Botany

Plant Morphology B

First year Biological SciencesStudents - Botany

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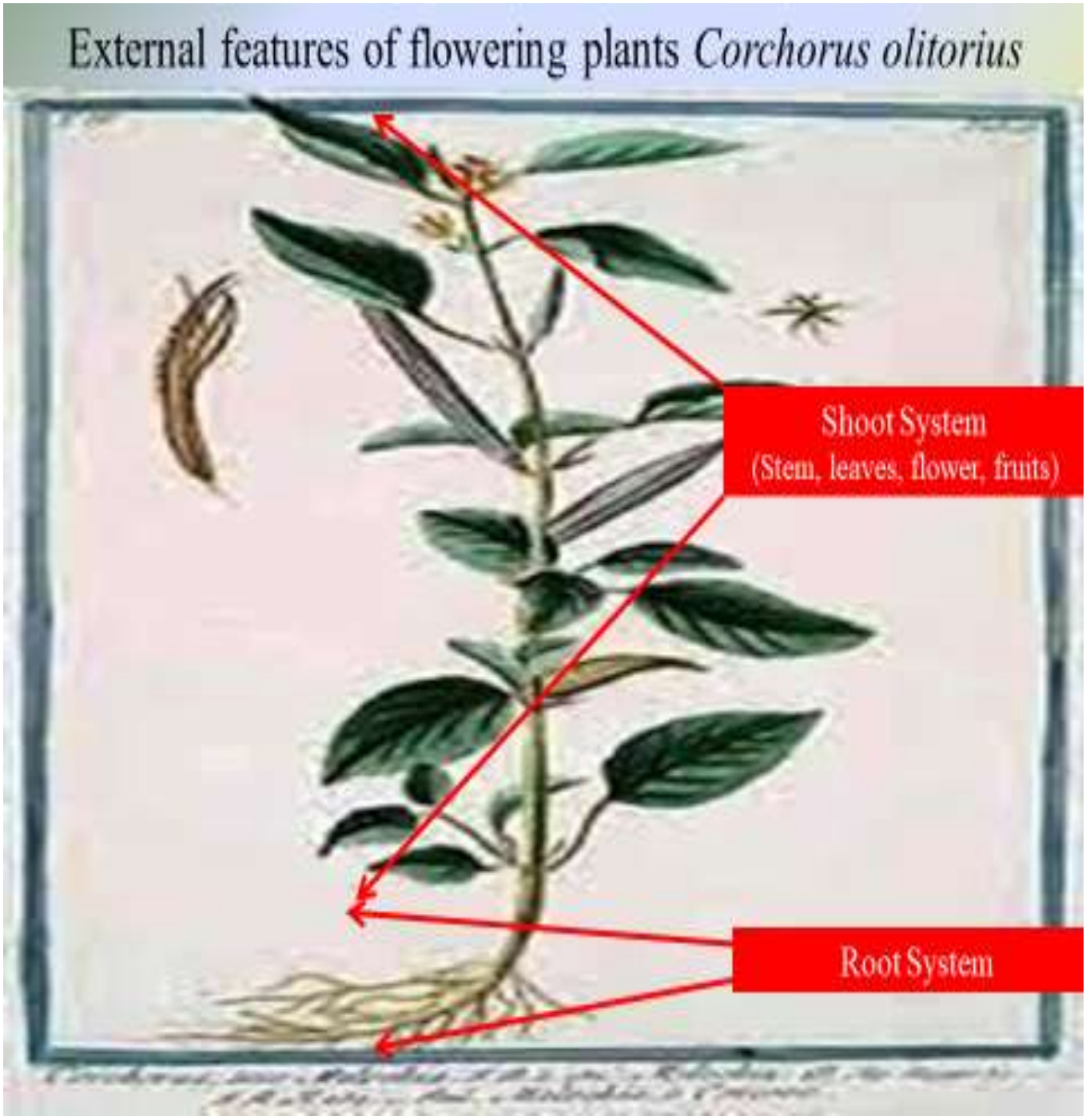
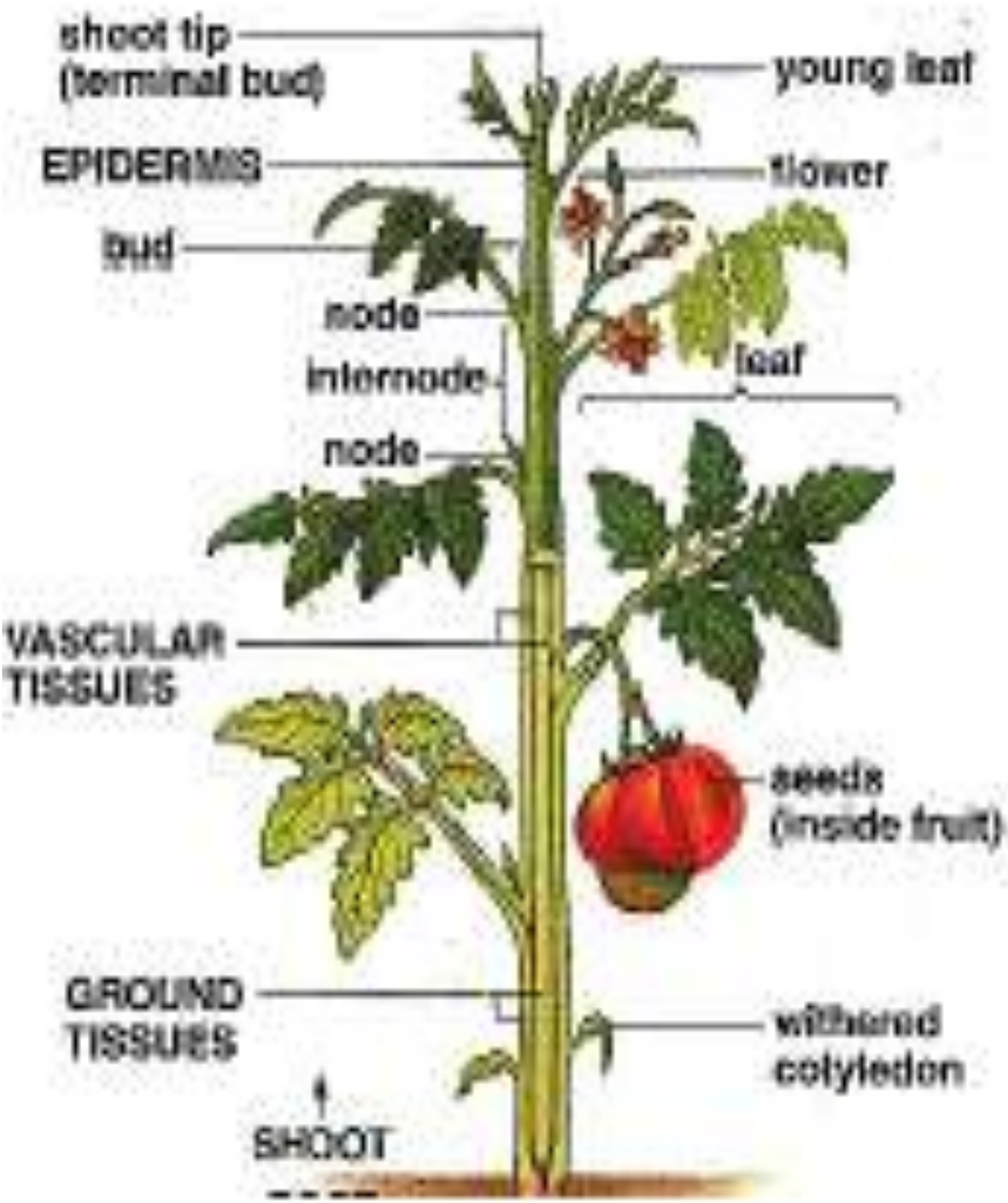
External features of flowering plants:

Most plant consists of two parts:

1. **Shoot System: which lies above ground and is characterized into the Stem, leaves, flower, fruits.**
2. **Root System: which lies in most plants in the underground where the root carries the secondary roots and rootlets.**




shoot tip
(terminal bud)
young leaf
EPIDERMIS
flower
bud
node
internode
leaf
node
VASCULAR
TISSUES
seeds
(inside fruit)
GROUND
TISSUES
withered
cotyledon
SHOOT

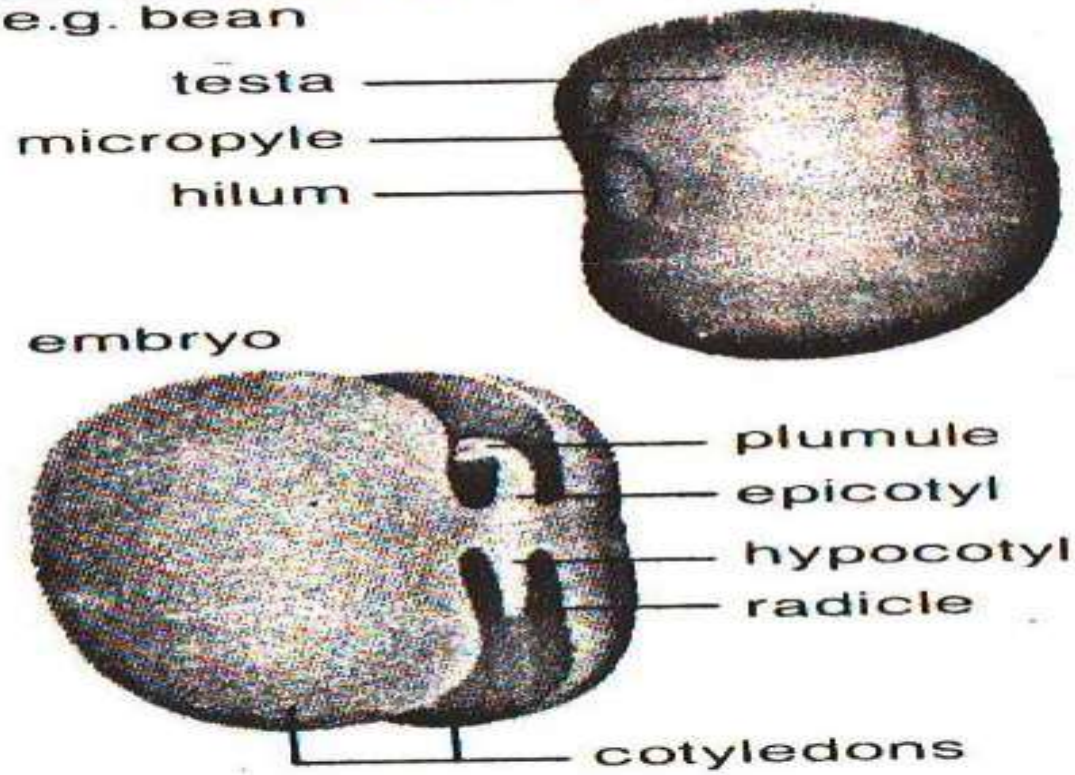
The Seed

- **<u>Seed:</u> A fertilized ovule. It consists of; a young *Dicot* plant called the Embryo in dormancy; feeds on a variable amounts of Endosperm (seed is <u>Endospermic</u> where it appears small in size) or none (seed is <u>Exendospermic</u> where it appears fleshy and large); and protective layers Testa. It has only one scar that represents the Hilum.**

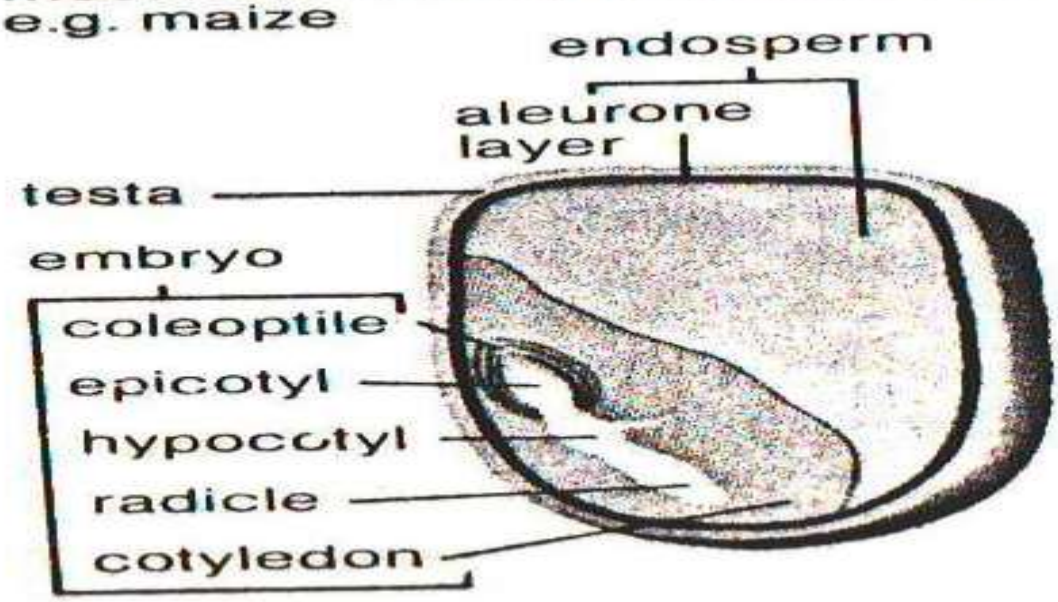
- **<u>Embryo</u>: It consists of one (Monocot) or two (*Dicot*) leaves Cotyledons; primary root Radicle; primary shoot Plumule.**
- **<u>Types of Seeds</u>:**
  - **<u>Endospermic (*Albuminous)* Seed:</u> A young embryonic plant with reserve food material to supply the developing embryo in its early stages of germination where it is kept outside the embryo in a separate tissue known as Endosperm. The seed is usually <u>small</u> in size.**
  - **<u>Exendospermic (*Exalbuminous)* Seed:</u> A young embryonic plant with no endosperm where the seed is <u>large</u> and the reserve food is stored in the cotyledons.**
- **<u>Grain:</u> A fertilized ovary. It consists of; a young embryonic *Monocot* plant; two scars : one represent the point of attachment to the style and the other is the point of attachment to the receptacle (Hilum).**
- ***<u>Micropyle</u>*: a hole where the seed obtain its water.**
- ***<u>Caruncle</u>* : a spongy tissue above the Micropyle**
- ***<u>Testa</u>* : Protective layers covering the embryo.**

- **<u>Types of Germination</u>:**
  1. ***<u>Hypogeal</u>*: Elongation of the *Epicotyl.***
  2. ***<u>Epigeal</u>*: Elongation of the *Hypocotyl***

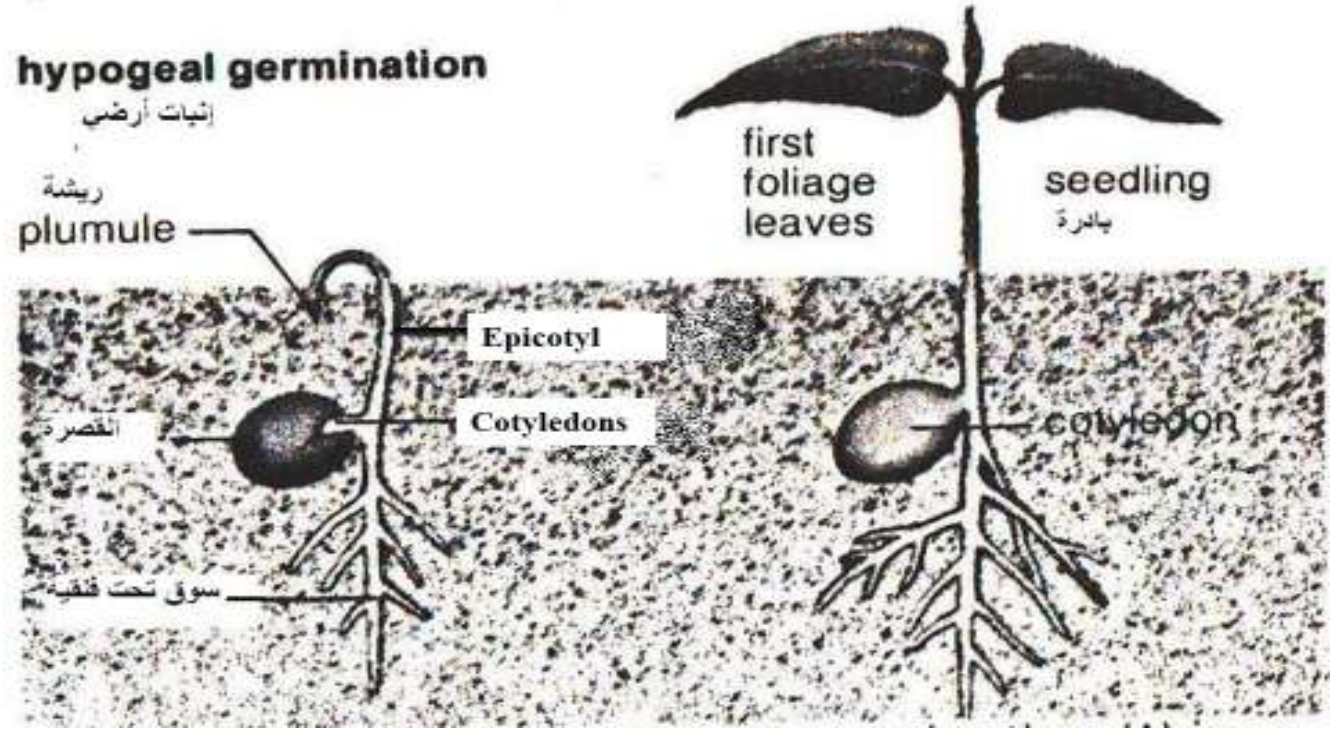
exalbuminous seed
food stored in cotyledons
e.g. bean



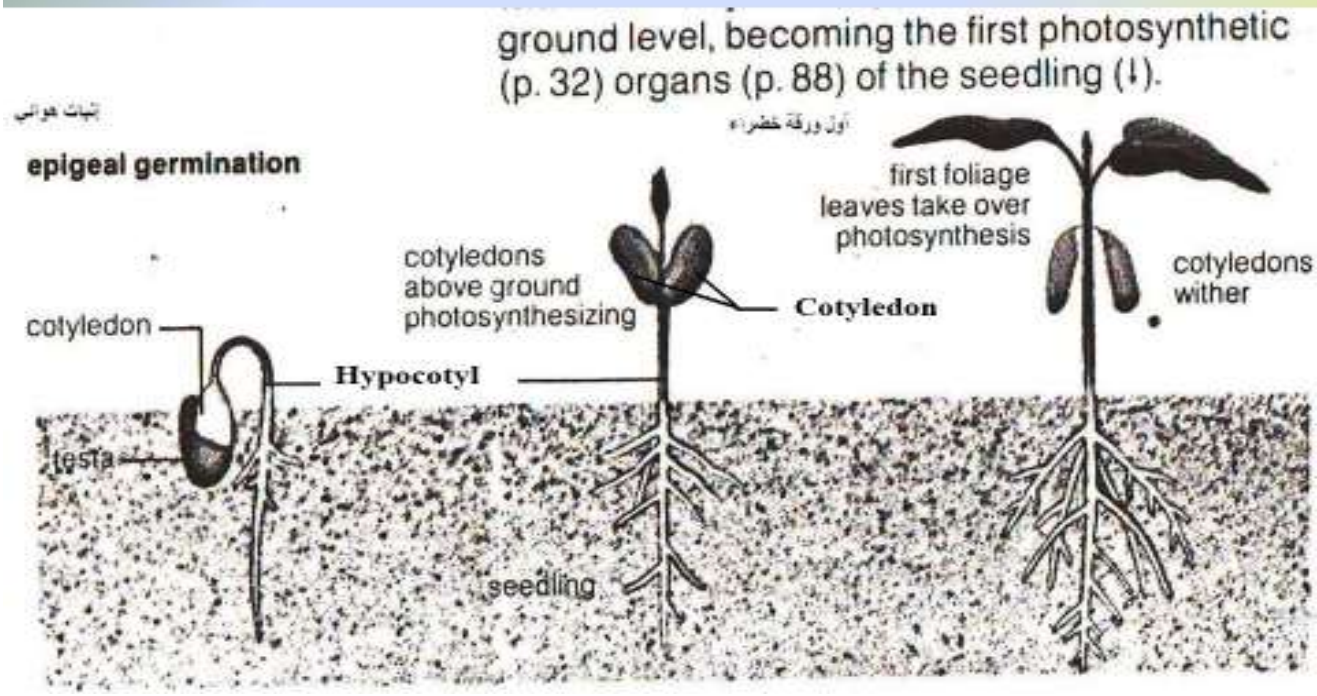
albuminous seed
most food stored in endosperm
e.g. maize



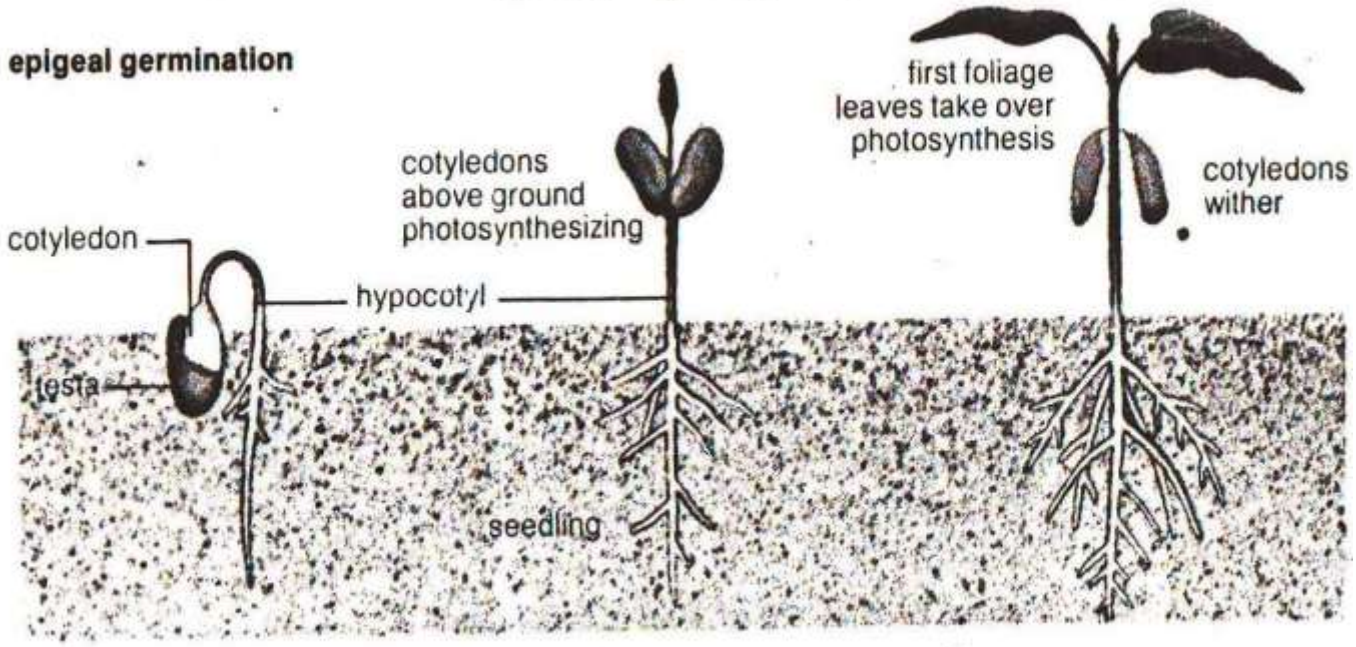
Hypogeal Germination

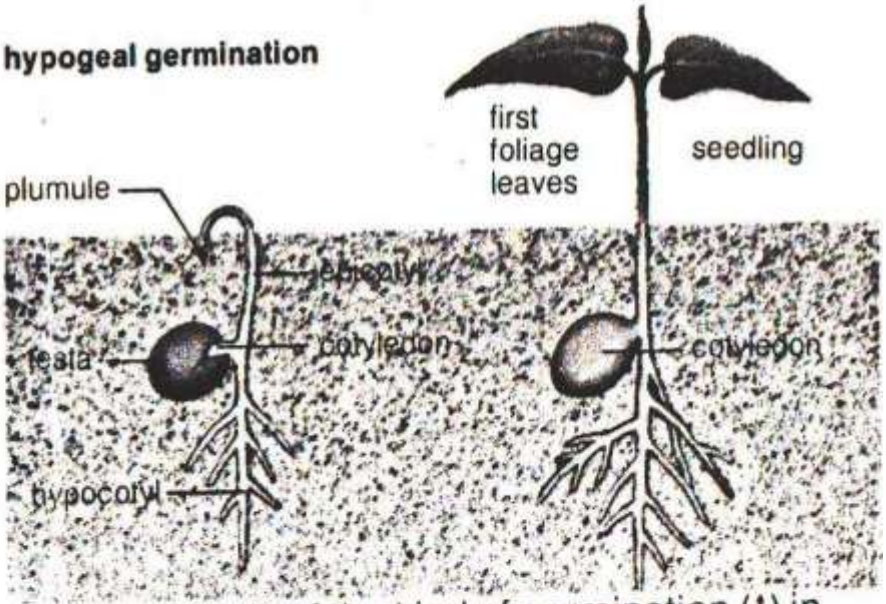


Eipogeal Germination



ground level, becoming the first photosynthetic (p. 32) organs (p. 88) of the seedling (↓).





hypogeal (*adj*) of the kind of germination (↑) in which the cotyledons (↑) remain below ground. Their stored food is used up in the early growth of the epicotyl (↑) and the hypocotyl (↑).

seedling (*n*) a young plant growing from its seed. It is usually called a seedling until it loses its cotyledons (↑).

