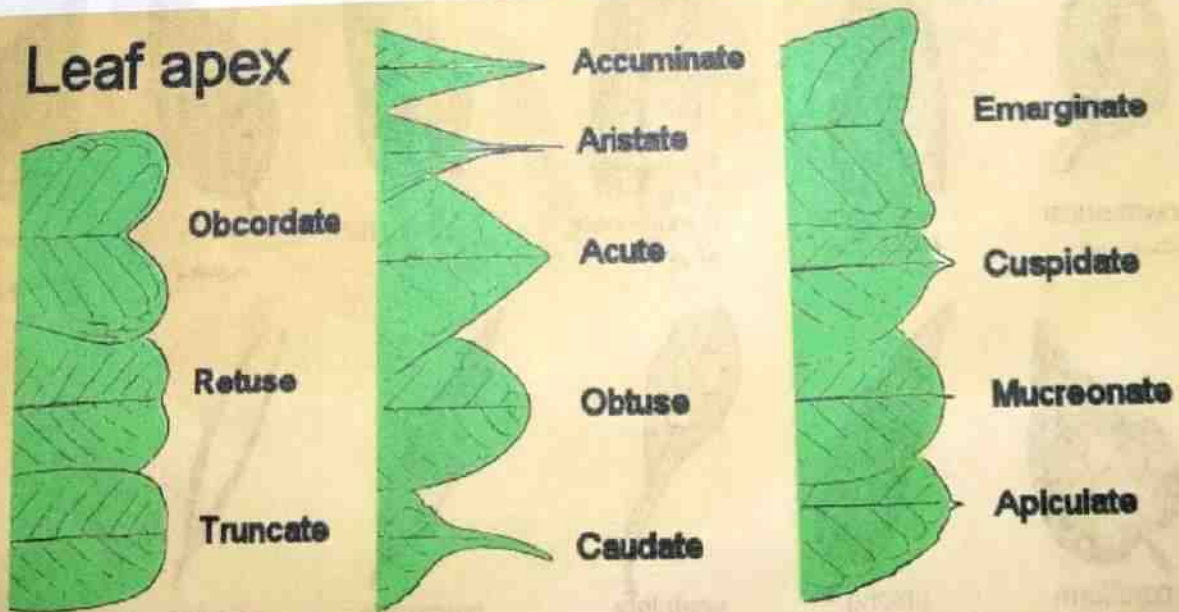


3. Margin الحافة



4. Apex القمة

Leaf apex



5. Base

Symmetrical

متمائل

Two sides of the blade are equal in size

Asymmetrical

غير متمائل

Unequal in size

Decurrent

متقطع

Blade has wings around the stem or petiole & extend down along the stem

Base of the lamina



Symmetric



Asymmetric



Decurrent

6. Venation

Reticulate

شبكة

Parallel

متوازي

Pinnate

ريشي

Palmate

راحي

Longitudinal (Basal)

Transverse (Costal)



7. Metamorphosis:

The leaf may become modified to perform special functions.

1- For reduction of transpiring surface:

The leaves modified into scales to reduce the transpiring surface.

e.g. Ruscus

2- For protection:

The leaves and/or stipules become spiny for protection of the plant against grazing animals.

3- For climbing:

The leaf or stipules become spiny or tendril for climbing

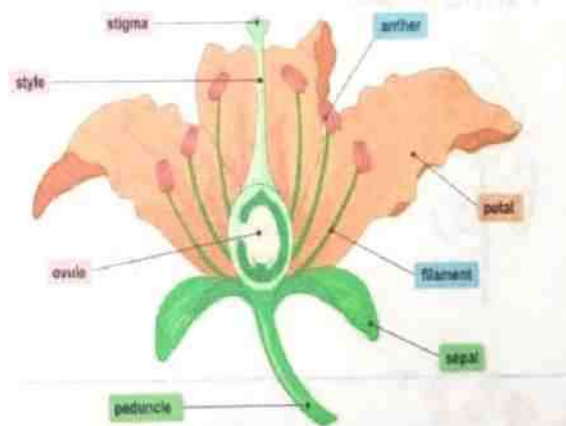
e.g. Lathyrus plant.

4- For storage:

In onion the white fleshy leaves store food and water.