Conditions necessary for germination:

- **<u>Internal</u>: (Concerning the Seed):**

  Vitality of the Embryo: It depends on the dormancy period of the embryo, seed storage in dry silos (water content of the seed is 1%). Some need long dormancy periods, short or no dormancy at all; it is according to the seed type and nature:

  1. ***Testa* Hardness**
  2. **Incomplete growth of the embryo.**
  3. **Genetic factors**

- **<u>External</u>: (Concerning environmental conditions):**

  1. Humidity (Water Content) **2.Oxygen**

  3.Temperature **4. Light**

- **<u>Other Factors</u>: *i.e.* mechanical removal of the Testa by:**

  1. Oxygen **2. Radiation**

  3. Acids **4. High Temperature**

  5. Mixing the host seeds with parasite seeds

Changes occurring in seed during germination:

<u>Seed changes during soaking in water</u>:

- **<u>Physical</u>: 1. Increase in Size 2. Breakage of *Testa***
- **<u>Chemical</u>:**

  1. **<u>Catabolism</u>: the dissolution of the solid complex reserve food material to simple one through enzymatic activity.**
  2. **<u>Enzymatic Activity</u>:**

Starch $\xrightarrow{\text{Diastase}}$ **Monosaccharide sugar**

Protein $\xrightarrow{\text{Protease}}$ **Amino acids**

Lipids $\xrightarrow{\text{Lipase}}$ **Triglyceride acids + Glycerin**

- **Vitality:**

  Physiological Activity:

  1. **The protoplasm turns from gel to sol (semi-solid).**
  2. **Cells get turgid (enlarged)**
  3. **Growth of the radicle and then the plumule.**
  4. **The seed becomes a seedling by forming its 1st foliage leaf.**

Stages of Germination

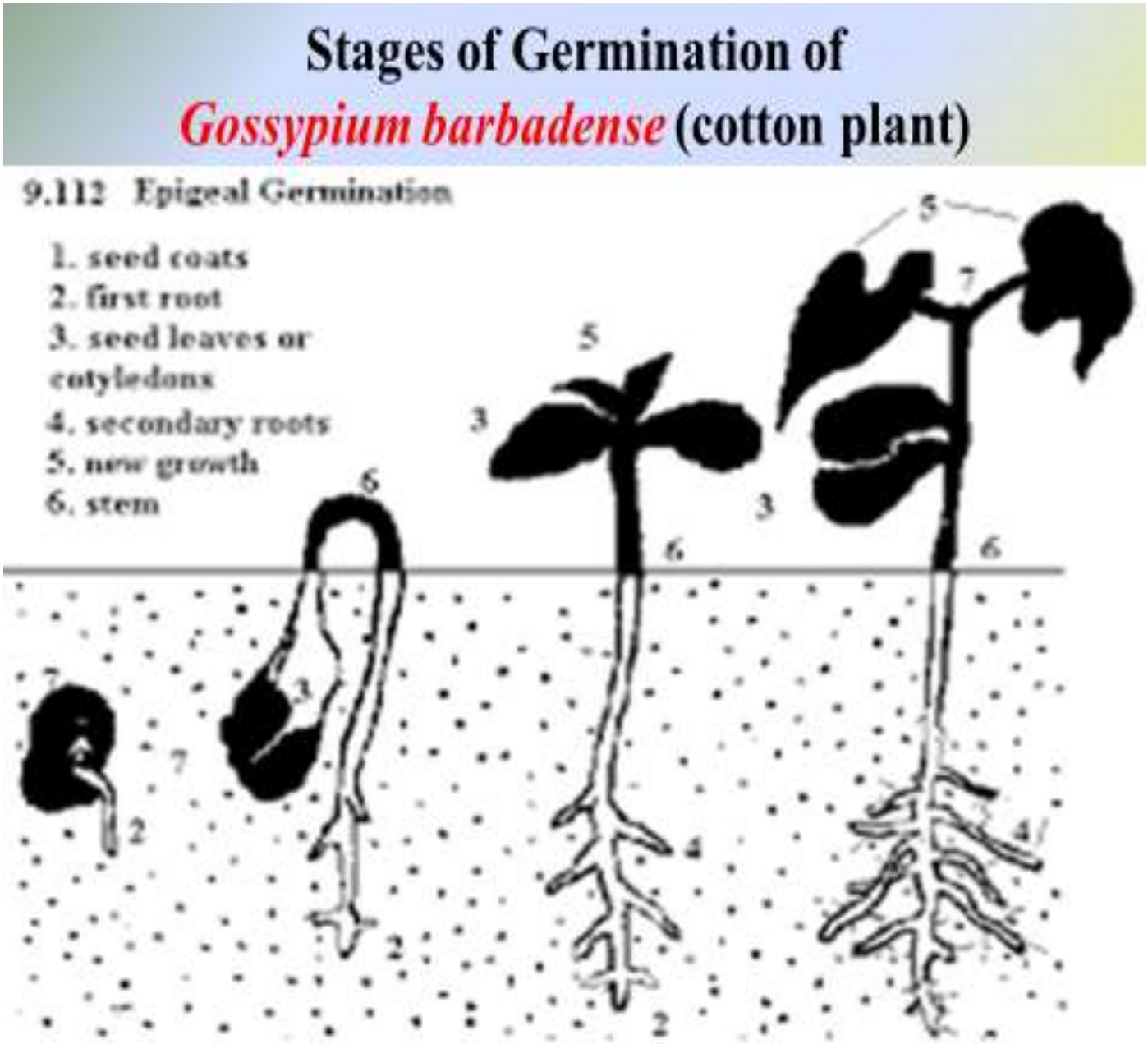
1st Stage: Swelling of seed and removal of *Testa*.

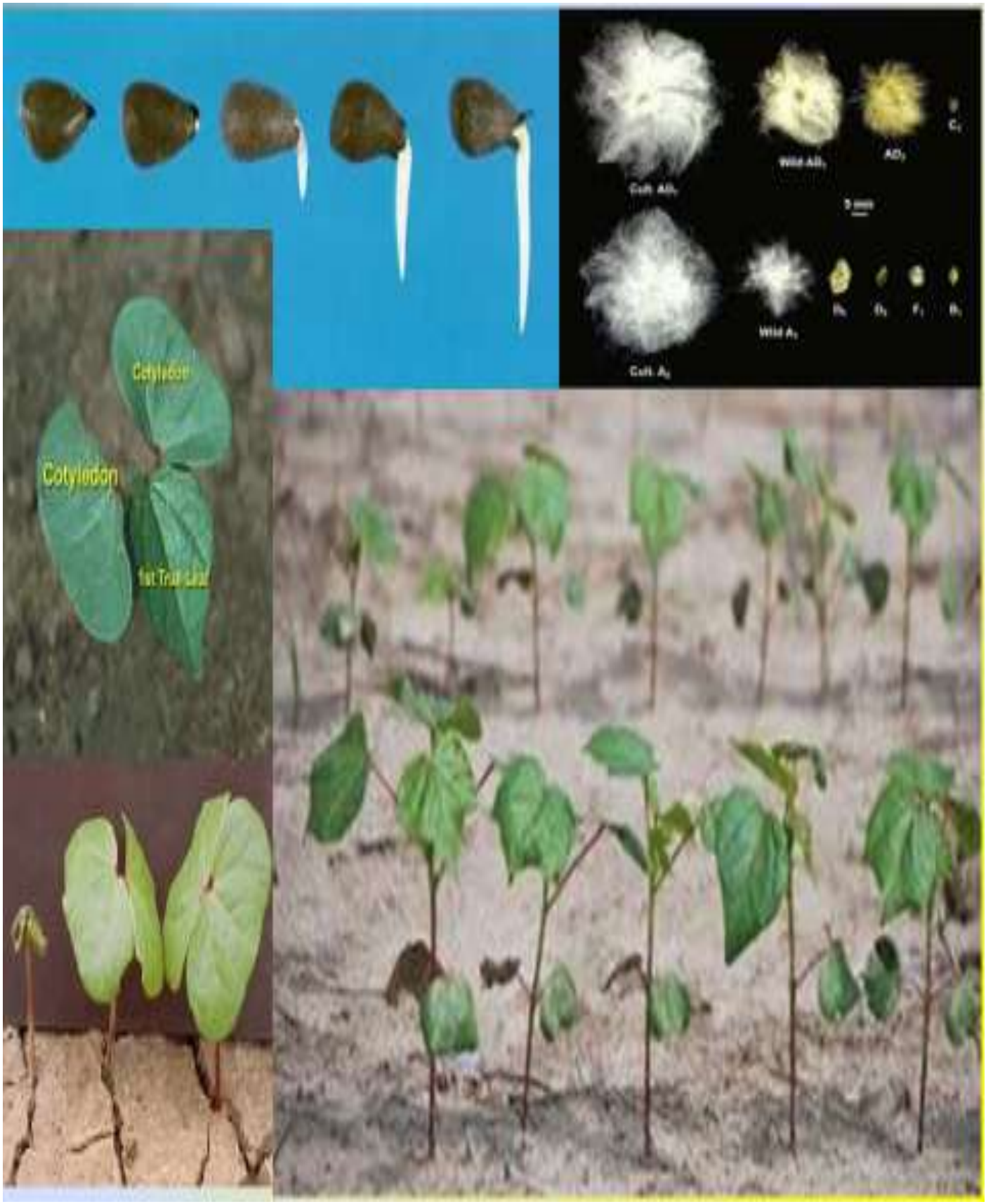
2nd Stage: Growth of Radicle.

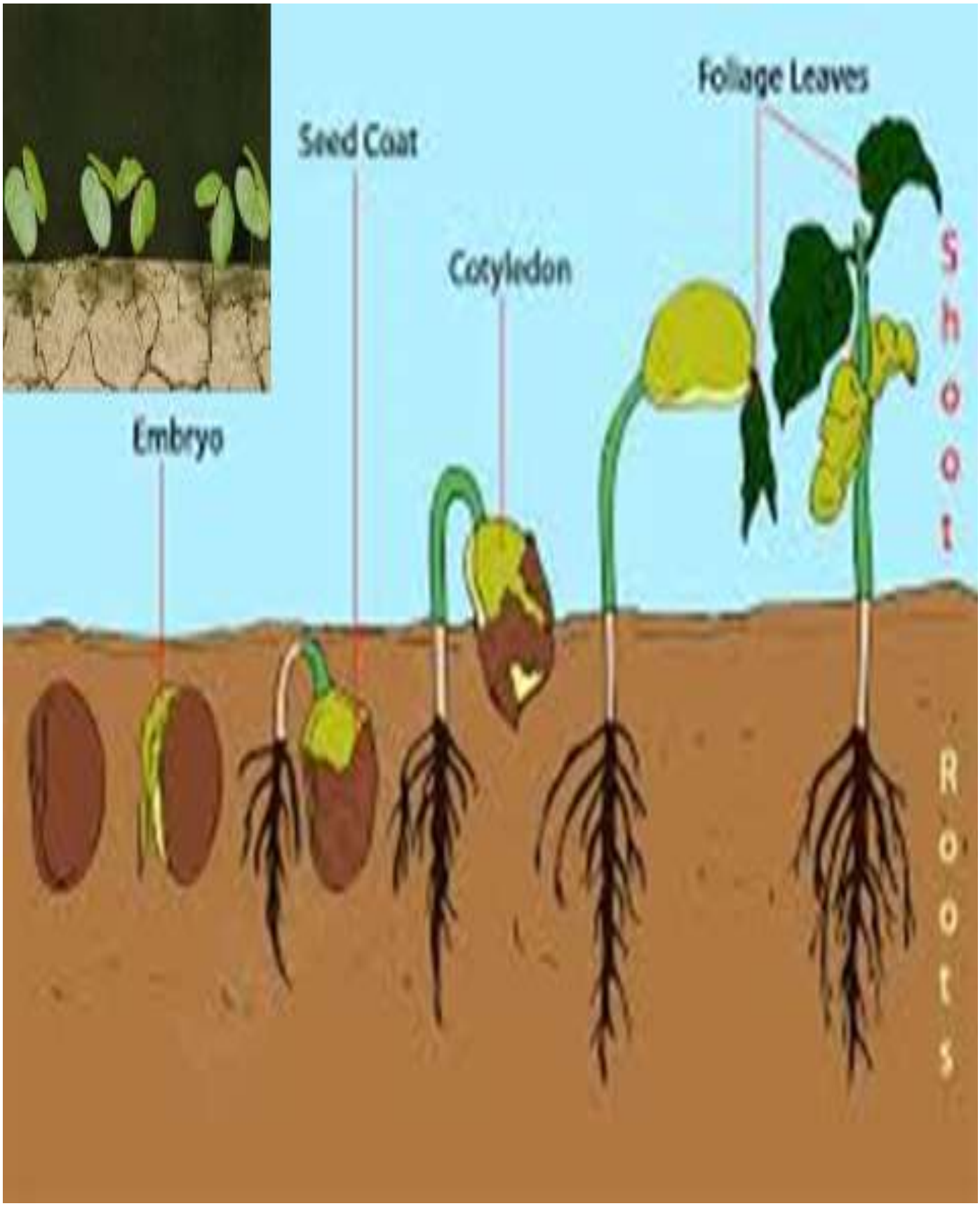
3rd Stage: Growth of Plumule.

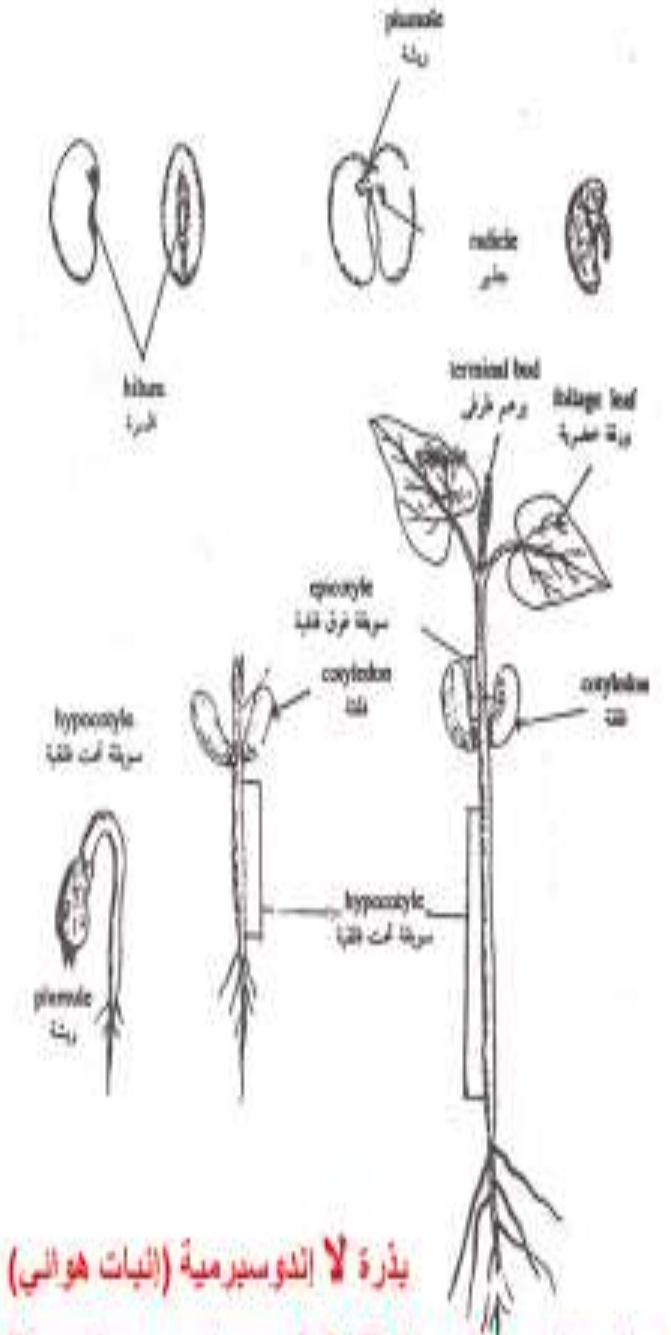
4th Stage: Formation of the first foliage leaf.

Examples of *Dicotyledonous* Seeds and seedlings




Cotyledon
Cotyledon


Foliage Leaves
Seed Coat
Cotyledon
Shoot
Embryo
Roots

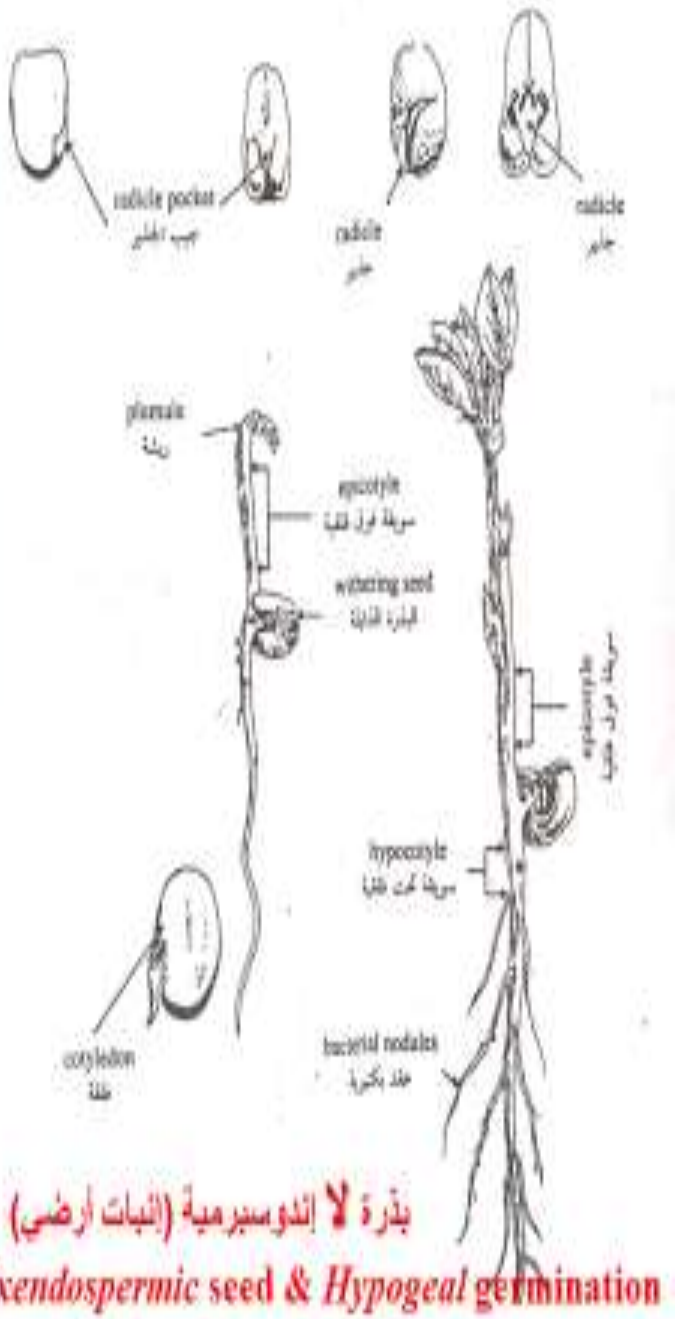


بذرة لا إندوسبرمية (النبات هوائي)

Exendospermic seed & *Epigeal* germination

(Fig. 31) *Phaseolus vulgaris* seed & germination.

(شكل ٣١): بذرة نبات الفاصوليا وإنباتها

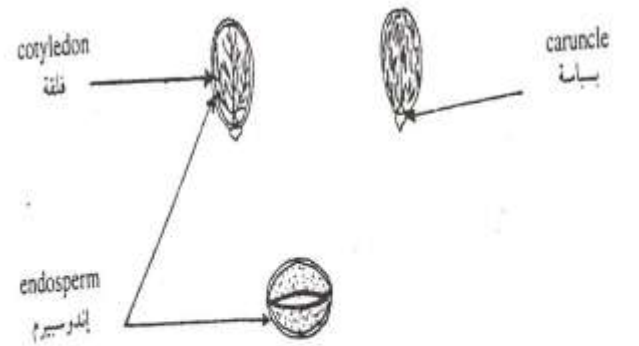


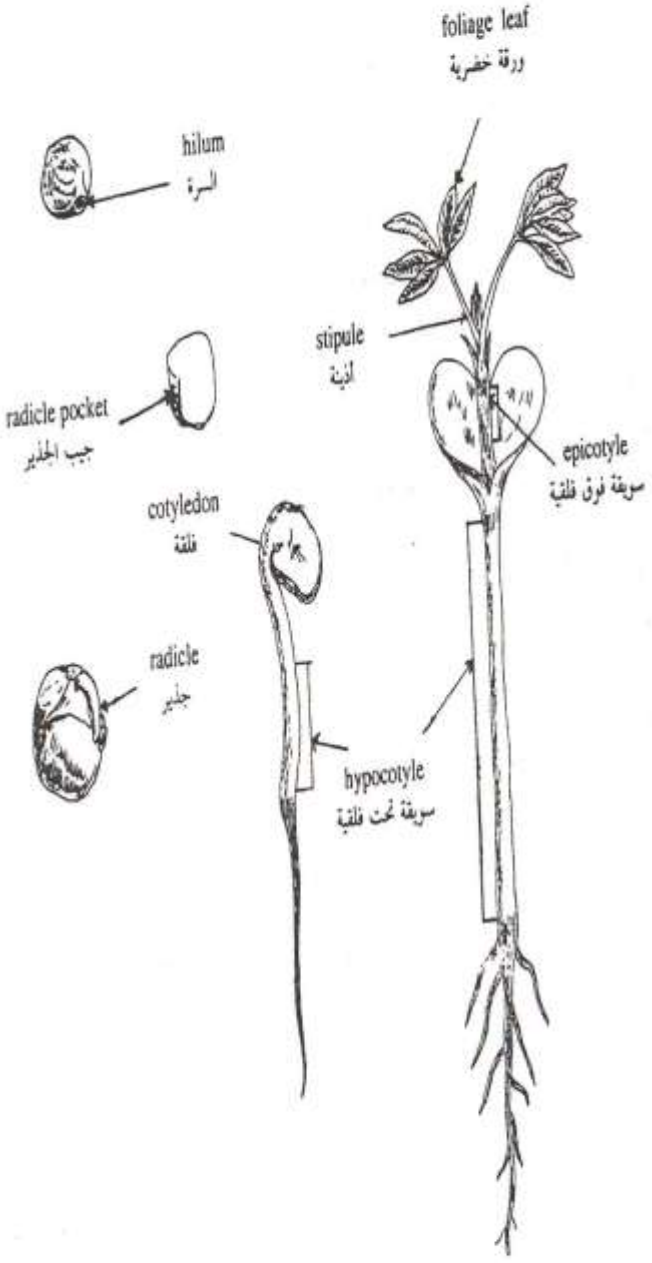
بذرة لا إندوسبرمية (النبات أرضي)

Exendospermic seed & *Hypogeal* germination

(شكل ٣٠): بذرة الفول الرومي وإنباتها

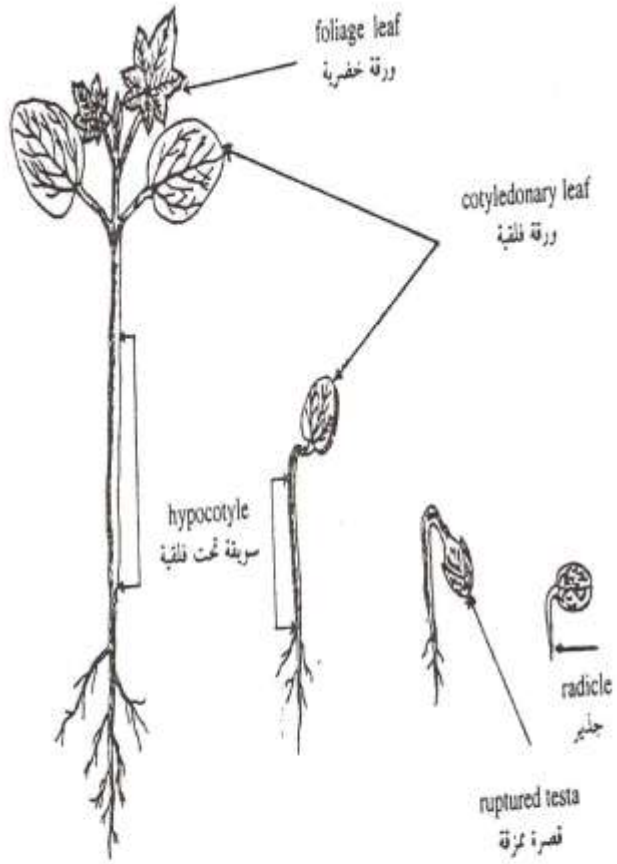
(Fig. 30) *vicia faba* seed & germination.





(Fig. 33) *Lupinus termis* seed & germination.

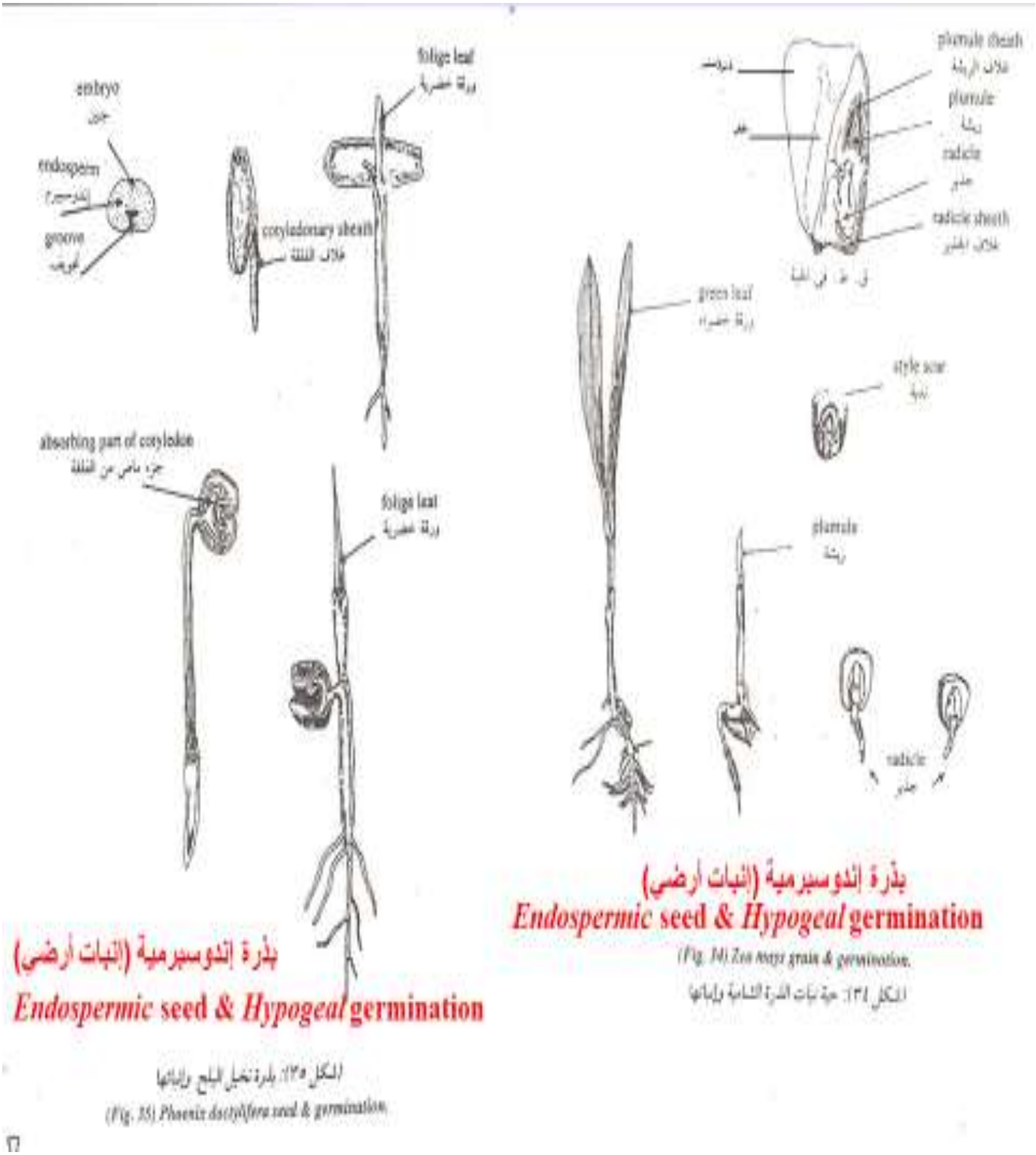
(شكل ٣٣): بذرة نبات الترمس وإنباتها



(Fig. 32) *Ricinus communis* seed & germination.

(شكل ٣٢): بذرة نبات الخروع وإنباتها

Examples of *Monocotyledonous* Seeds and seedlings



Roots

- **Function:**

  1. Absorption 2. Anchor 3. Storage

- **Root forms:**

  1. **Smooth.**
  2. **Whitish or yellowish in color**
  3. **Tapering towards the end.**

- **Root Structure:**

  1. **Growing apex: A root cap protecting the delicate meristemtic cells (of growing point at the tip of the root) from injury. The root cap (Calyptra) is slimy to allow the root to slide easily in its course. It is continuously torn away and renewed from the underlying meristem.**
  2. **Elongation zone: A bare zone next to the growing zone. The increase in length of the whole root takes place in this region.**
  3. **Absorption Zone: limited area of length and life-span (that does its function for a few days and then dies out). They are covered by numerous root hairs.**

- **Root can be characterized by the presence:**

  1. **Bare zone: It lacks any root hairs.**
  2. **Permanent Zone: lateral roots are produced in succession, the youngest being the nearest to the root hairs. Root branches are almost always endogenous.**

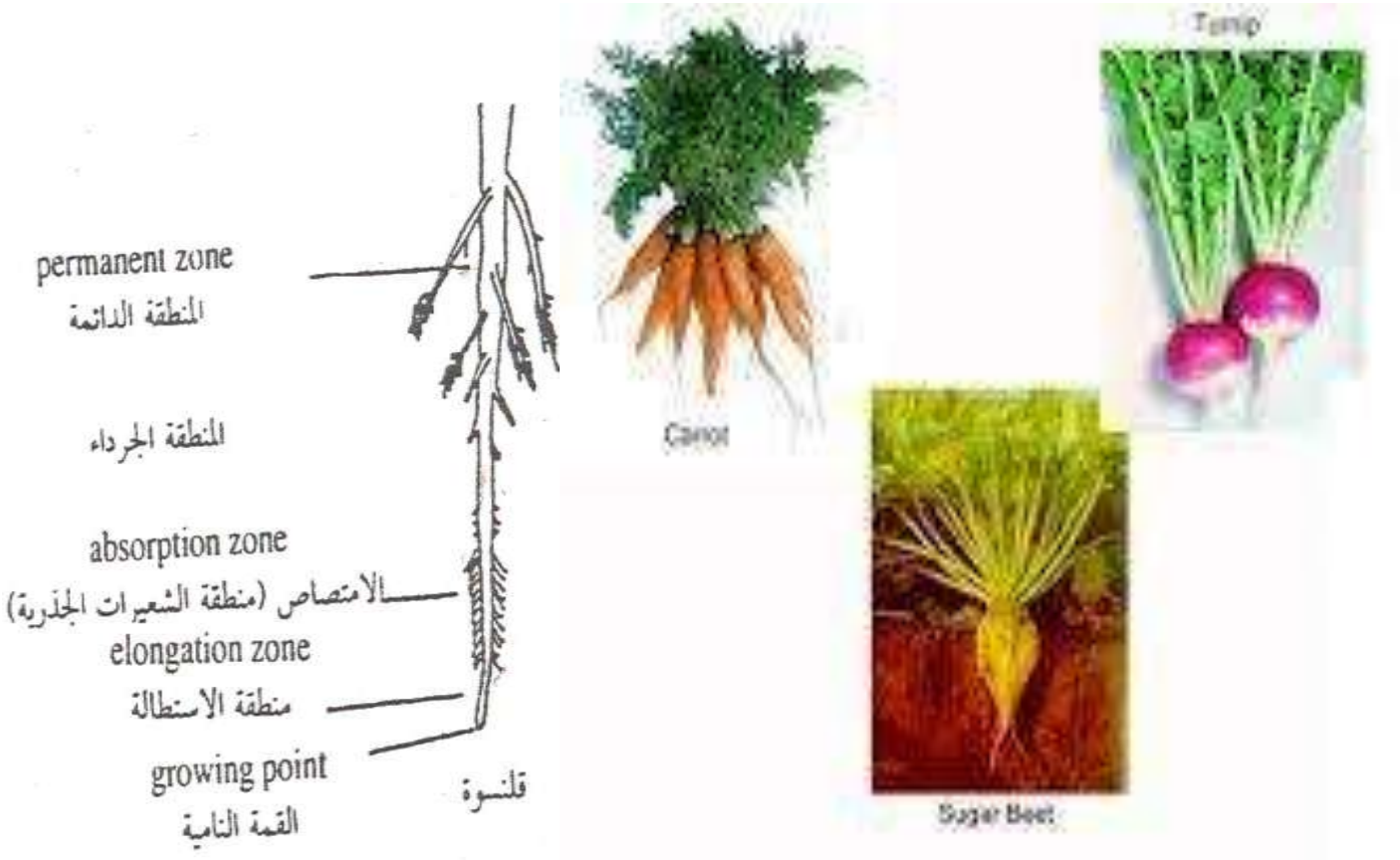
- **Root Forms:**

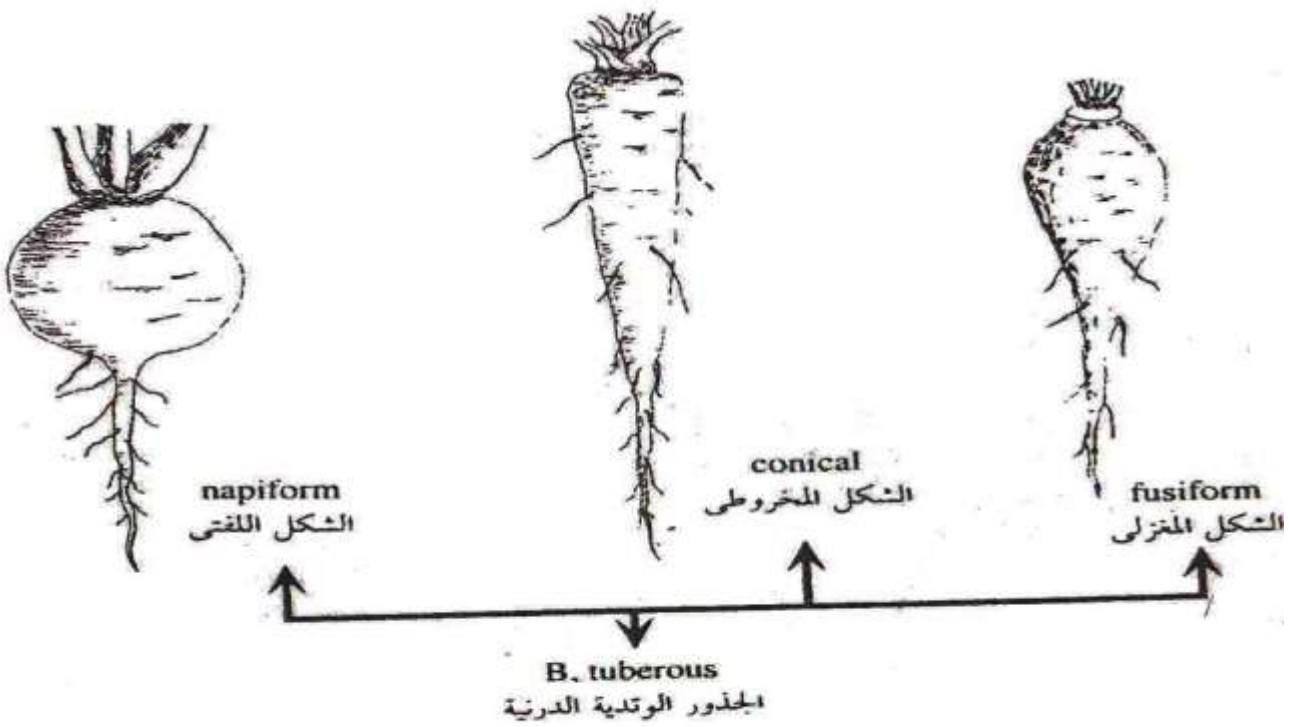
  1. **Primary Root: Originates from the embryo (radicle). It is divided into:**

     a. Normal Tap Root: Smooth, whitish or yellowish in color and tapering towards the end.

     b.Tuberous Root: It's thickened for storage, examples:

     - **Conical: *i.e.* Carrot**
     - **Fusiform: *i.e.* Radish**
     - **Napiform: *i.e.* Turnip**





(شكل ٣٦): الأنواع المختلفة للجذور الوتدية

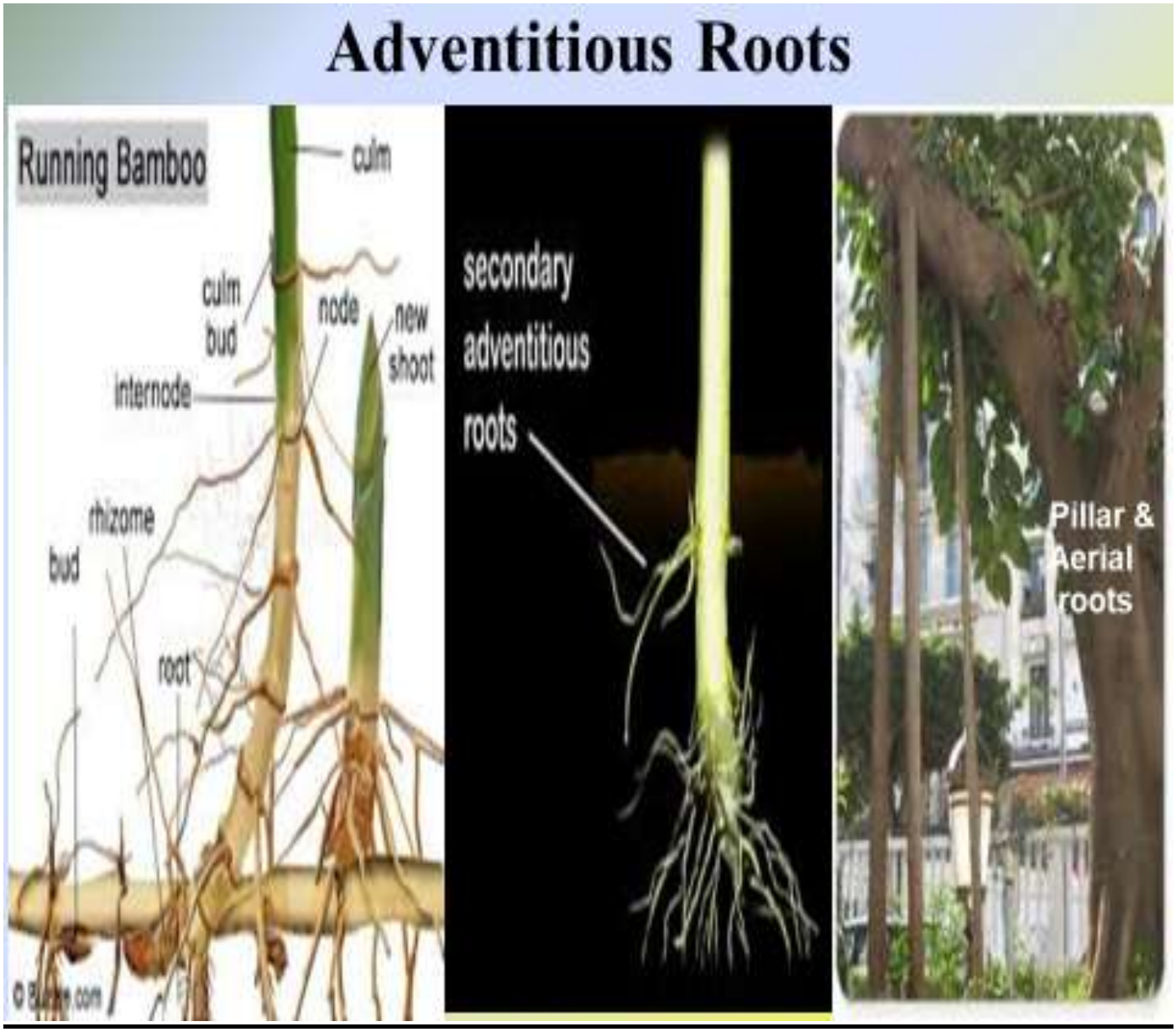
(Fig. 36) different types of tap roots.

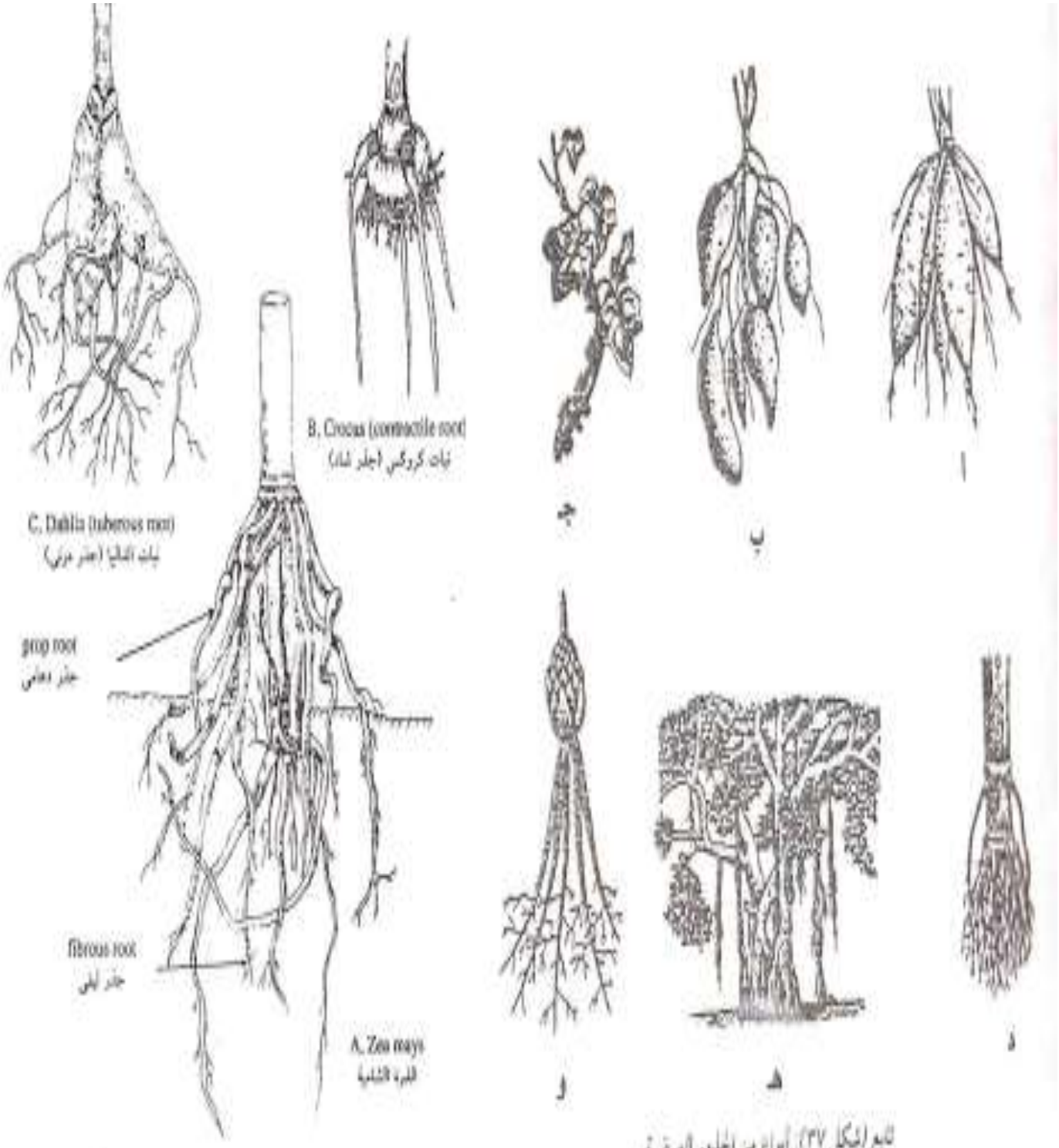
2. Adventitious Root: It arises from any parts of the plant *i.e.* stems and leaves. It is mostly found in *Monocots*. It is divided into:

1. Fibrous roots **2. Prop roots** **3. Storage roots**

4. Climbing roots **5. Aerial roots** **6. Haustoria**

7. Pillar roots **8. Contractile roots** **9. Respiratory roots**





(شكل ٣٧) الأنواع المختلفة للجذور العرضية

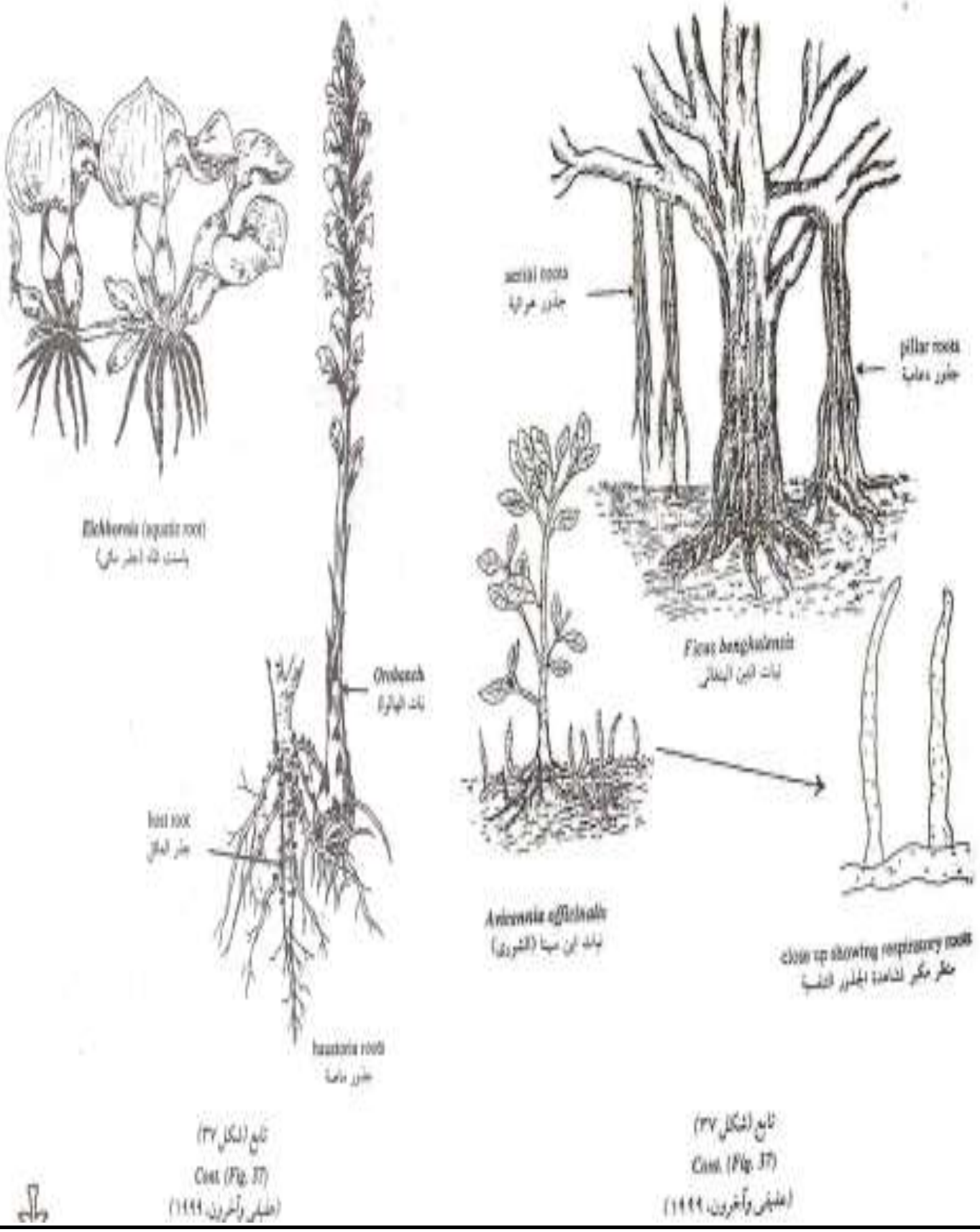
(Fig. 37) different types of adventitious roots

(عفيفي وآخرون، ١٩٩٩)

تابع (شكل ٣٧) أنواع من الجذور العرضية

Cont. (Fig. 37) types of adventitious roots

أ- جذور درنية في نبات الدالیا
ب- جذور درنية في نبات البطاطا
جـ- جذور معلاقية
د- جذور ليفية وساعدة
هـ- جذور هوائية دعامية
و- جذور شادّة



تابع (لشكل ٣٧)

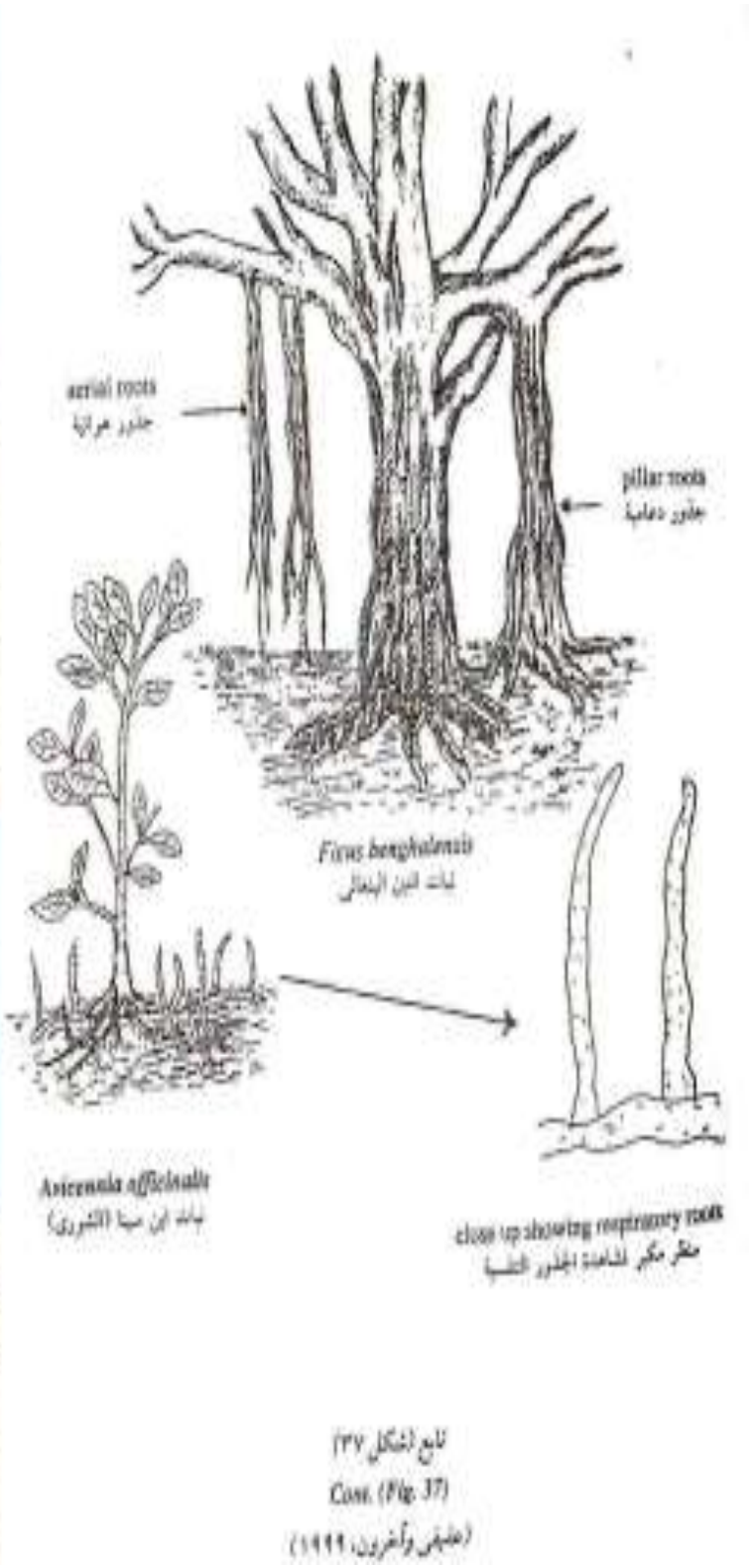
Cont. (Fig. 37)

(طبيلي وآخرون، ١٩٩٩)

تابع (لشكل ٣٧)

Cont. (Fig. 37)

(طبيلي وآخرون، ١٩٩٩)



تابع (شكل ٣٧)

Cont. (Fig. 37)

(عليقي وآخرون، ١٩٩٩)

Stems

- **Morphology of different Stems**

Definition:

It's a leaf-bearing axis. It arises from the plumule. In the majority of plants, the stem, the leaves, buds, flowers and fruits collectively constitute the Shoot System.