5- For reproduction:

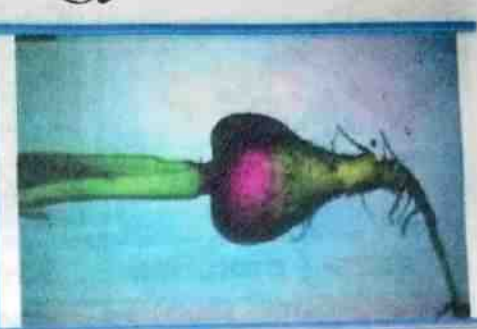
The flower is a modified stem, its receptacle usually carries sepals, petals, stamens, and carpels which are actually modified leaves.



8. Heterophylly:

The same plant carries two or more different forms of leaves e.g. Vicia seedling.

Scheme Morphology

		
Normal tap root	Conical tuberous tap root	Napiform tuberous tap root
		
fusiform tuberous tap root	Prop adventitious root	aerial adventitious root
		
climbing adventitious root	tuberous adventitious root	Leafy stem (phylloclade e.g. <i>Ruscus</i>)
		
Succulent stem (phylloclade e.g. <i>Opuntia</i>)	Leafy stem (cladode e.g. <i>Asparagus</i>)	Climbing stem



Rhizome (modified underground stem)



Rhizome (modified underground stem)



Spiny stem (e.g *Alhagi*)



corm (modified underground stem)



Garlic bulb (modified underground stem)



tuber (modified underground stem)



Storage leaves



Onion bulb (modified underground stem)

1- Root system:

Always absent but if present is called **Normal tap root**

2- Shoot system

a- Stem

- 1- **Habit:** Herb or woody
- 2- **Nature:** Erect or weak
- 3- **shape:** Cylindrical
- 4- **surface:** Smooth or rough or spiny
- 5- **internal structure:** Hollow or solid
- 6- **Colour:** green or greenish or brown
- 7- **Dwarfness:** Normal or dwarf
- 8- **Buds:** according to position → Apical bud & lateral bud.

Duration → Summer bud or winter bud.

- 9- **Branching:** Unbranched or lateral monopodial

- 10- **Metamorphosis:** absent or present.

Note that:

1 4 5 6 9

Herb → Smooth → Hollow → green → unbranched

Woody → rough → Solid → Brown- lateral monopodial

* shape usually → cylindrical

* Buds usually according to position → Apical bud & lateral

According to duration → Summer bud.

* (Nature) Erect → Metamorphosis → Absent.

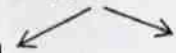
Weak → Metamorphosis → present.

b- Leaf:

1- Insertion: Cauline or Radical

2- Duration: Evergreen or Deciduous

3- Arrangement: Alternate, opposite, whorled

Superposed  decussate

4- Leaf base: Exstipulate or stipulate.

5- Leaf petiole: petiolate or sessile.

6- Leaf Blade:

a- Composition: Simple or Compound

pinnate

palmate

b- shape: ovate or lanceolate

c- Margin: Entire, serrate, dentate.

d- Apex: Acute, acuminate, notched

e- Base: Symmetrical or asymmetrical.

f- Venation: Reticulate pinnate or reticulate palmate.

7- Metamorphosis: Absent or present.

8- Kinds of leaves: foliage leaves

9- Heterophylly: Absent

~~prostrata~~ Dwarf-like ss → ~~trunk~~ trunk

Weak stem

- ↳ climbing by السلق twining
- ↳ shape → cylindrical
- Surface → glabrous / smooth
- internal structure → solid
- Nature → weak
- Habitat → herb



root

-Tubercous taproot

||Conical||

-leaf insertion → radical



Normal Tap root

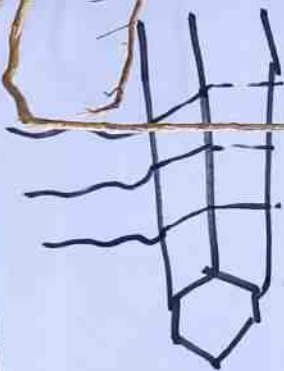
where ebrides
Prunses



Tubercous tap root
Napiform



Adventous
Climbing
root



Contractile adv. root
(Fibrous root)



Pr

root

Prop adventitious
root



leaf modified
into spine
↳ to reduce
transpiration

نبات البقر الشوكي
+ Phylloclade → modified stem



leaf modified
to spine
to reduce
transpiration
نبات البتة الشوك
xerophyte → modified stem

- more P.D.
② leaf
③ Bas
④ le

Underground modification
of stem.
Rhizome



Underground modification
((metamorphosis)) Stem

Corms

القلع





Simple



Complex (Compound)

"Bulb"

underground
modification of
Stem

metamorphosis

tubers
vitabacell

2019



un- 2

Climbing by
tendrils.
|| modified stems

fixation
stem)
ن



Phyllocladus

Leaf Composition:-

(1) Compound

Trifoliate.



Bipinnate.

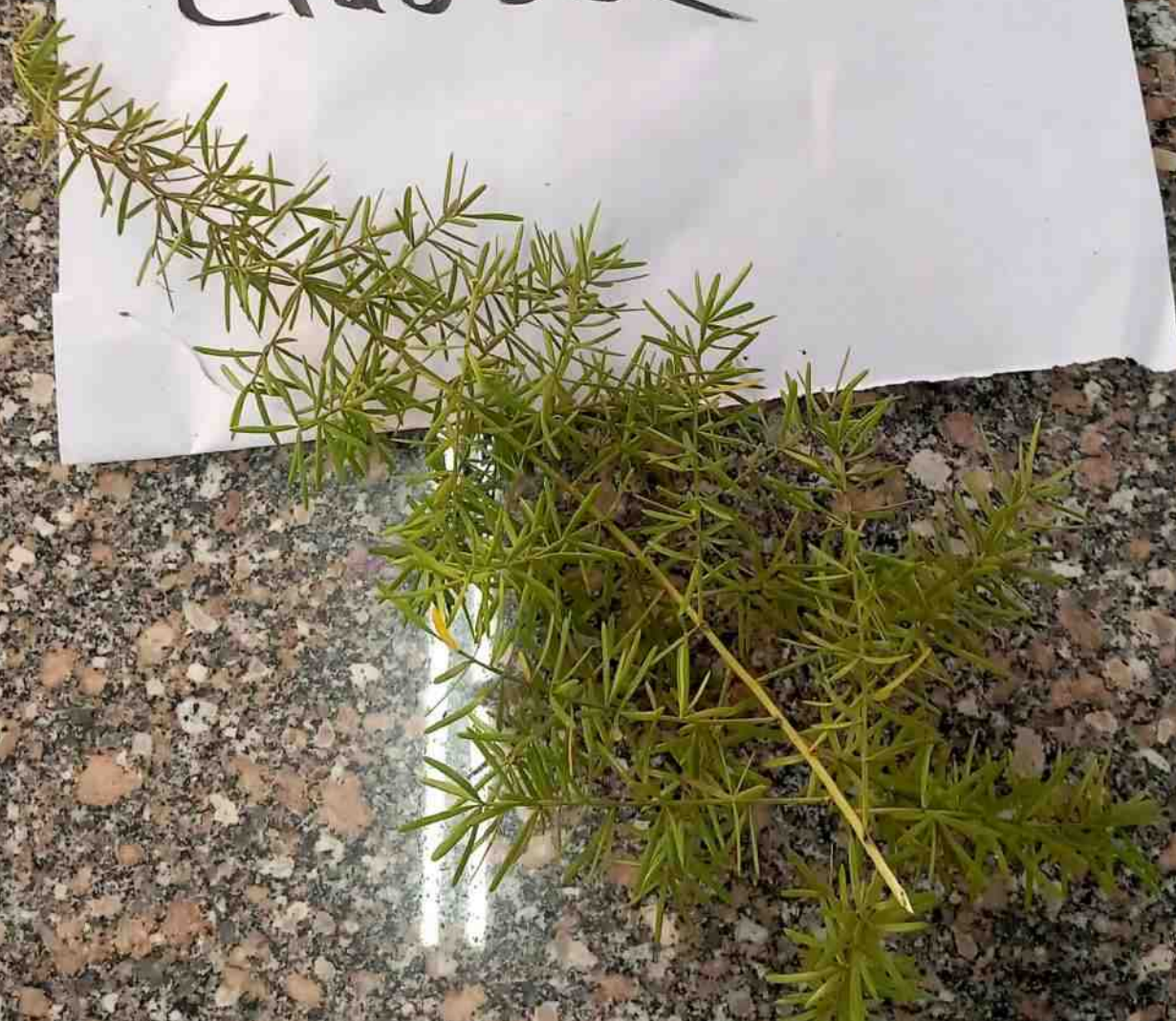


metamorphosis

التحولات

Aerial modification of
stem.

Cladode



leaf Composition:

lobed



normal

Dissected.



Vennation:-

Parallel.

- longitudinal

transverse.



leaf margin:-

toothed

serrate

Entire.