Function:

1. **It carries leaves, buds and flowers.**
2. **It conducts the Xylem and Phloem sap.**

Types of Stems:

1. **Aerial**
2. **Subterranean (underground)**

Nature of the Stem:

1.Woody or Herbaceous

2. Erect or Weak (Prostrate, twining or runner)

3. Long or dwarf

T.S. in Stems:

1. Solid

2. Hollow

Stem Outline:

1. Circular

2.Flattened

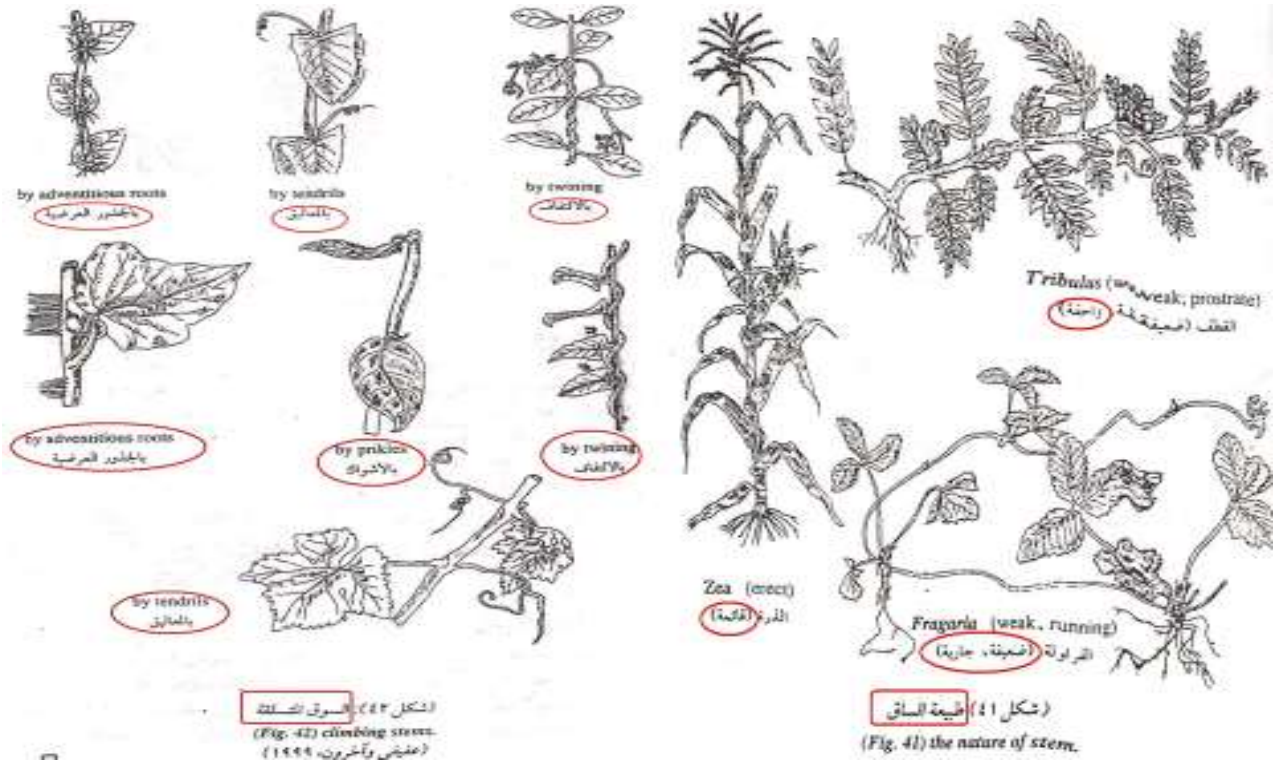
3. Angular

Surface:

1. Smooth

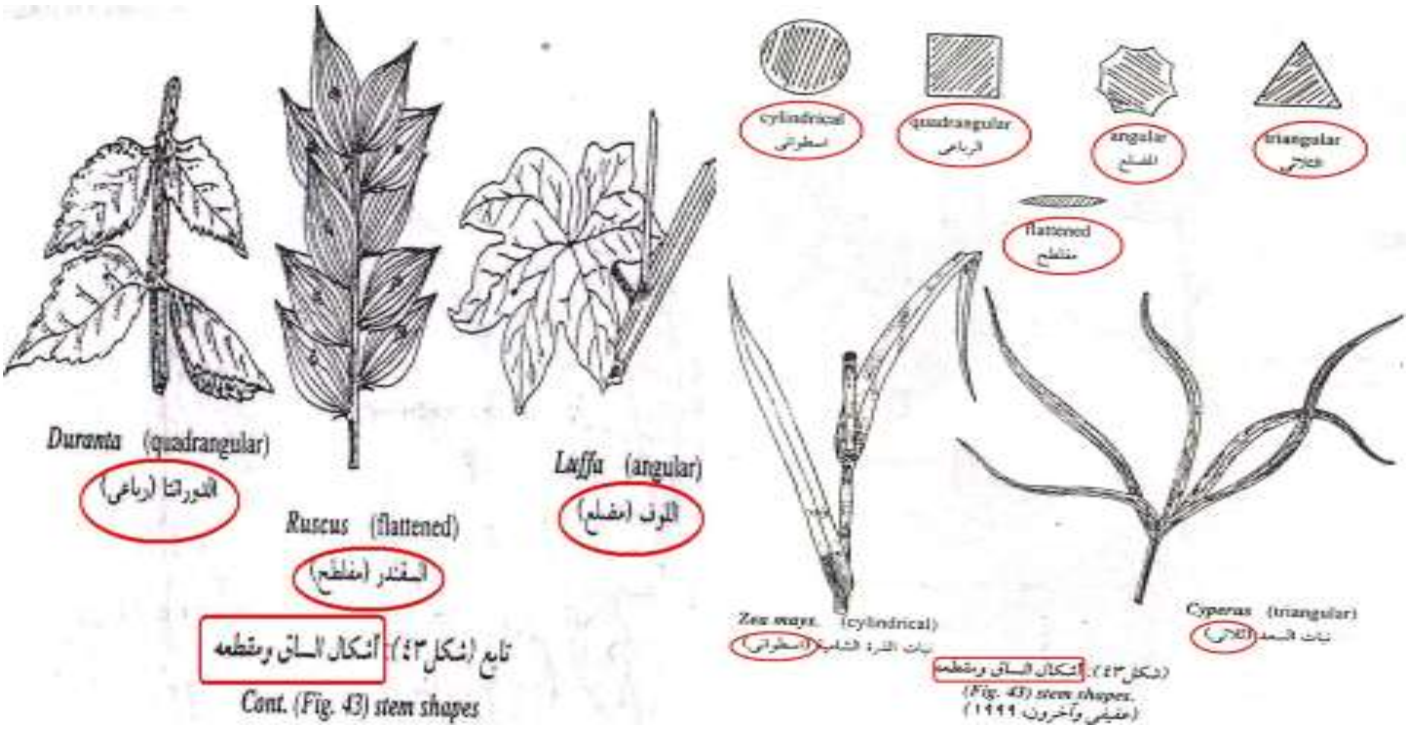
2. Rough

3. Hairy or Prickly



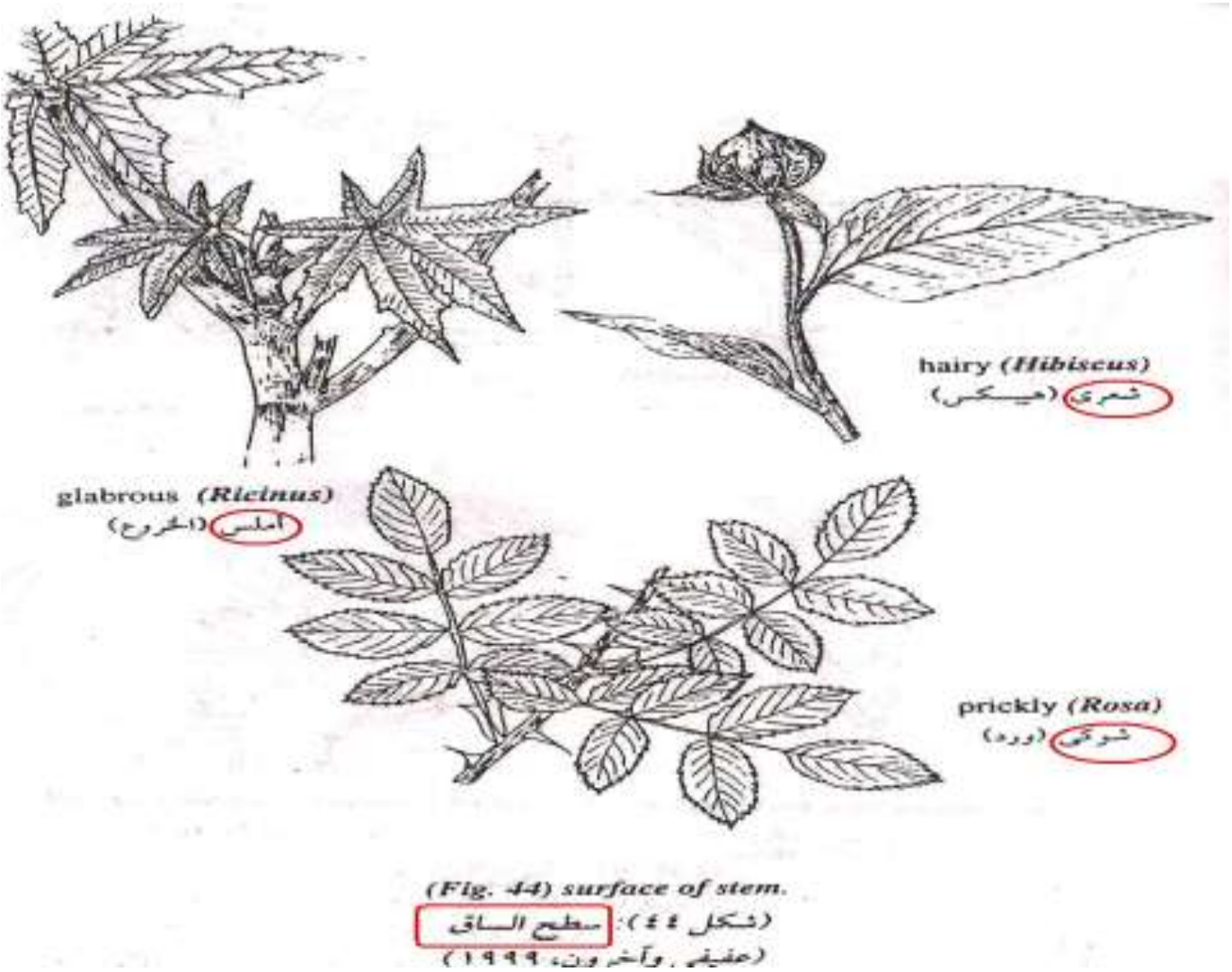
(شكل ٤٢) السوق المتسلقة
(Fig. 42) climbing stems.
(عفيفي وآخرون، ١٩٩٩)

(شكل ٤١) طبيعة الساق
(Fig. 41) the nature of stem.



تابع (شكل ٤٣) أشكال الساق ومقطعه
Cont. (Fig. 43) stem shapes

(شكل ٤٣) أشكال الساق ومقطعه
(Fig. 43) stem shapes.
(عفيفي وآخرون، ١٩٩٩)



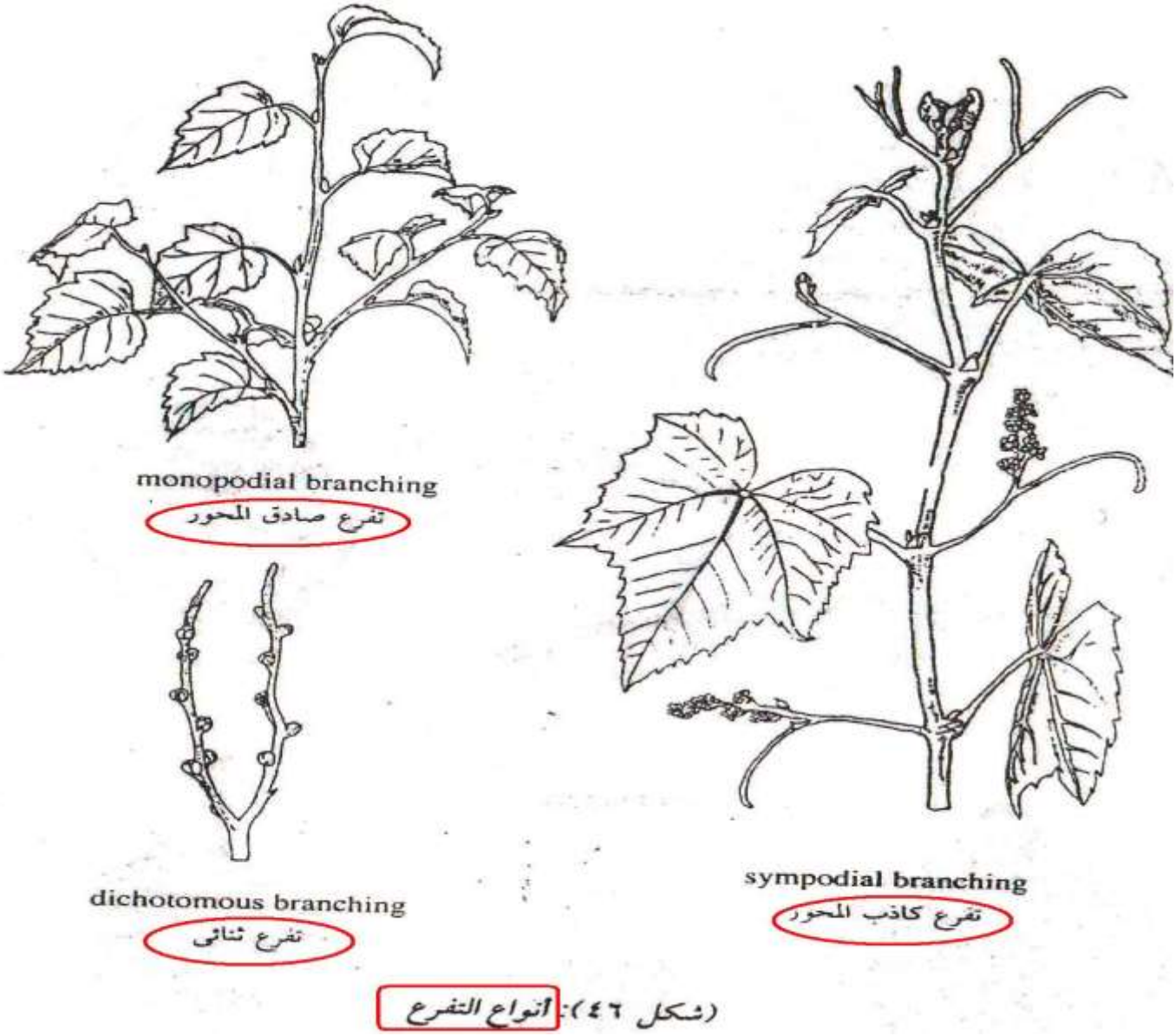
(Fig. 44) surface of stem.
(شكل ٤٤): سطح الساق
(حفيفي , وآخرون، ١٩٩٩)

Branching:

1. **Apical: Dichotomy**
2. **Axillary:**

1. Monopodium: The apical bud retains permanently its capacity for active growth and the branches develop from axillary bud which remain lateral and subordinate to the main axis and again branch in the same manner.

2. Sympodium: Frequently the apical bud is transformed into a flower or tendril which ends its career. The axillary bud of the terminal leaf continues the growth of the axis forming one or more internodes which are terminated by another flower or a tendril and so on.



(شكل ٤٦): أنواع التفرع

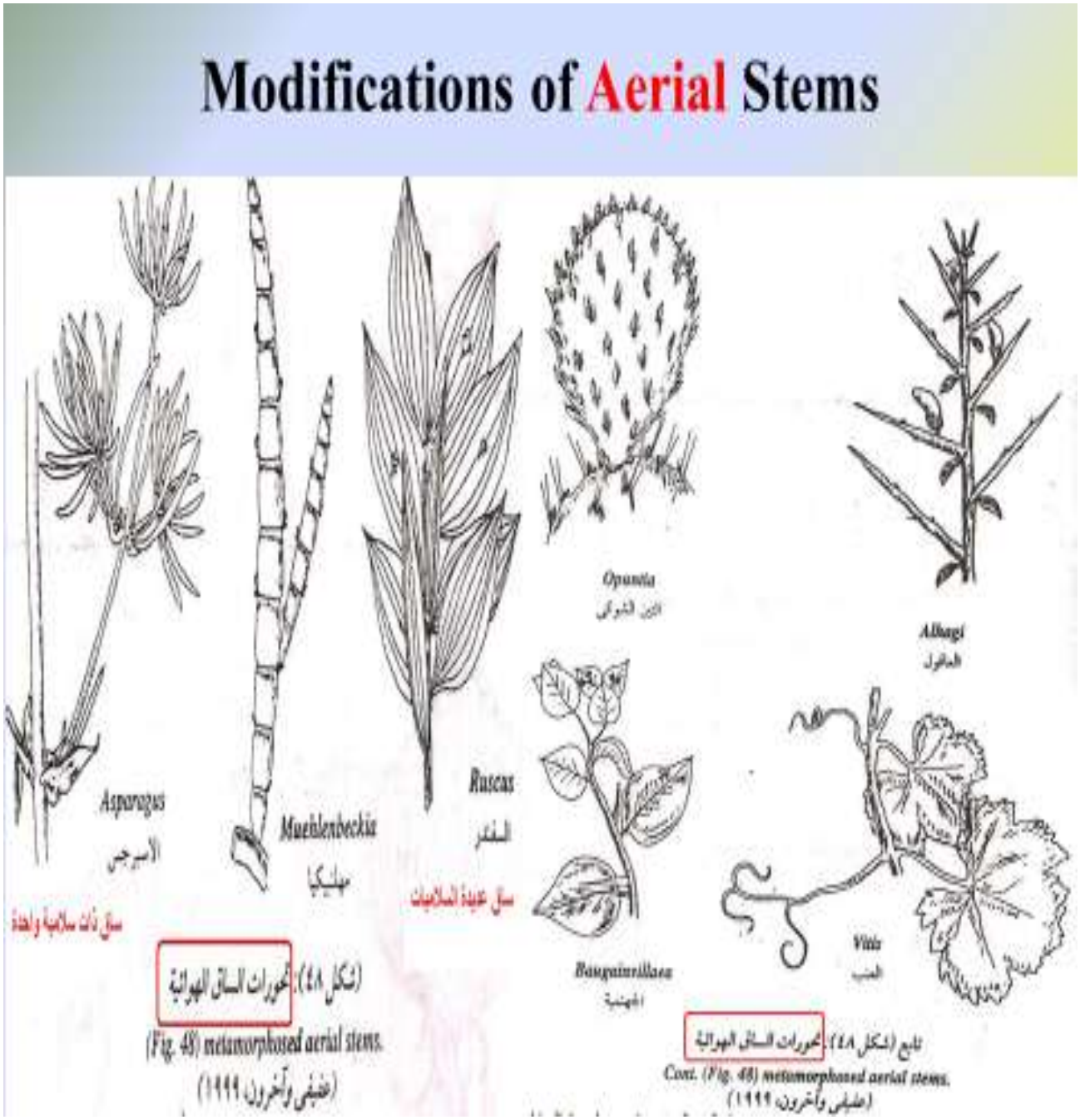
Stem Modifications:

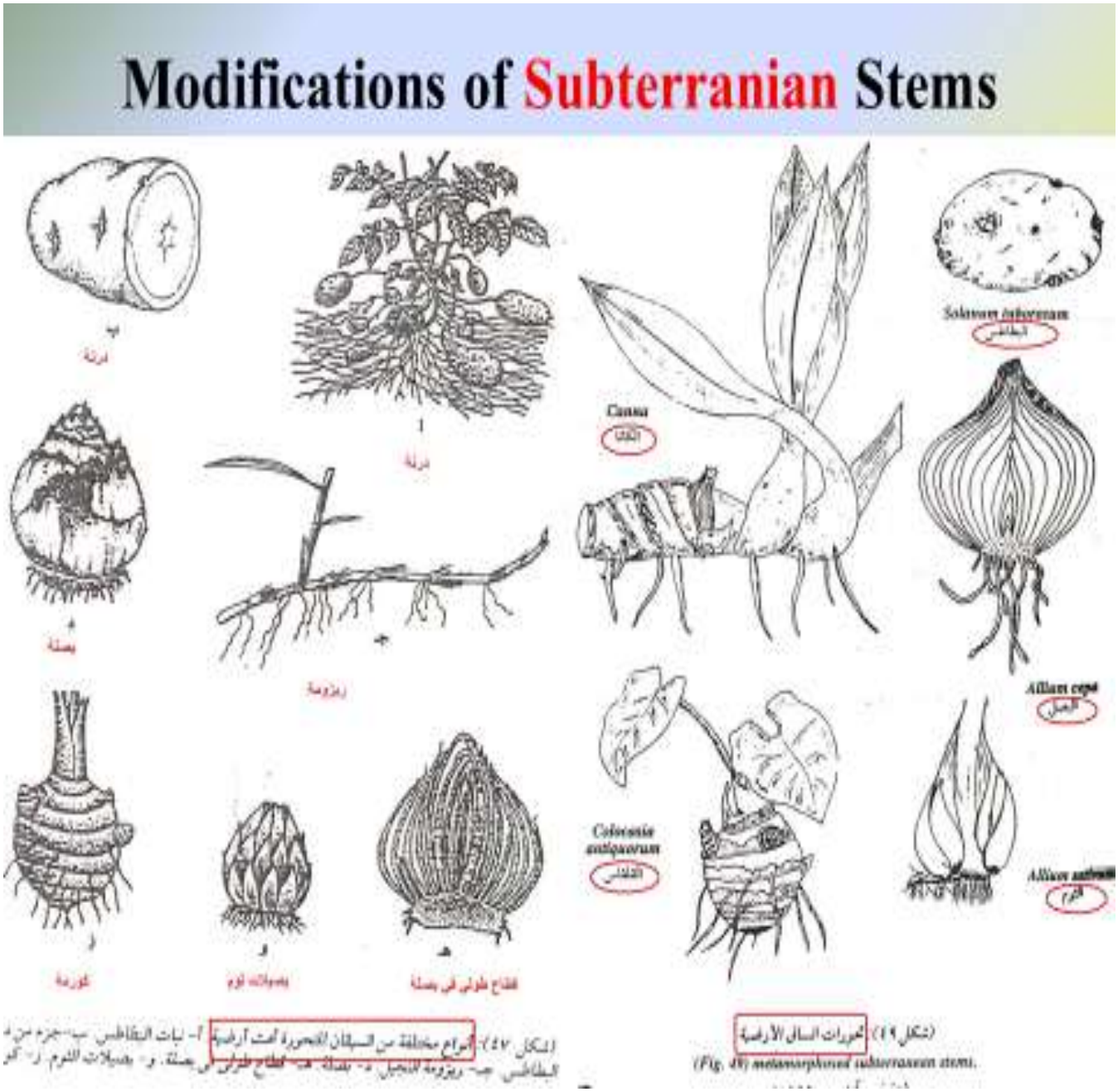
- **Aerial:**

  1. **Leafy stems: Leaves are reduced to mere scales. Leaf's function is taken over by modified flat branches containing chlorophylls tissue.**
     1. **Cladode: *Asparagus***
     2. **Phylloclade: *Ruscus***
  2. **Juicy Stems: *Opuntia***
  3. **Thorny Stems: *Zilla spinosa , Alhagi***

4. **<u>Stem Tendrils</u>: *Vitis***

- **<u>Subterranean</u>: In addition to perennation, they serve for food storage and also for vegetative reproduction. Types of which:**
  1. **<u>Rhizome</u>: *Cyperus***
  2. **<u>Corm</u>: *Colocasia***
  3. **<u>Bulbs&Bulbils</u>: Onion and garlic**
  4. **<u>Tubers</u>: potatoes**



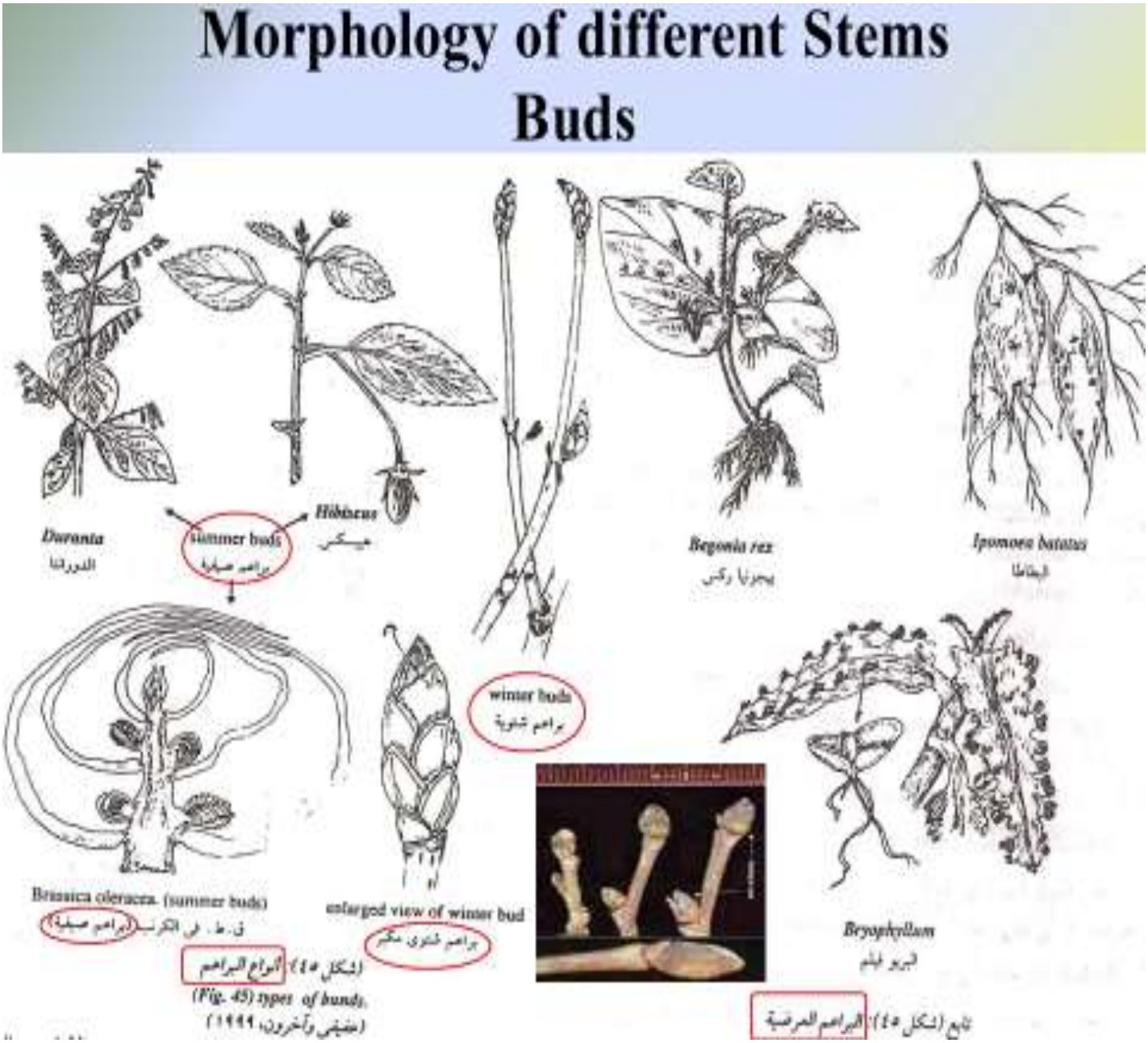


Buds

- **Divided into:**
    1. **Principal Bud: The largest in size.**
    2. **Accessory Bud: Additional buds.**
- **Types according to seasons:**
    1. **Summer Bud: Green and small in size**

2. **Winter Bud: Brown covered by scale leaves and are larger in size.**

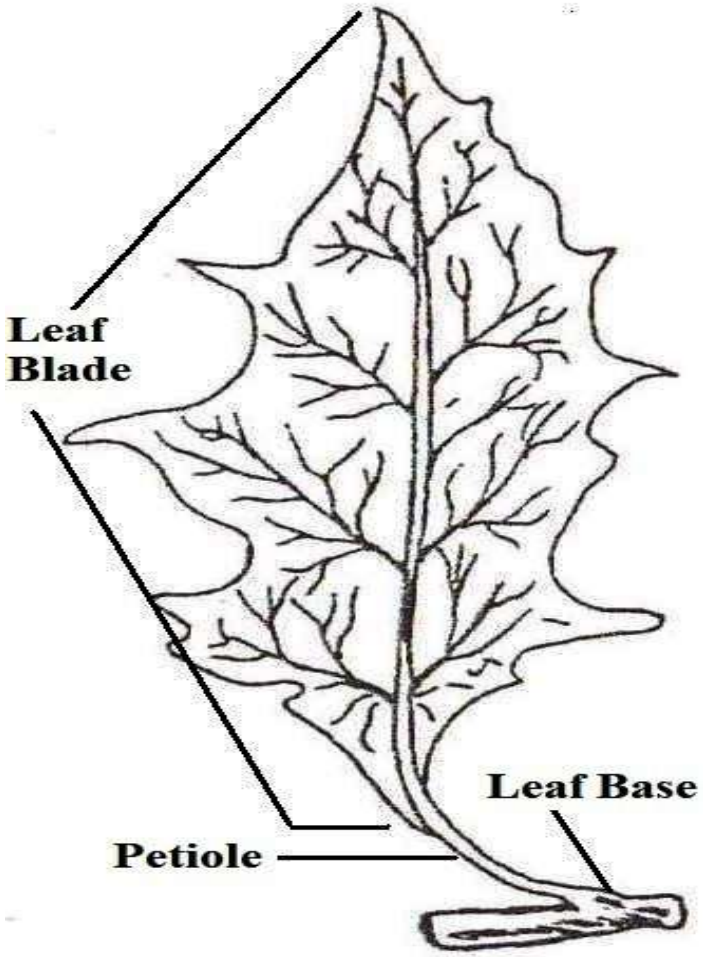
- **<u>Position:</u>**
  1. **Terminal: At the Apex of the stem**
  2. **Axillary: At the axis of the leaf.**
     - **<u>Cladode</u>**
     - **<u>Phylloclade</u>**



Leaves

Leaf parts

- **Definition: They originate as lateral protuberances just behind the growing point. They arise in regular succession at the tip of the axis. They are exceedingly variable in form, but the most common ones are green-colored, flat and broad to allow maximum exposure to the sun rays.**
- **Function:**
  1. **Photosynthesis**
  2. **Anabolism**
  3. **Respiration**
  4. **Transpiration**
- **Leaf Composition:**
  1. **Leaf Base**
  2. **Leaf Stalk (Petiole)**
  3. **Leaf Blade (Lamina)**



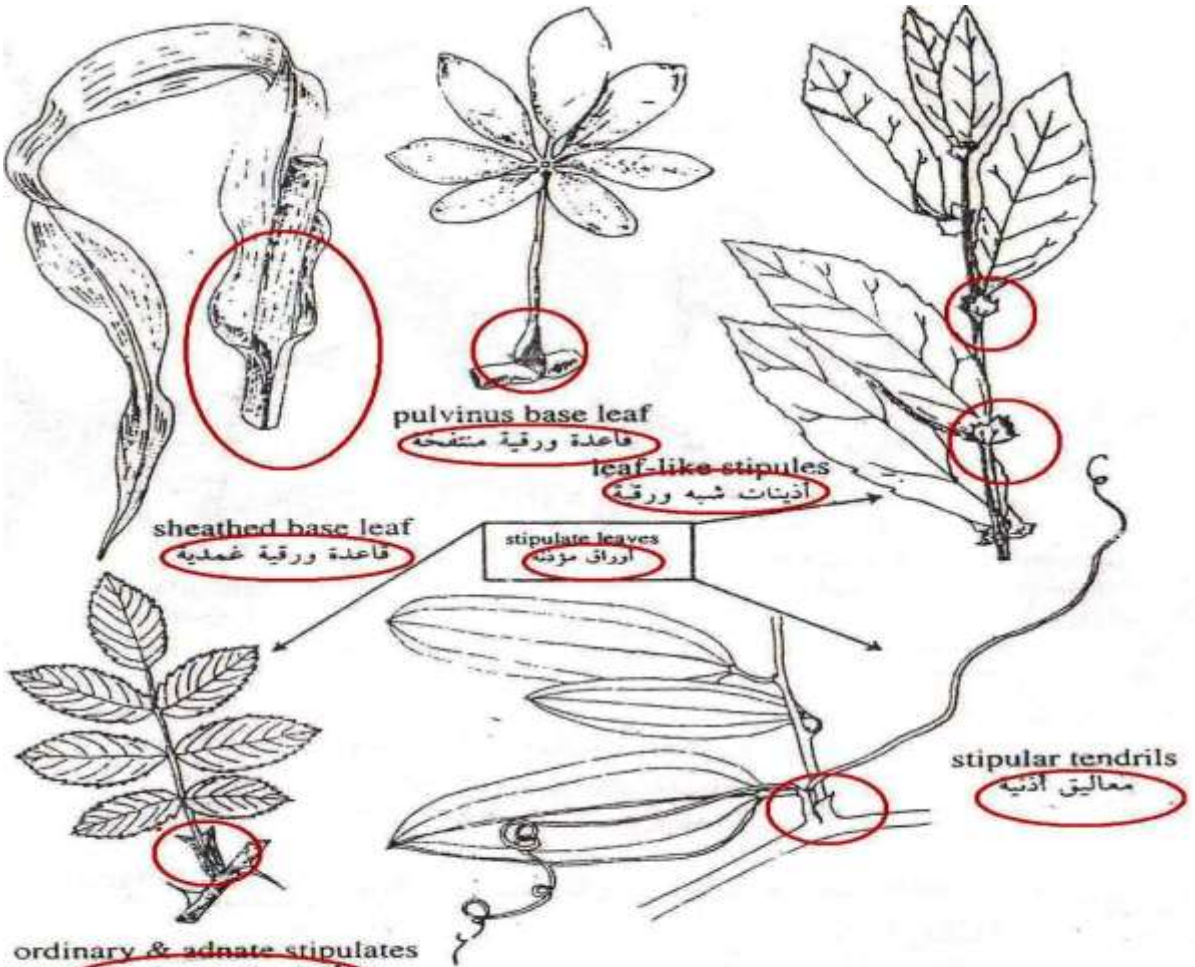
1. Leaf Base:

It is the part next to the stem at the node. It usually serves to protect the bud.

- **Enlargement:**
  It appears as a more or less marked enlargement at the base of the leaf which facilitate the movement of the leaf. Types of which are:

  1.Ordinary **2.Pulvinus** **3.Sheathed**

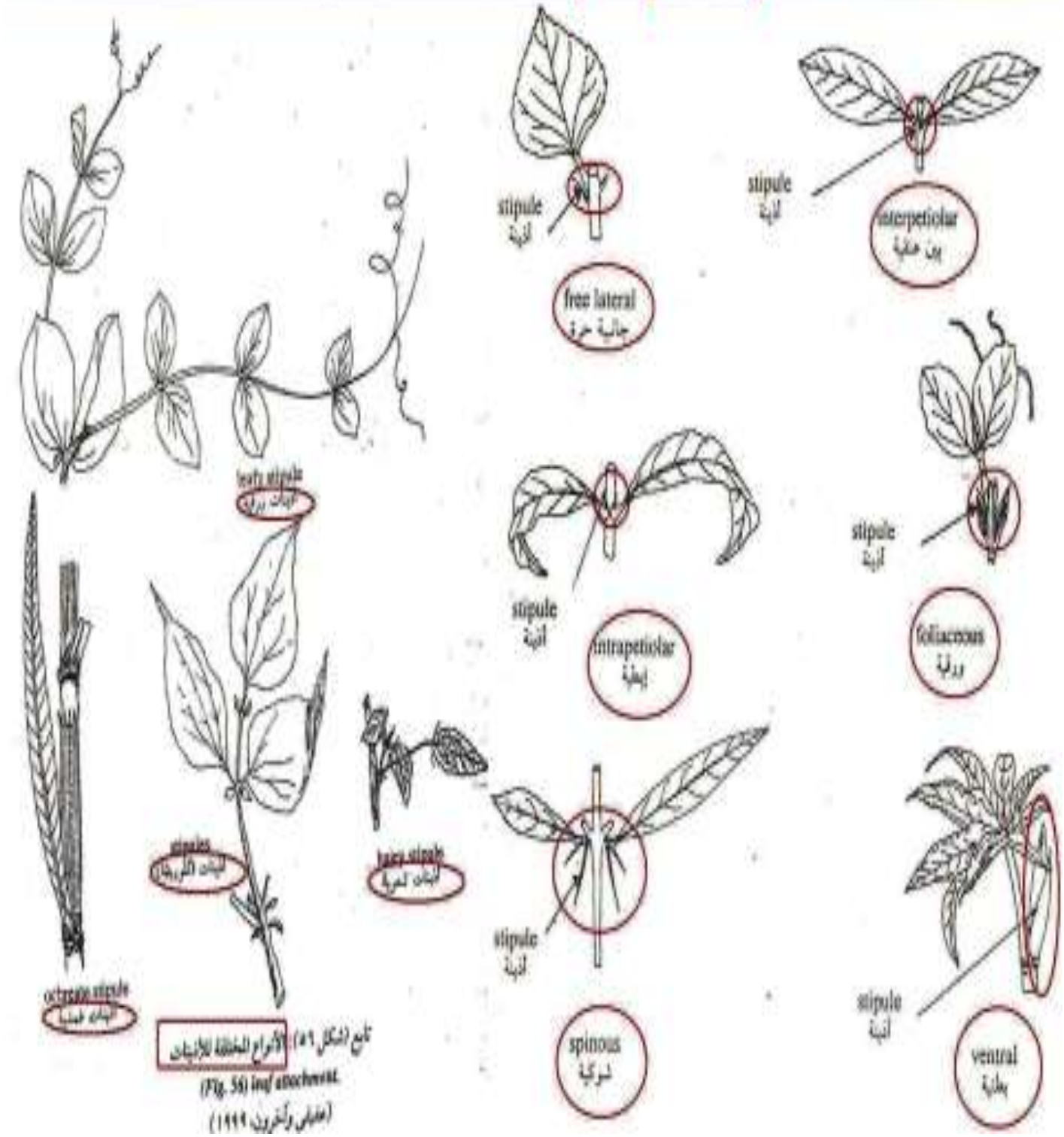
- **Stipules:**
  They frequently developed from the leaf base, forming a pair. Types of which are:
  1.Exstipulate
  2.Stipulate:
  - **Hairy**
  - **Foliaceous**
  - **Tendrillar**
  - **Spinous**
  - **Adnate**
  - **Ochreate**



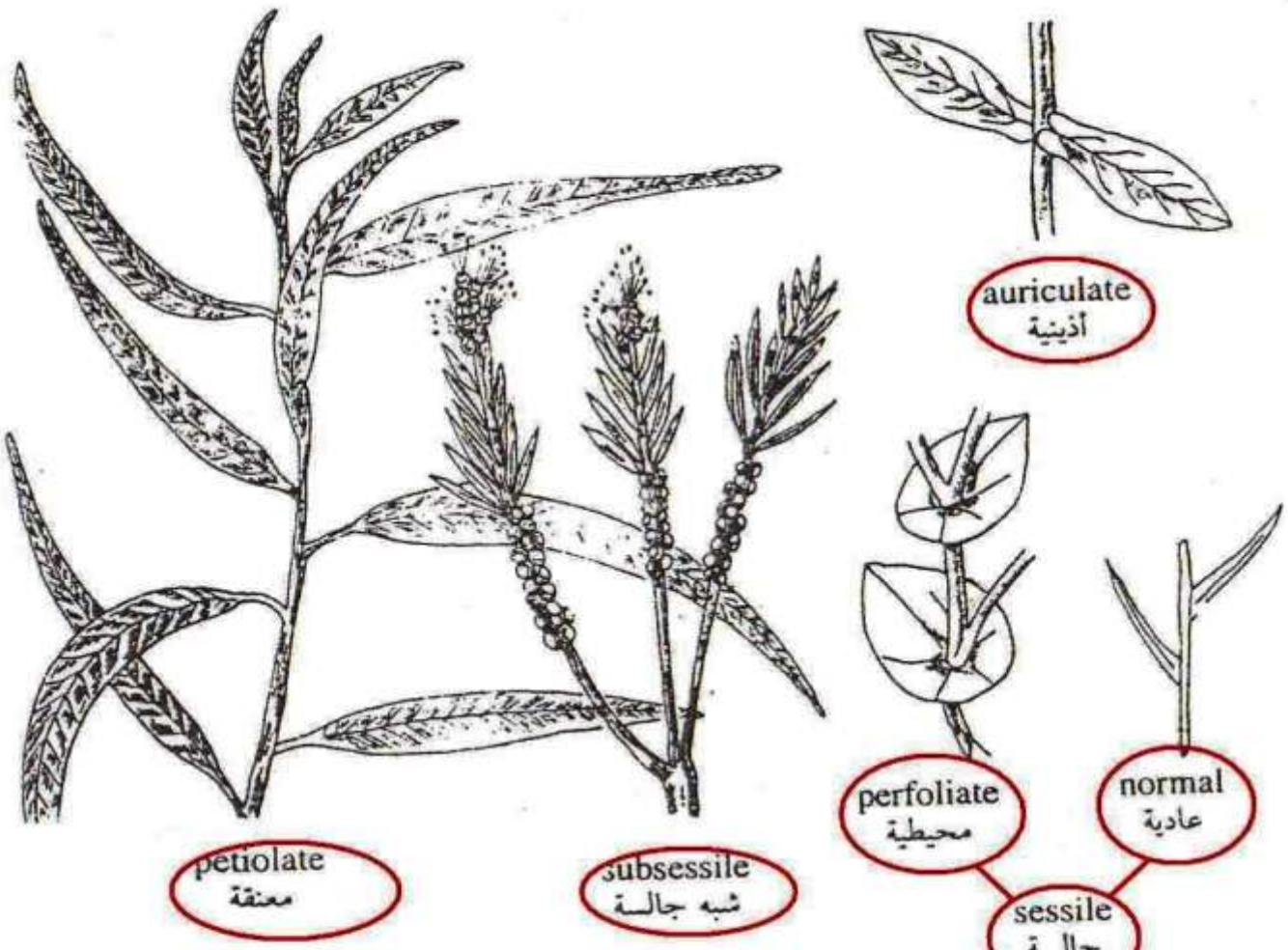
(شكل ٥٥): قاعدة الورقة
(Fig. 55) leaf base.
(عفيفي وآخرون، ١٩٩٩)

Leaf parts

1. Leaf Base (Stipules)



3. **Leaf Stalk (Petiole):**
    1. **Petiolate**
    2. **Subsessile**
    3. **Sessile**



(شكل ٥٦): اتصال الأوراق بالساق

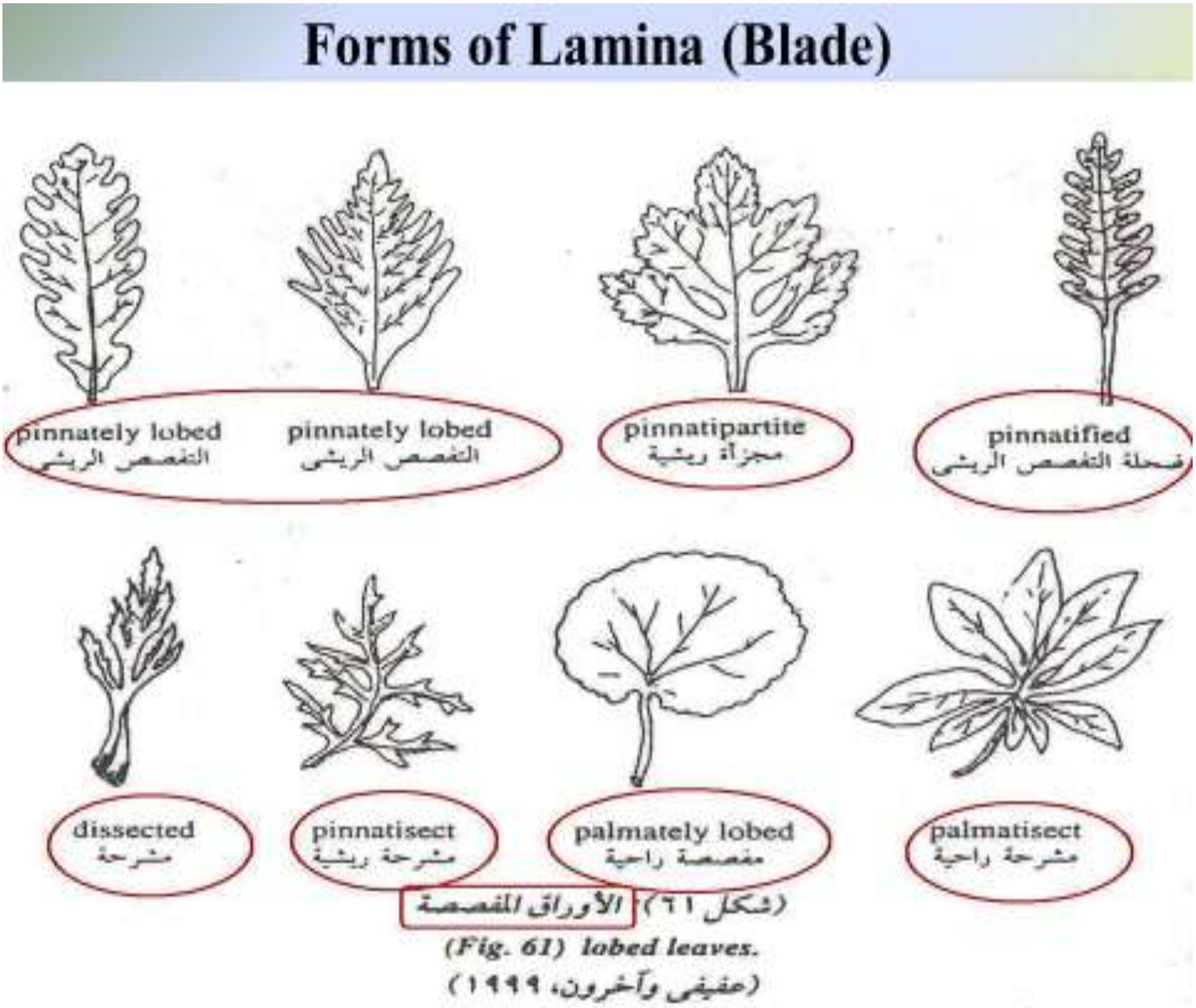
(Fig. 56) leaf attachment.