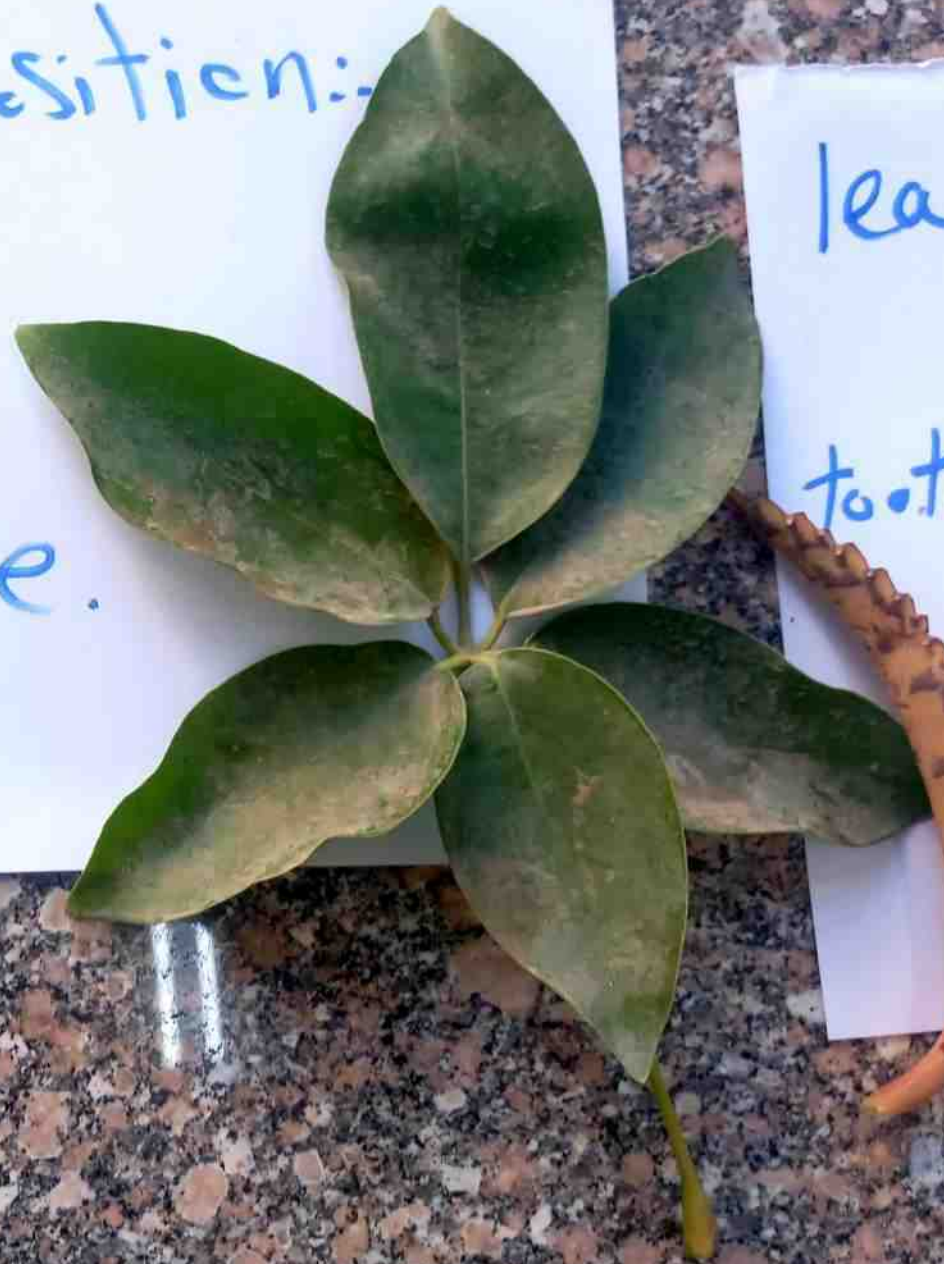


lobed



leaf Composition:

Compound
palmate.



leaf

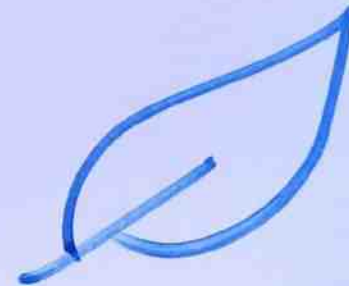
to other

Base & lamina.