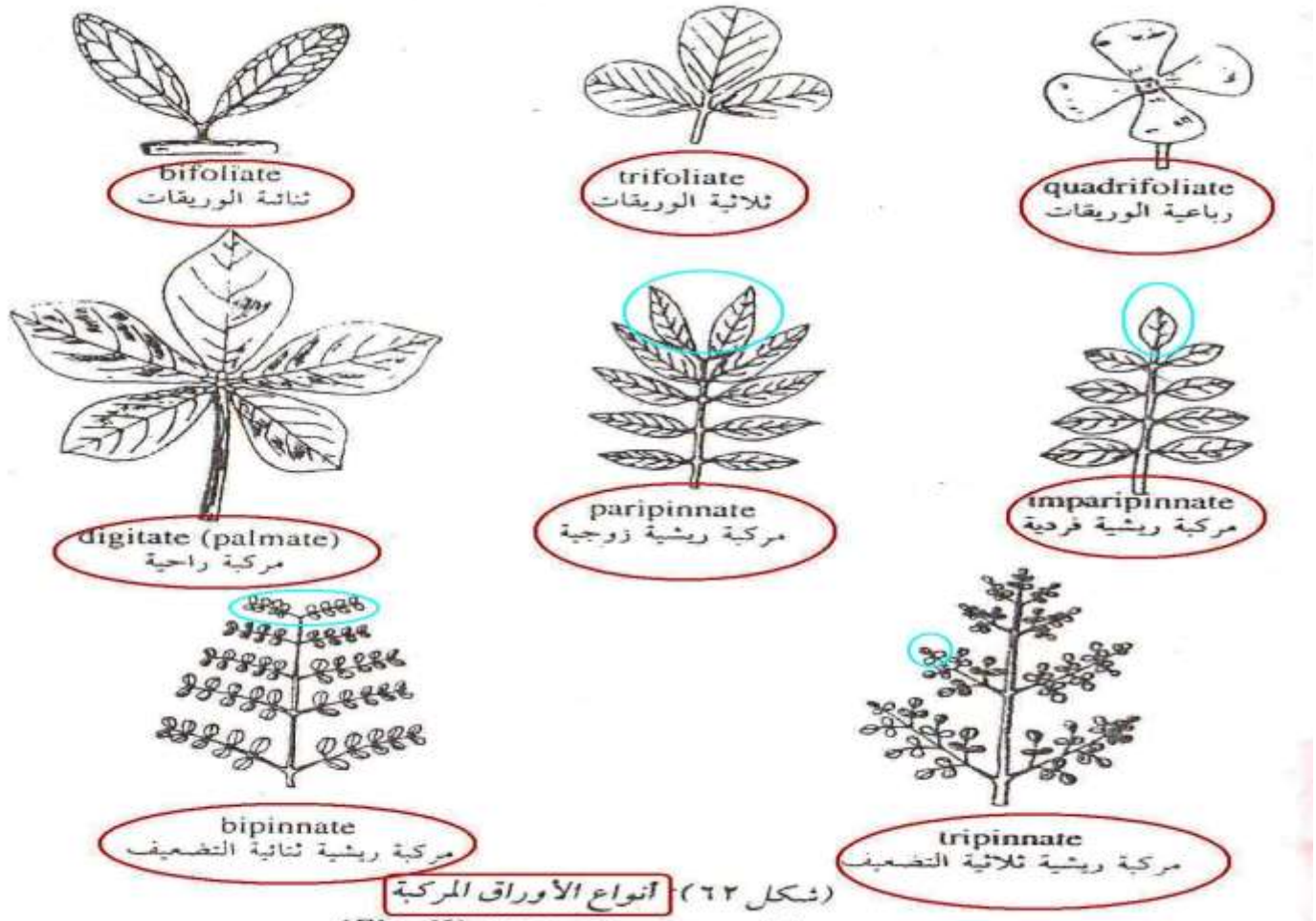
(عفيفى وآخرون، ١٩٩٩)

4. **Leaf Blade:**

- **Forms of Leaf Blade (Lamina):**
    1. **Simple: One continuous or slightly divided surface.**
    2. **Lobed: Incomplete deep divisions, divided into a number of lobes connected by an undivided portion (not reaching the midrib). Lyrate, Runcinate.**

3. **<u>Dissectified:</u> Complete deep divisions (Close to the midrib).**
4. **<u>Palmate:</u> They are palm-like. If the incisions are less than half the distance between the margin and the midrib *i.e.* Palmatified, but if they are more than half *i.e.* Palmatisect.**
5. **<u>Pinnate:</u> If incisions are less than half the distance between the margin and the midrib *i.e.* Pinnatified, if they are more than half *i.e.* Pinnatipartite, but if incisions are so deep reaching the midrib *i.e.* Pinnatisect.**
6. **<u>Compound</u>: The divisions are so independent that they appear as distinct leaflets born on a common stalk (Palmately or Pinnately), (Bifoliate, Trifoliate, Paripinnate, Imparipinnate), or the leaflets of compound leaves themselves exhibit subdivision called *Pinna* (Bipinnate, Tripinnate).**





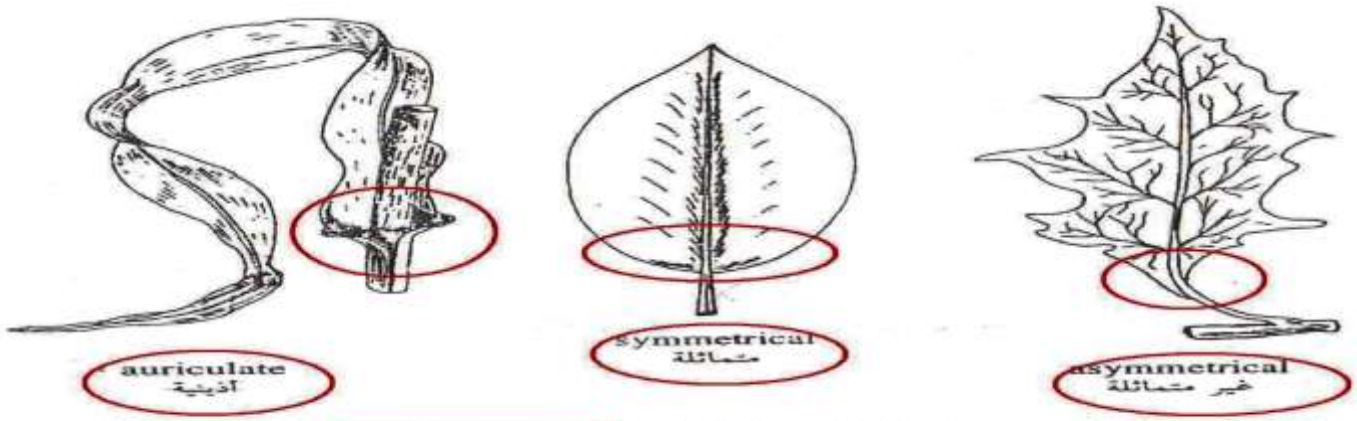
أنواع الأوراق المركبة (شكل ٦٢)

(Fig. 62) types of compound leaves.

Lamina

1. Base Of Lamina:

Symmetrical, Asymmetrical or Auriculate



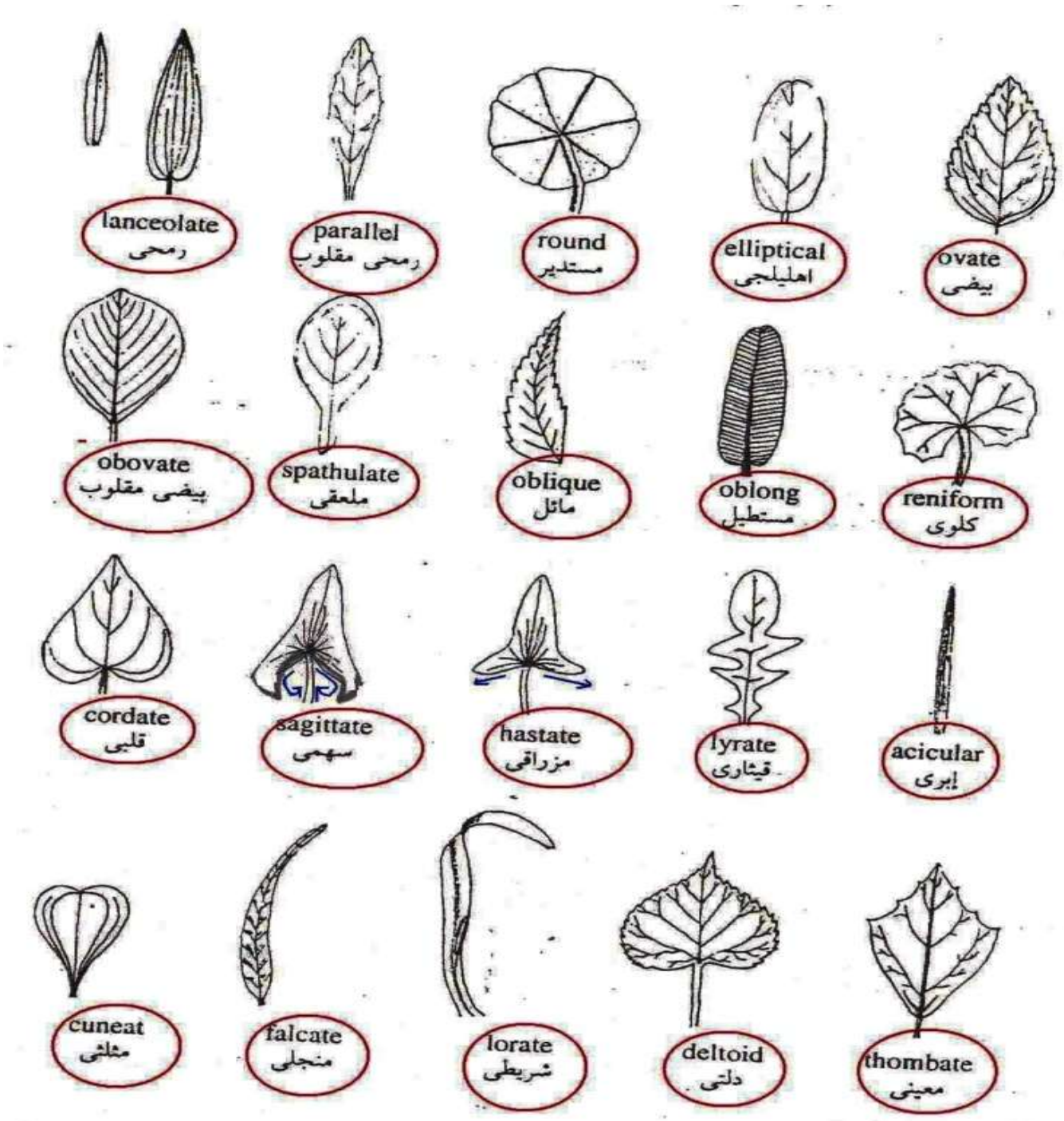
تابع (شكل ٥٥): أشكال قاعدة نصل الورقة

Cont. (Fig. 55) forms of the lamina base.

(هانيفي وآخرون، ١٩٩٩)

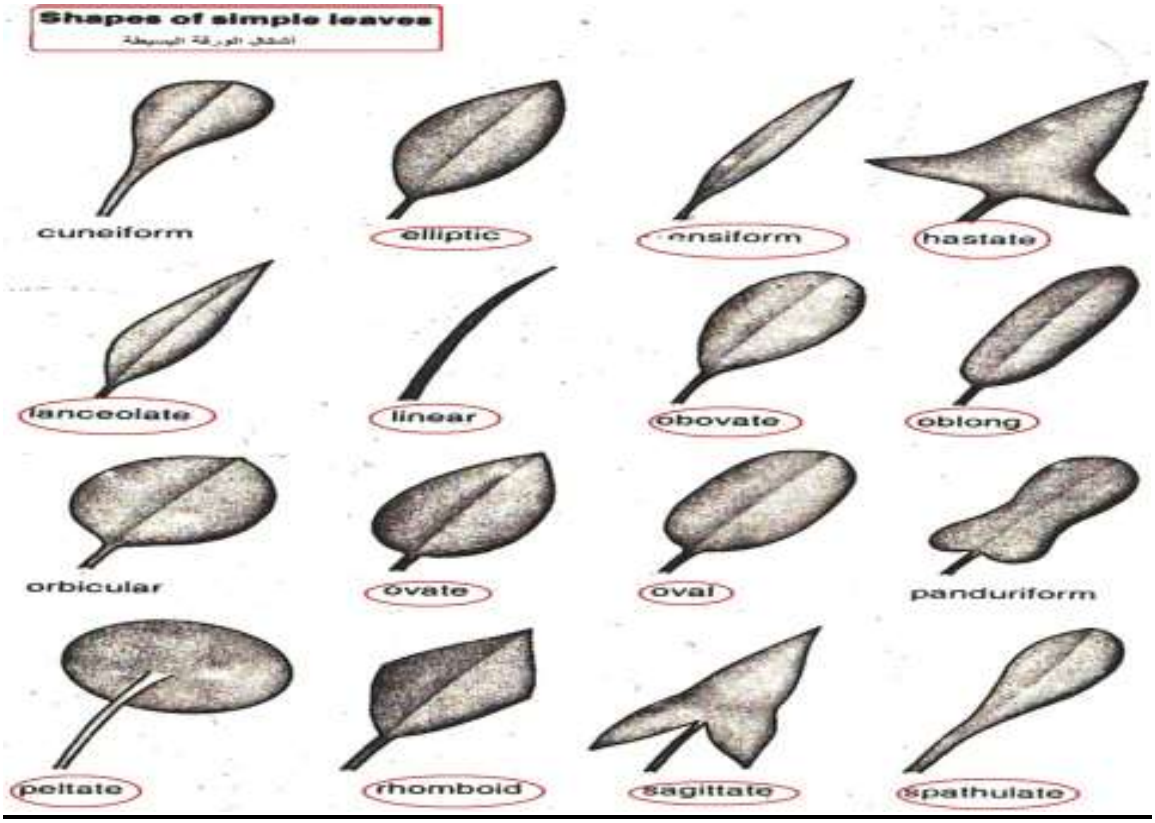
Shape Of Lamina:

Acicular, Tubular, Lanceolate, Ovate, Oblong, Spathulate, round, Reniform, Sagitate, Hastate, Lorate, Cordate, Lyrate, etc…



(شكل ٥٨): أشكال نصل الورقة

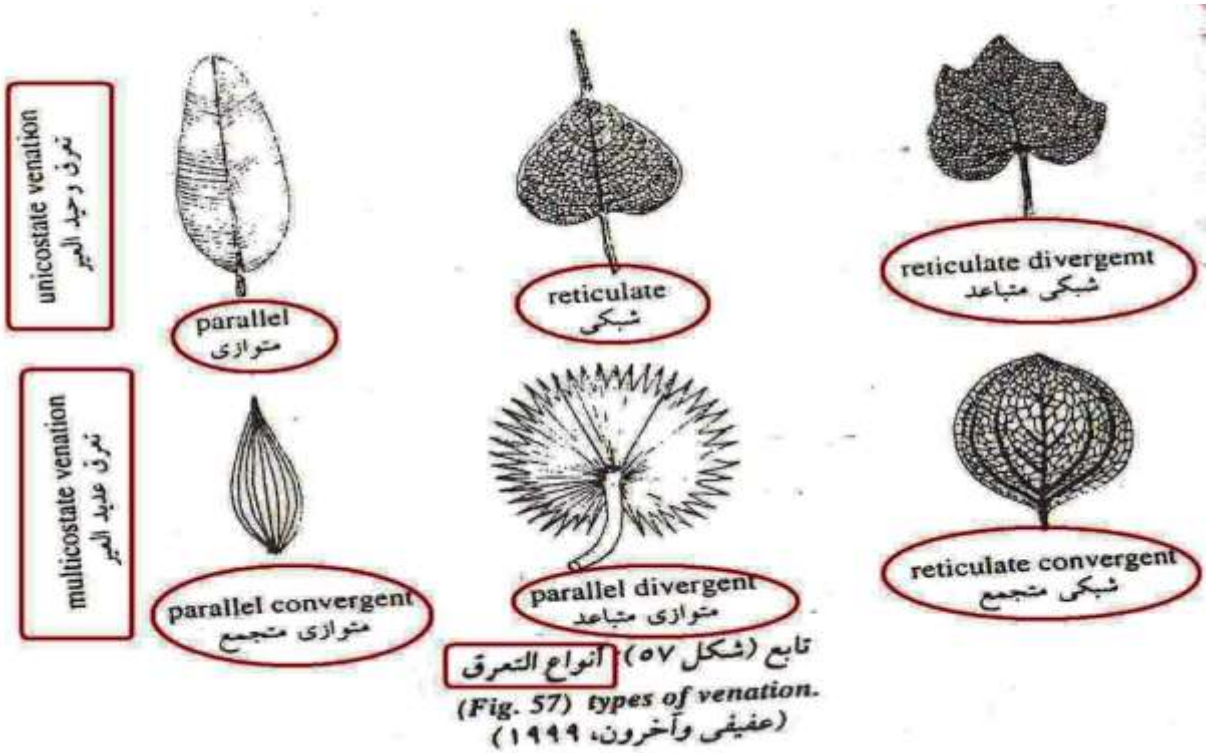
(Fig. 58) leaf shapes.



3. Leaf Vennation:

1. Reticulate

2.Parallel:(Longitudinal or Transverse)

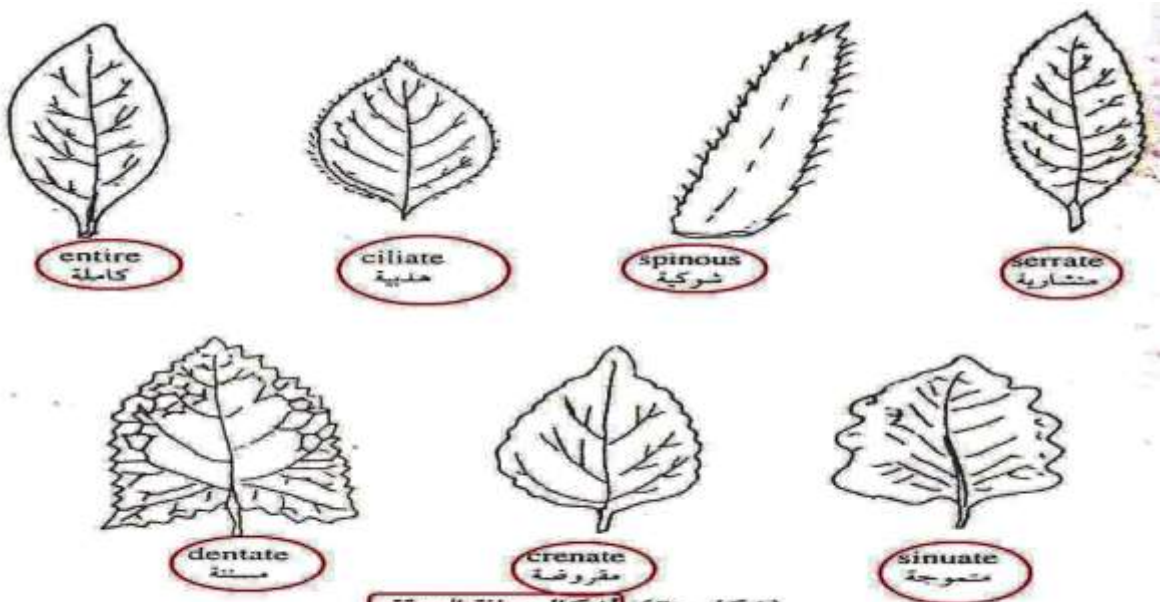


تابع (شكل ٥٧) أنواع التعرق

(Fig. 57) types of venation.
(عفيفى وآخرون، ١٩٩٩)

4. Margin Of Lamina:

Entire, Ciliate, Spinous, Serrate, Dentate, Crenate, Sinuate, *etc*…



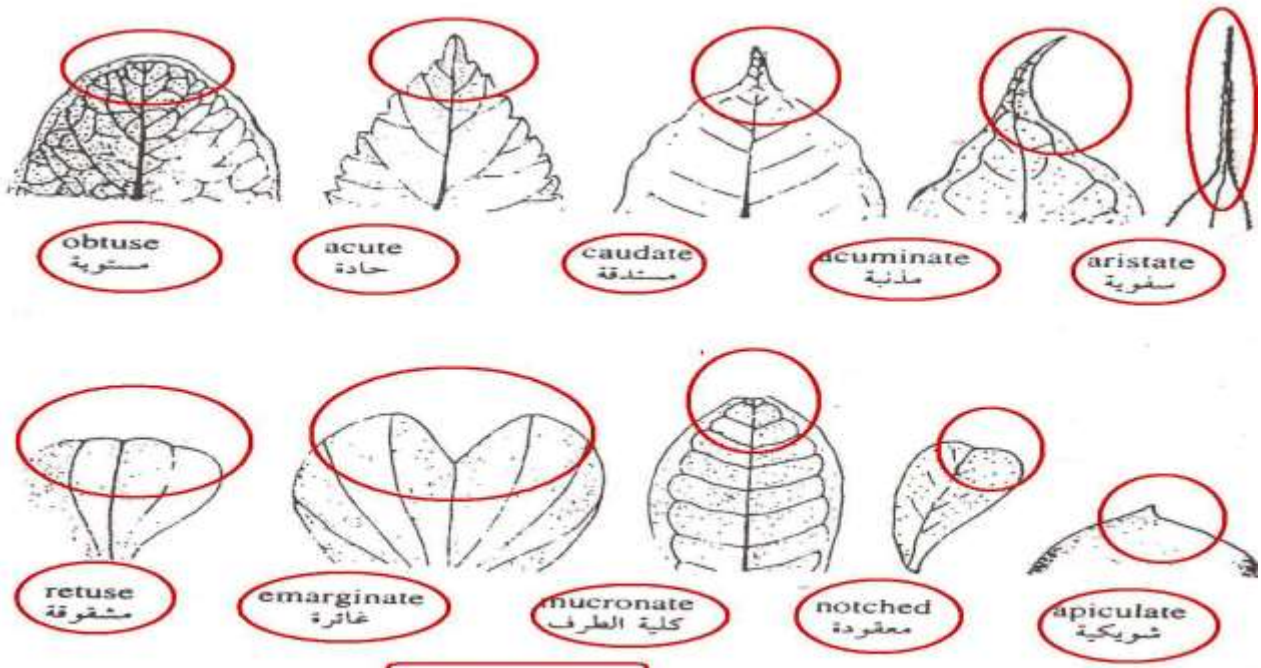
(شكل ٦٠): أشكال حافة الورقة

(Fig. 60) forms of the leaf margin.

(عفيفي وآخرون، ١٩٩٩)

5. Apex Of Lamina:

Obtuse, Acute, Caudate, Acuminate, Aristate, Retuse, Emarginate, Mucronate, Notched, Apiculate, etc…



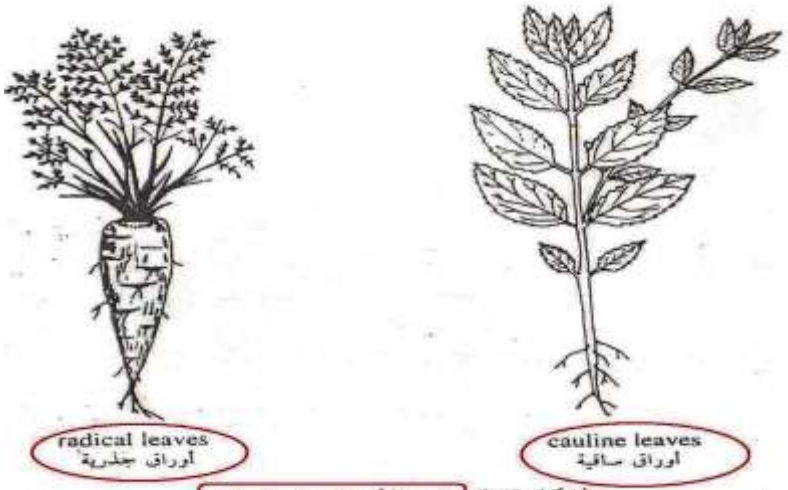
(شكل ٥٩): أشكال قمة الورقة

(Fig. 59) forms of the leaf apex.

(عفيفي وآخرون، ١٩٩٩)

Leaf Insertion

1. **Radical**
2. **Cauline**



(شكل ٦٣): وضع الأوراق على الساق

(Fig. 63) insertion of leaves.

Leaf Arrangement (*Phyllotaxis*):

1. **Dwarfed: Carrot**
2. **Alternate**
3. **Opposite superposed**
4. **Opposite decussate**
5. **Whorled**

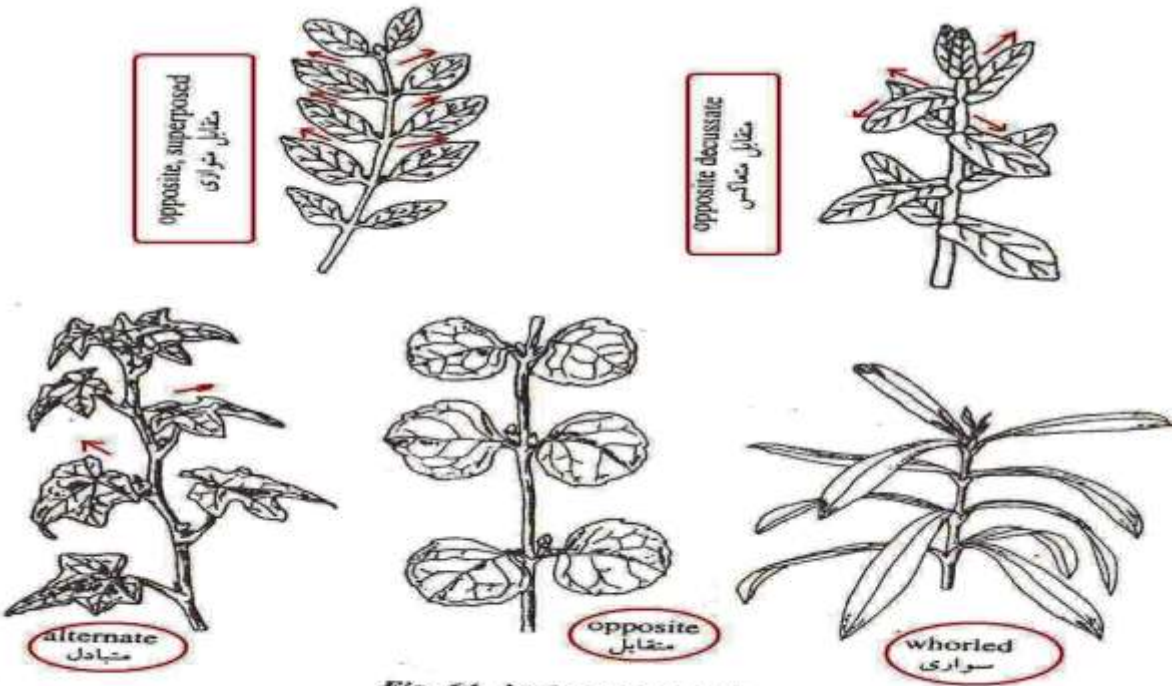
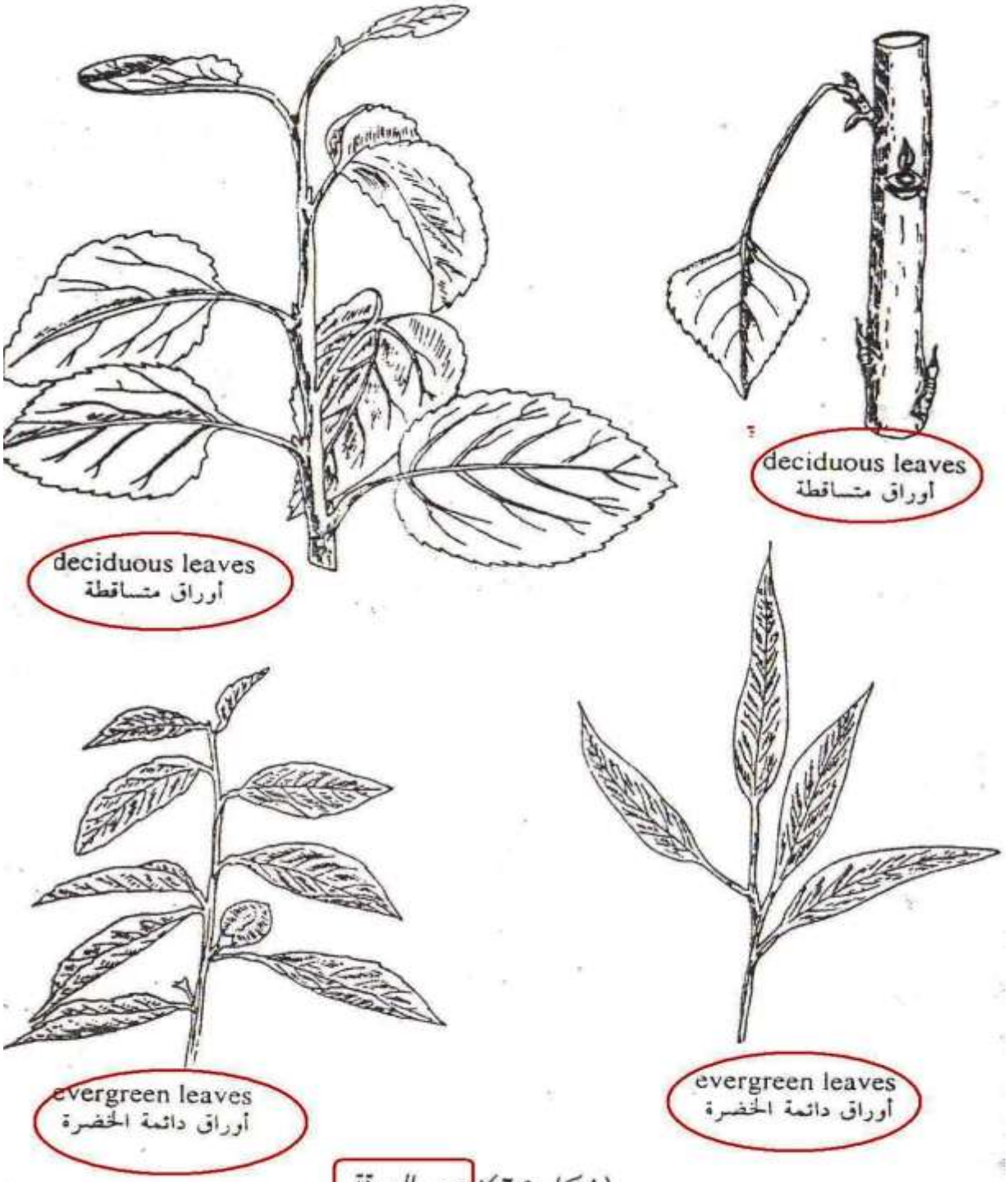


Fig. 64, leaf arrangement.

(شكل ٦٤): نظام الأوراق (ترتيب الأوراق)

Leaf Duration

1. Evergreen plants **2. Deciduous plants**



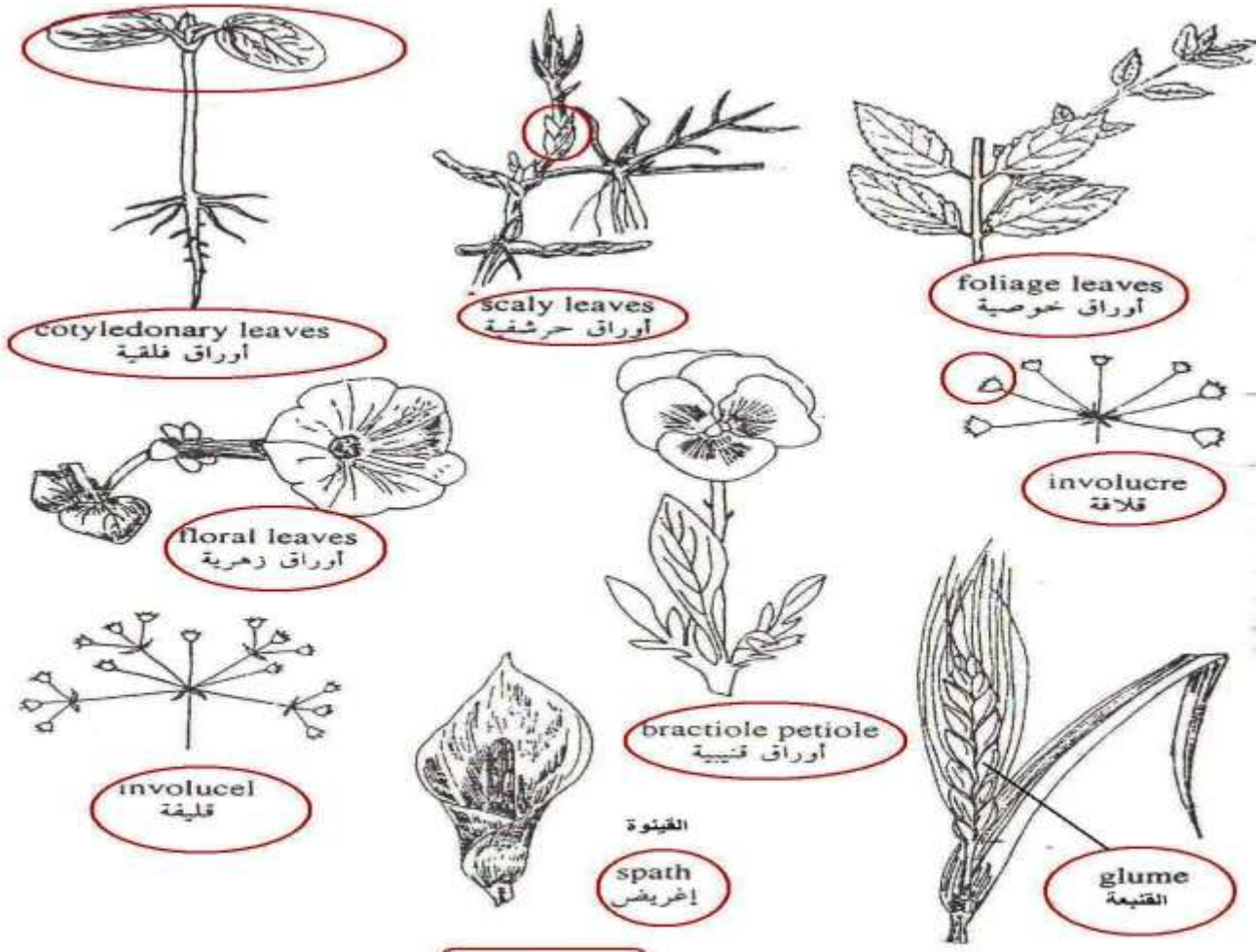
(شكل ٦٥): عمر الورقة

(Fig. 65) duration of the leaf.

Leaf forms

- **Cotyledonary leaves: *Epigeal* germination**
- ***Prophyllus*: *Fava* beans**
- **Scale leaves: Onion & Rhizomes**
- **Foliage leaves: Photosynthesis**
- **Floral leaves:**

1. Bract 2. Perianth (Invlocure) 3. Glume 4. Spath



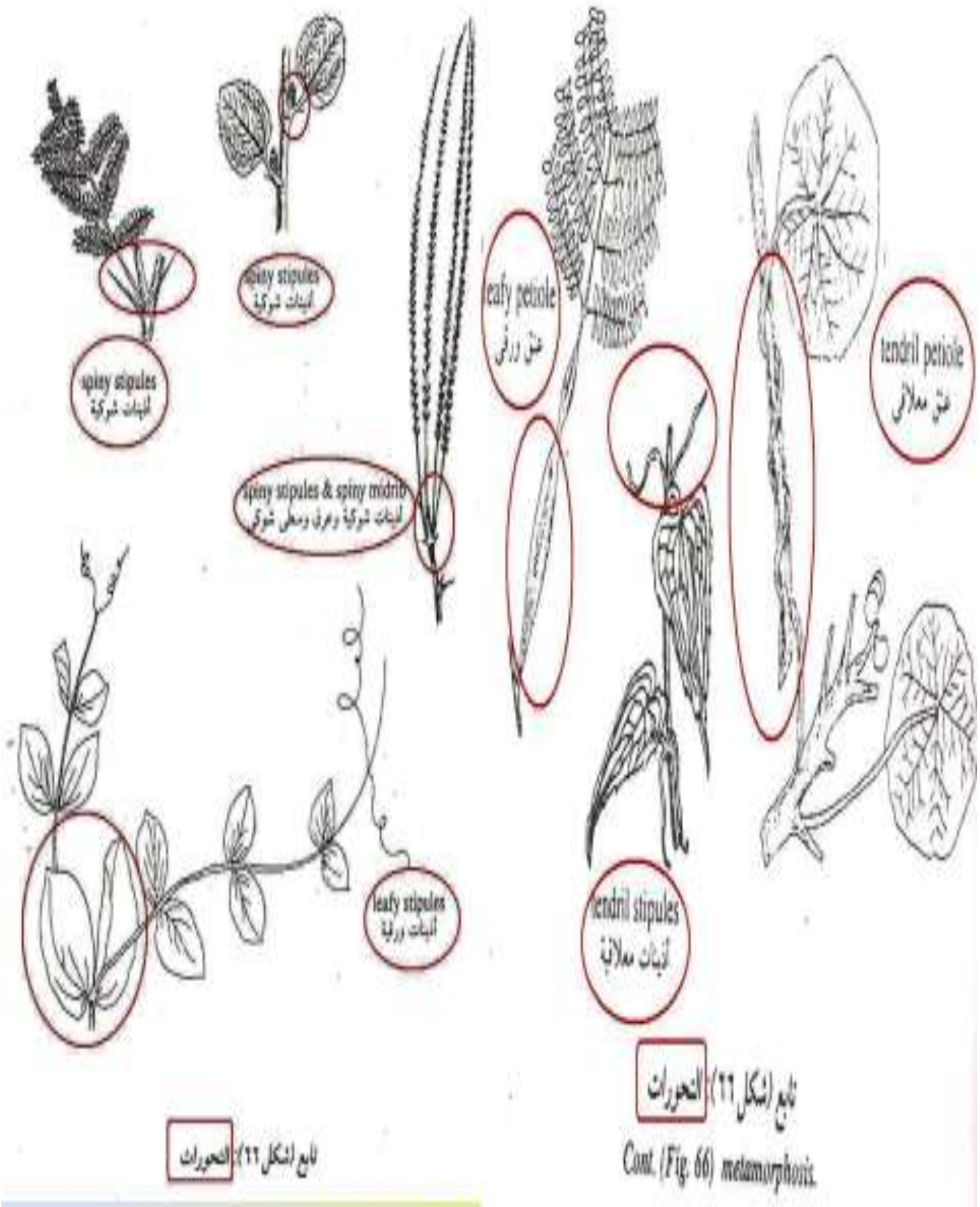
(شكل ٦٧): طراز الأوراق
(Fig. 67) kinds of leaves.
(عفيفي وآخرون، ١٩٩٩)

1. **Leaf Modifications:**
   - **Spiny leaves: *Berberis, Parkinsonia***
   - **Fleshy (Storage) leaves: *Zygophyllum***

- **Leaf tendrils:** ***Lathyrus decoratus***
- ***Phylloclade*** **(leafy petiole):** ***Zygophyllum, Acacia***
- **Insectivorous leaves:** ***Drocera***

(شكل ٦٦): بعض أنواع تحورات الورقة

(Fig. 66) some types of metamorphosis in the leaf.



تابع (شكل ٦٦) التحورات

Cont. (Fig. 66) metamorphosis.

Flower

- **Definition: It is a modified shoot carrying floral leaves.**
- **Function: Reproduction**
- **The flower is characterized by:**

1. **It arises from the axial of a leaf, called "Bract".**
2. **It is composed of a stalk "Pedicel". If there is no stalk, it is "Sessile".**
3. **Floral leaves are arranged on an extended end known as "Receptacle" or "*Thalamus*".**
4. **These floral leaves are usually found in whorls one inside the other, as:**

1. Calyx 2. Corolla 3.*Androceium* (A) 4. *Gynoecium* (G)

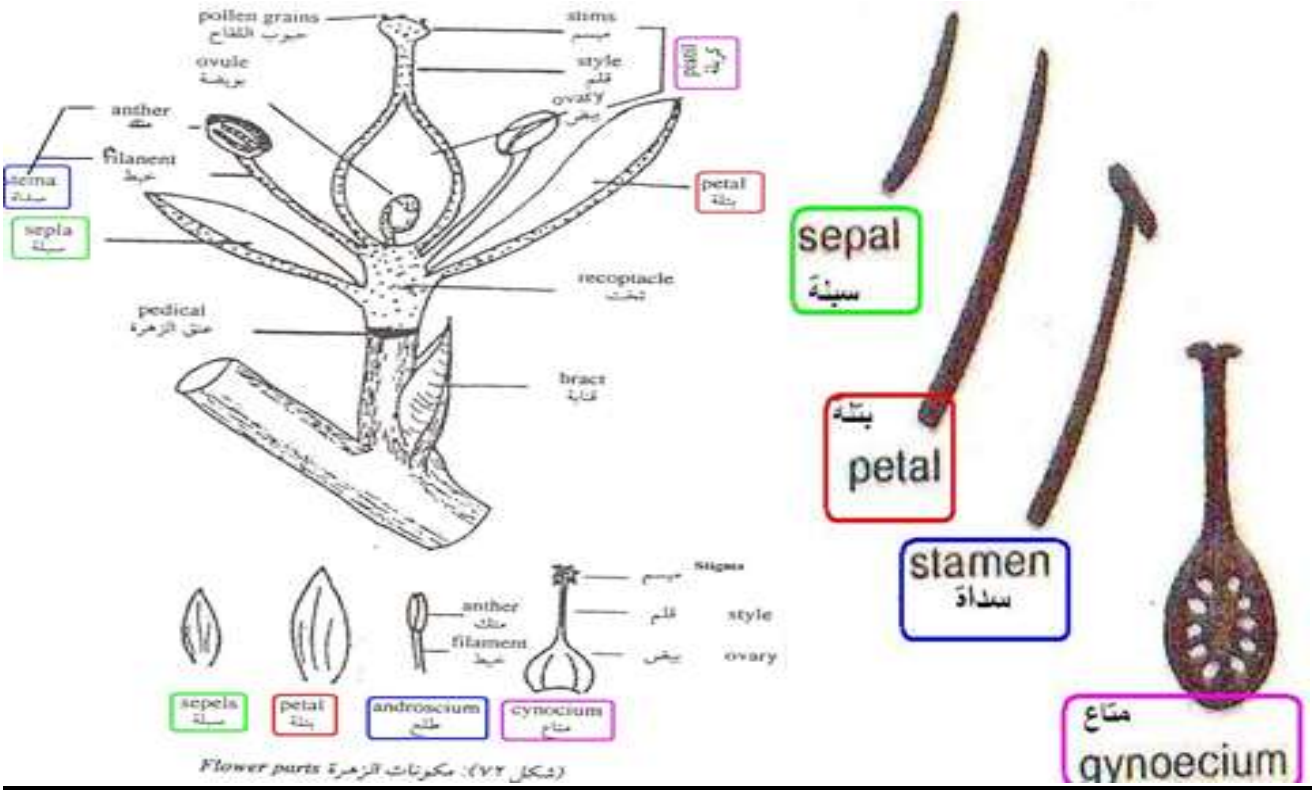
5. There maybe a floral whorl above the "*Calyx*" called the "*Epicalyx*"

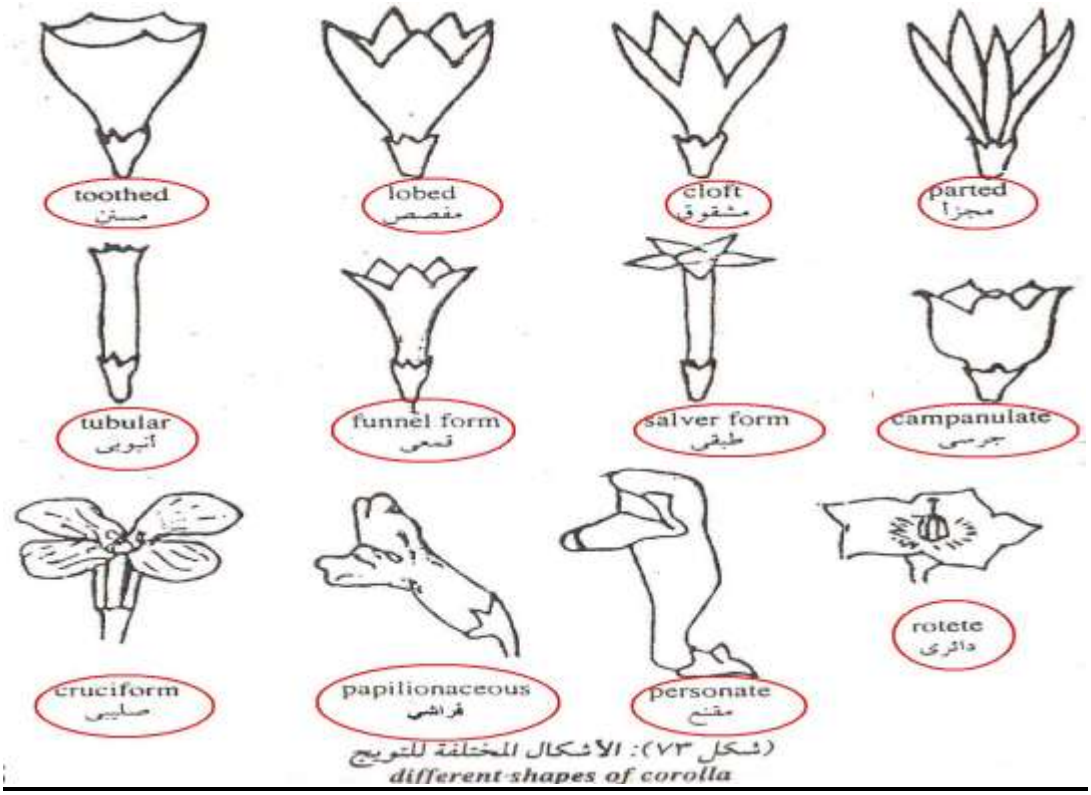
1. Calyx

- **It is the outermost whorl of floral leaves.**
- **It is composed of green leaf-like structures called "Sepals", varying in number from 2 -5, or sometimes more.**
- **When the sepals are free they are called "Polysepalous".**
- **And "Gamosepalous" when they are united.**

2.Corolla

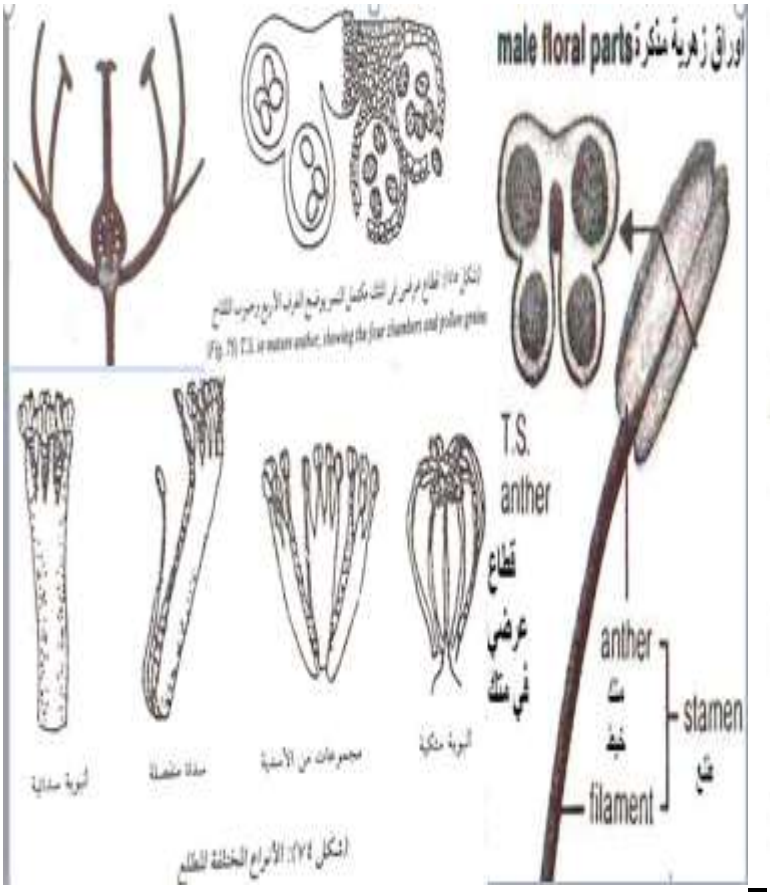
- **It follows the Calyx internally.**
- **It consists of colored leaf-like structures called "Petals".**
- **Petals always alternate with Sepals.**
- **When they are free, it is *Polypetalous* and when they are united, it is *Gamopetalous*.**
- **In some plants specially *Monocots* the sepals and petals are similar of tri-merious (3 or its replica) and designated collectively as Perianth (Tepals).**
- ***Dicots* are tetra- or penta-merious (4, 5 or their replica)**

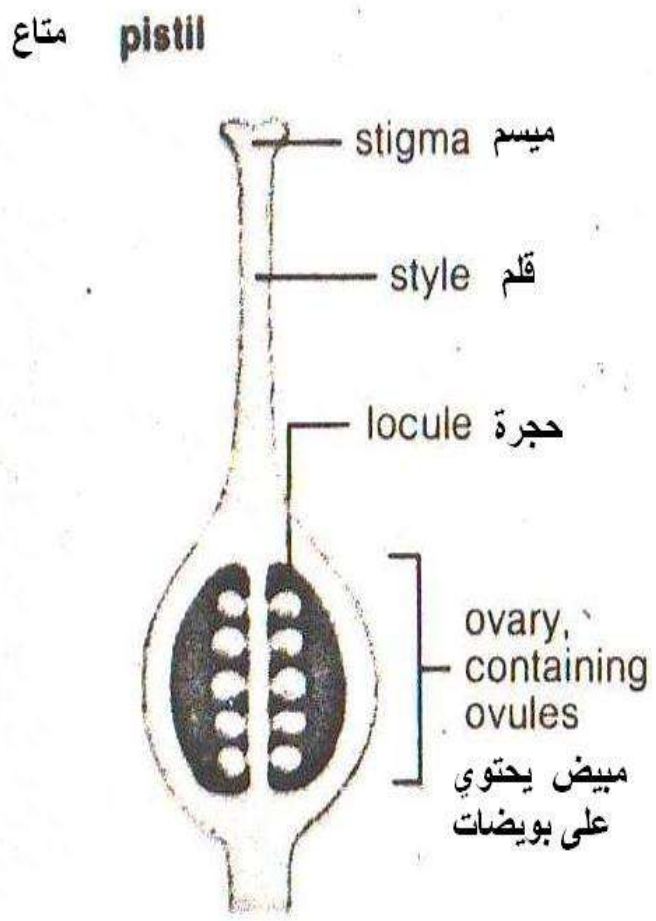

pollen grains
حبوب اللقاح
ovule
بويضة
anther
filament
خيط
sepla
سبلة
stims
ميسم
style
قلم
ovary
مبيض
petal
بتلة
recoptacle
pedical
عنق الزهرة
bract
قنابة
sepal
سبلة
petal
بتلة
stamen
سداة
gynoecium
متاع
Stigma
anther
filament
style
ovary
androecium
cynocium
(شكل ٧٢): مكونات الزهرة Flower parts


toothed
lobed
cloft
parted
tubular
funnel form
salver form
campanulate
cruciform
papilionaceous
personate
rotete
(شكل ٧٣): الأشكال المختلفة للتويج
different shapes of corolla

3.Androceium

It lies inside the Corolla and represents the male sexual organs. It is made up of a number of Stamens varying widely in number. Each stamen is composed of a filament ending with a lobe-like structure named the anther. The stamens maybe free or united by their filaments forming a tube "*Monadelphous*" or several bundles "*Polyadelphous*" or by their anthers "*Syngenesious*". They maybe separate from the petals or united "*Epipetalous*"



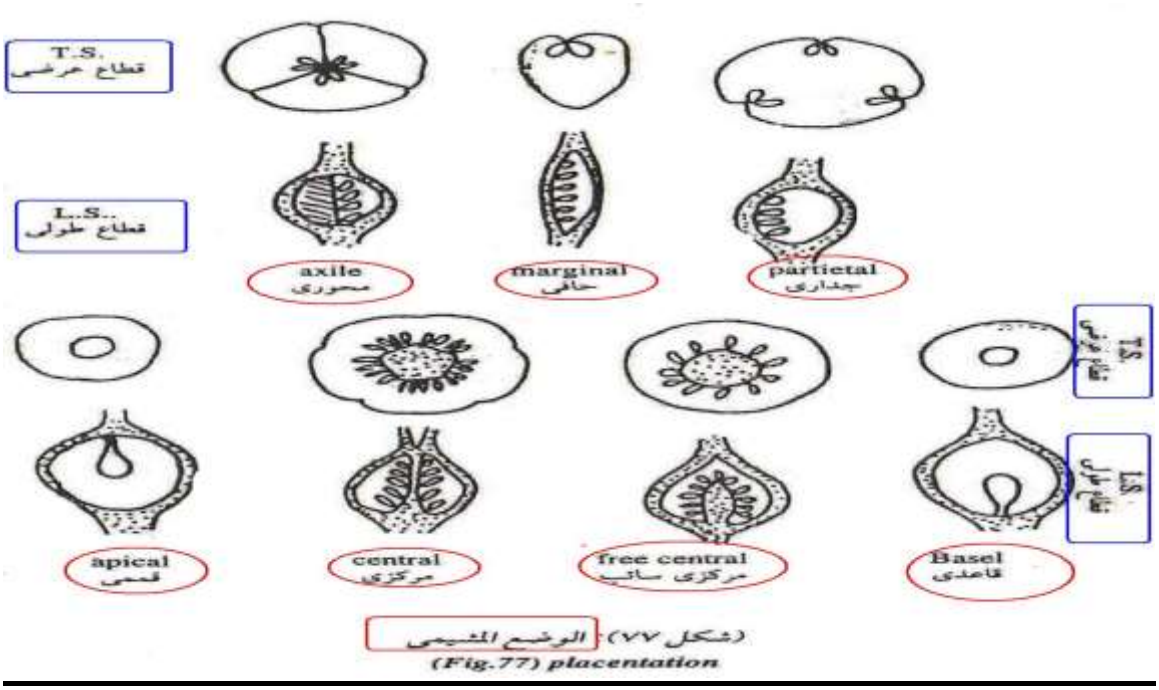


4.Gynoceium

It is present inside the *Androceium* and represent the male sexual organ. It is composed of one or more carpel. Fused carpels form the "*Pistil*" which is composed of Ovary, Style and Stigma. The ovary may contain one or more "Locules".