Symmetrical

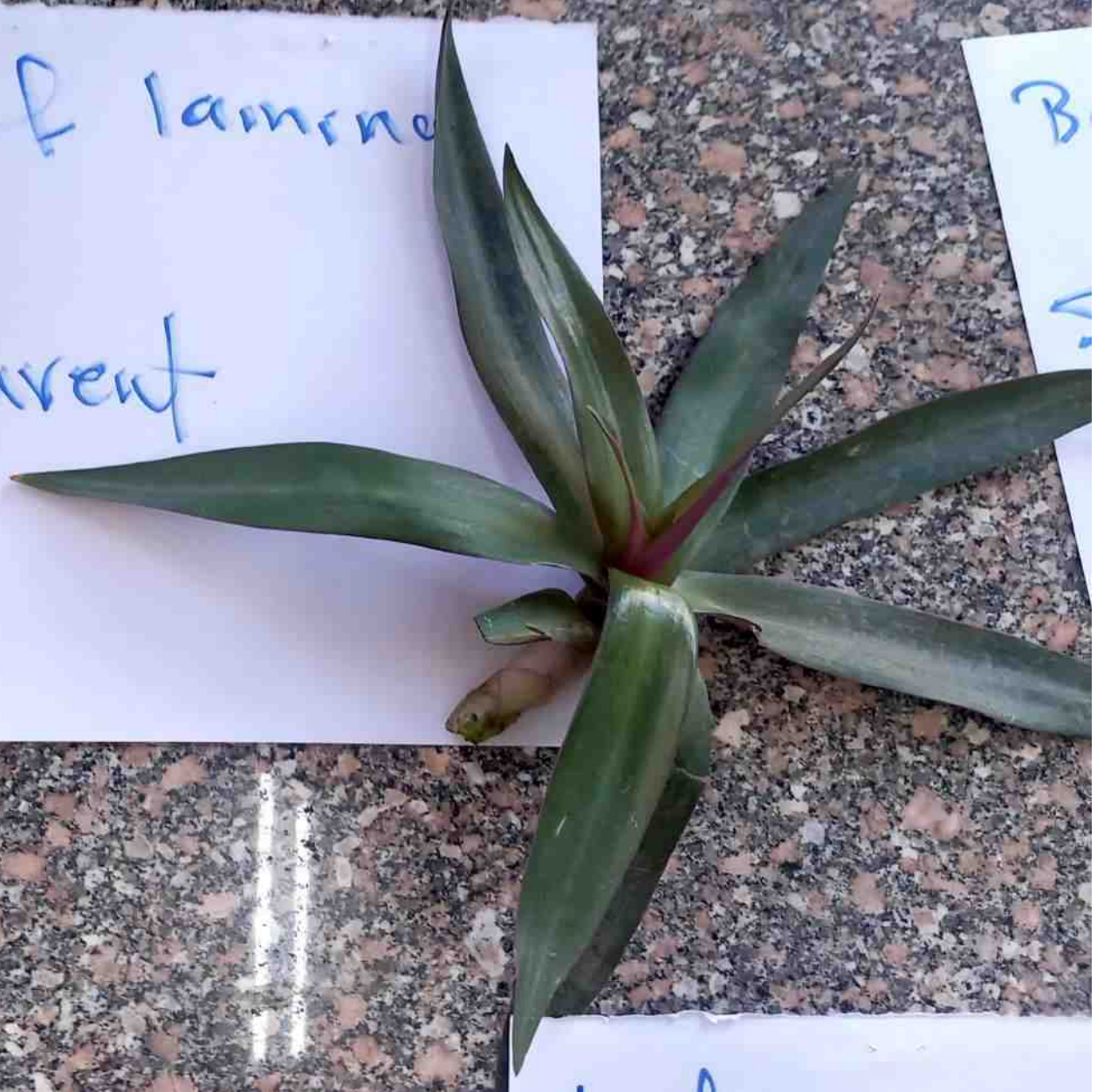


asymmetrical.

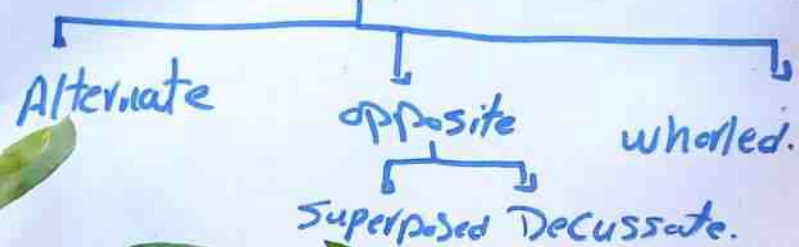


Base of laminae

Decurrent



leaf arrangement



leaf margin:-

toothed

serrate

Entire.

lobed

Vennation:-

Reticulate:-

Pinnately

Palmately.