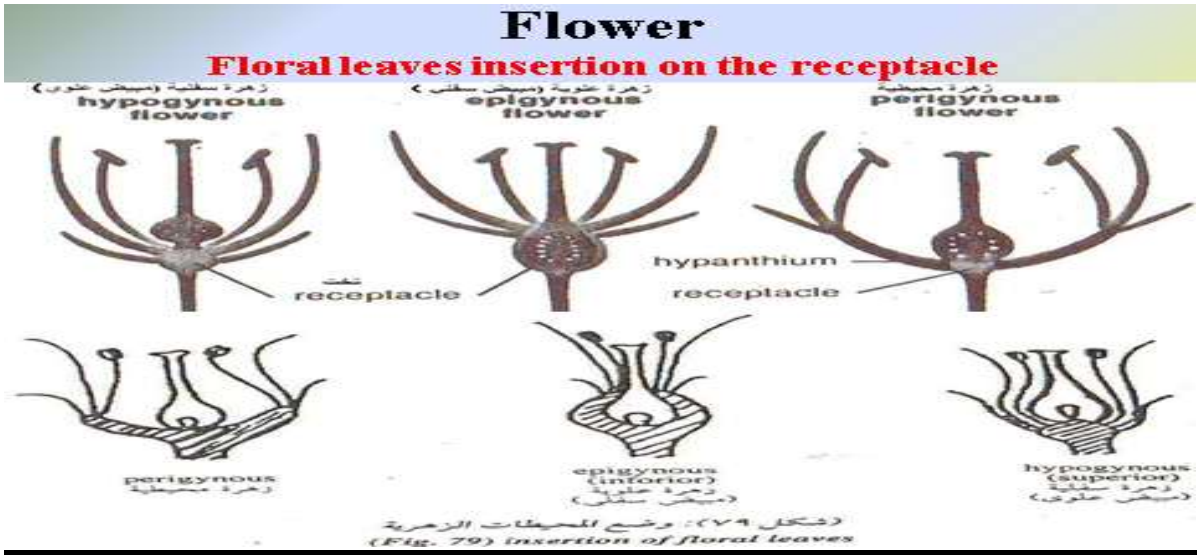
Placentation

It is the arrangements of ovules along "*Placenta* "



الوضع المشيمي (شكل ٧٧)

(Fig.77) placentation



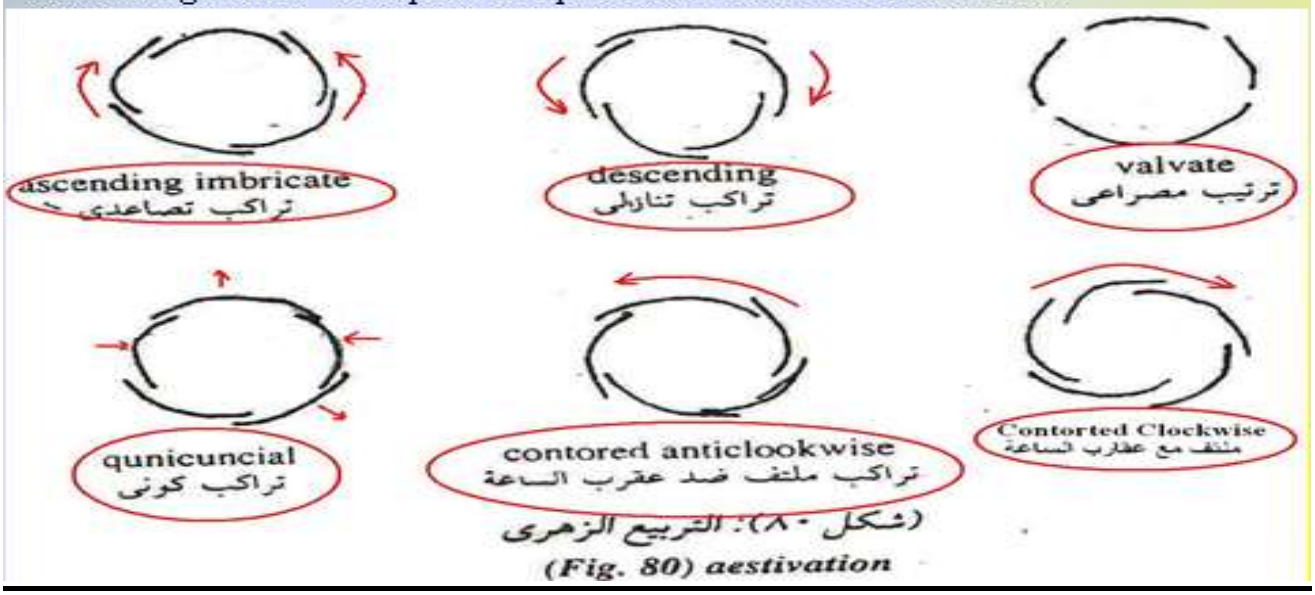
(شكل ٧٩): وضع المحيطات الزهرية

(Fig. 79) insertion of floral leaves

Flower

Aestivation:

The arrangements of sepals and petals in relation to each other.



(شكل ٨٠): التربيع الزهرى

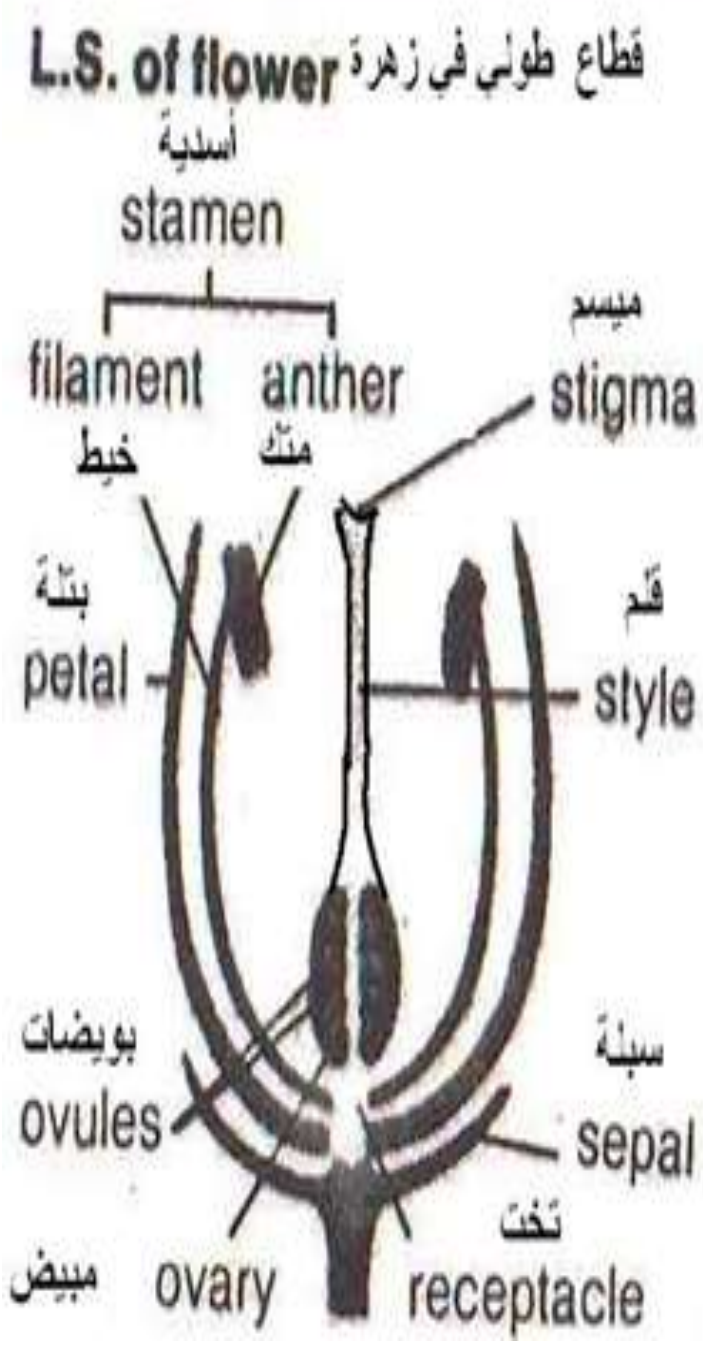
(Fig. 80) aestivation

The floral formula:

The characters of the flower can be described in brief by using a number of symbols that constitute what is known as the floral formula.

Actinomorphic flower (regular)	⊕
Zygomorphic flower (irregular)	%
Male flower (pistillate)	♂
Female flower (staminate)	♀
Bisexual flower (hermaphrodite)	⚥
Sepals	S
Petals	P
Androecium	A
Gynoecium	G

Flower


L.S. of flower قطاع طولي في زهرة
أسدية
stamen
filament
anther
خيط
متك
ميسم
stigma
بتلة
petal
قلم
style
بويضات
ovules
سبلة
sepal
مبيض
ovary
تخت
receptacle

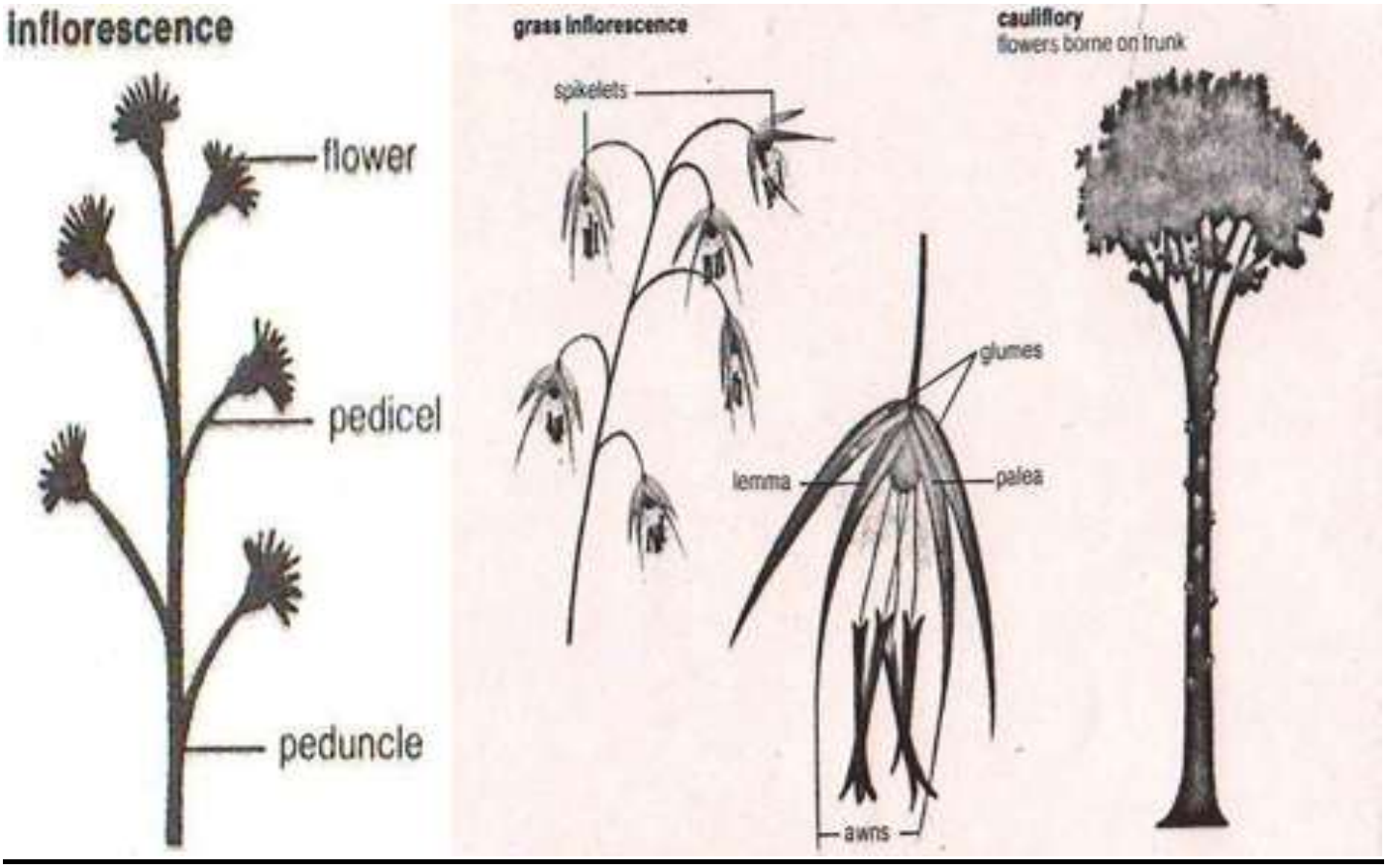

floral diagram مسقط زهري
a flower with 6 petals,
6 stamens, 6 sepals
ovary
مبيض
stamens
طلع
بتلات
petals
سبلات
sepals

Inflorescence

- **<u>Inflorescence</u>:** Sometimes flowers are solitary, but more commonly a number occurs on a flower-bearing shoot known as the axis "*Peduncle*" .
- **<u>It is divided into:</u>**

1. **<u>Racemose (Indeterminate)</u>:** It is arranged in a *Monopodial* branching where flowers open from <u>below upward</u>, or from <u>outside inward</u>.
2. **<u>Cymose (Determinate)</u>:** It is arranged in a *Sympodial* branching where flowers open from <u>above downward</u>, or from <u>inside outwards.</u>
3. **<u>Mixed *Inflorescence*</u>:** Two or more of the above types of inflorescence are combined together. It is represented by cymes arranged on a raceme axis and also by a *Dichasium* with the ultimate branched forming *Monochasia*.

- It arises from the axial of a small leaf "Bract", or a normal leaf.
-

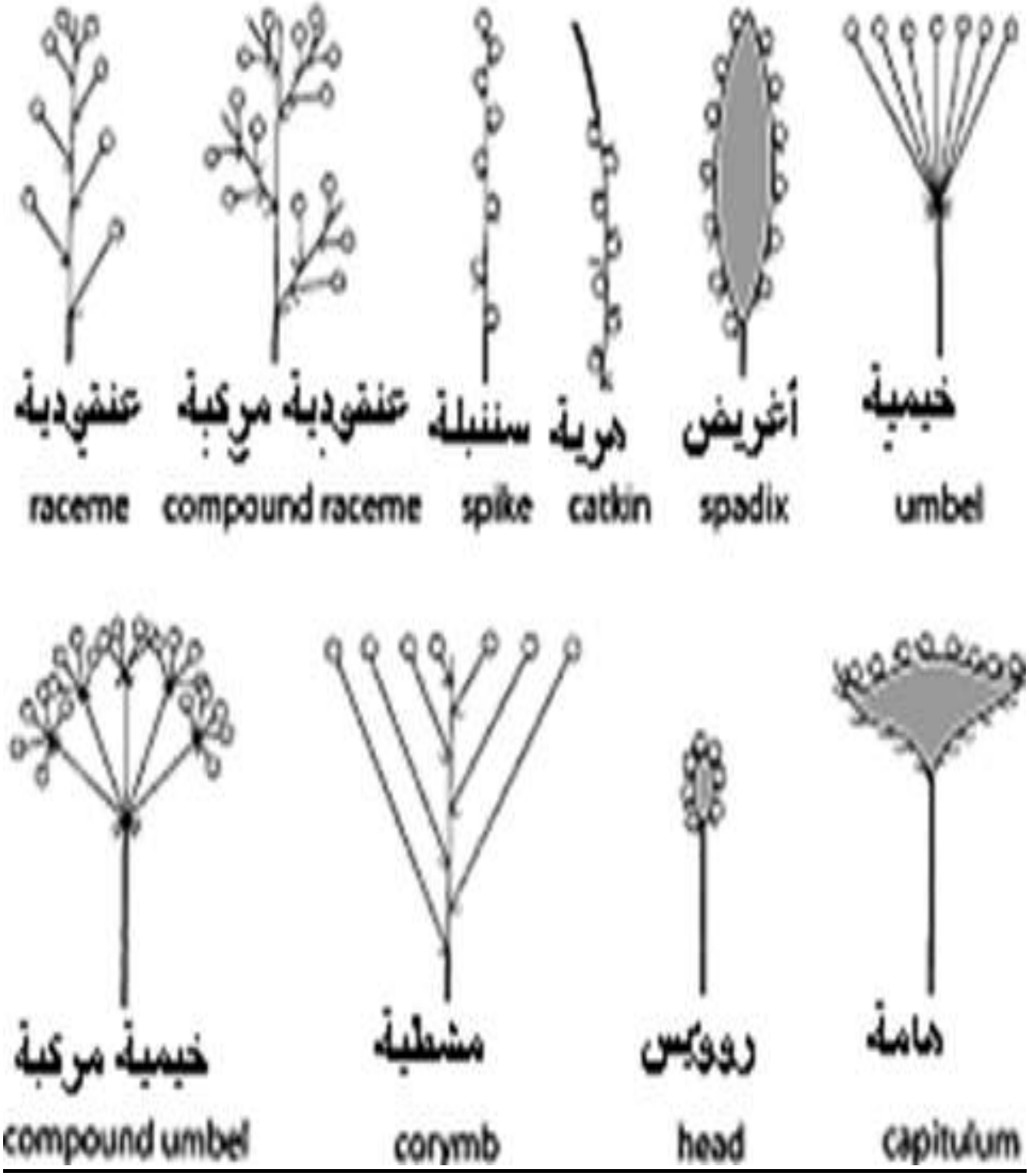


Racemose Inflorescence

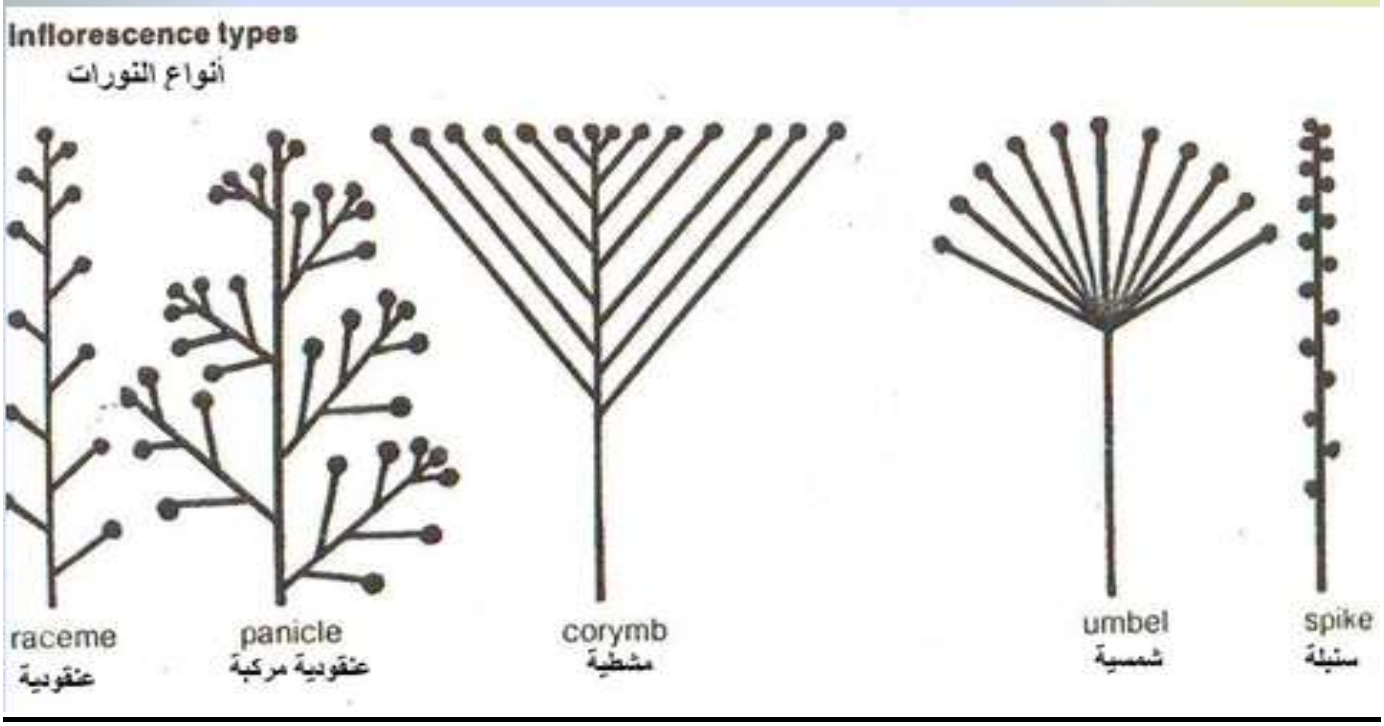
- **It is divided into:**

1. **Simple Raceme: Flowers are pedicellate and distributed along an axis with the youngest at the apex and the oldest at the base.**
2. **Compound Raceme (Panicle): The branches arising from the main axis of the inflorescence are themselves simple racemes.**
3. **Corymb: It is a simple raceme in which the pedicel of the lower most flowers become increasingly longer so that all flowers are on the same level.**
4. **Spike: It is a simple raceme with Sessile flowers.**
5. **Catkin: It is a pendulous spike often bears unisexual flowers and is frequently scaly-bracted.**
6. **Spadix: It is a spike with a fleshy axis. It often bears unisexual flowers and is enveloped by a leaf called Spathe.**
7. **Umbel: It is a simple raceme in which internodes are reduced so that the flower appears to arise from one point.**
8. **Compound Umbel: In which the flower of the simple umbels are replaced by small secondary umbels.**
9. **Capitullum (Head): It is a simple raceme with a short circular concave, flat or even convex pedicel on which sessile flowers are arranged.**

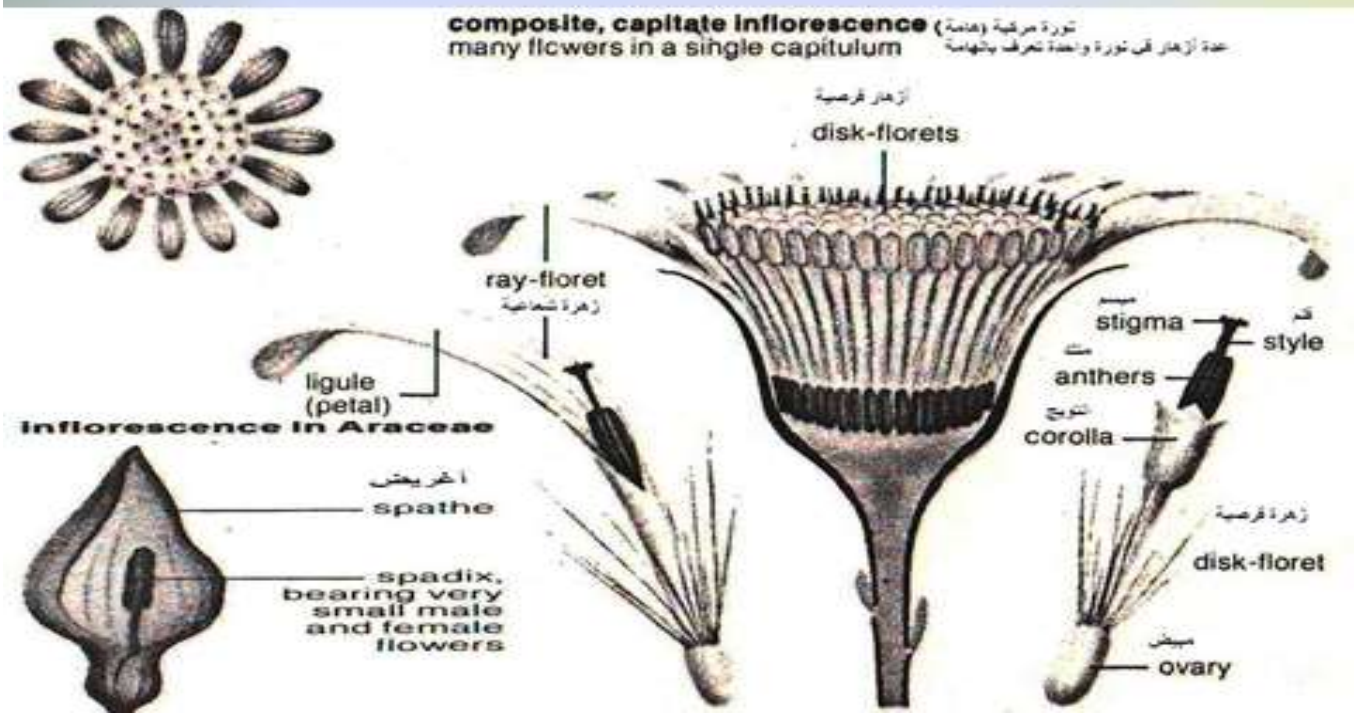
Racemose Inflorescence



Racemose Inflorescence



Racemose Inflorescence



Cymose Inflorescence

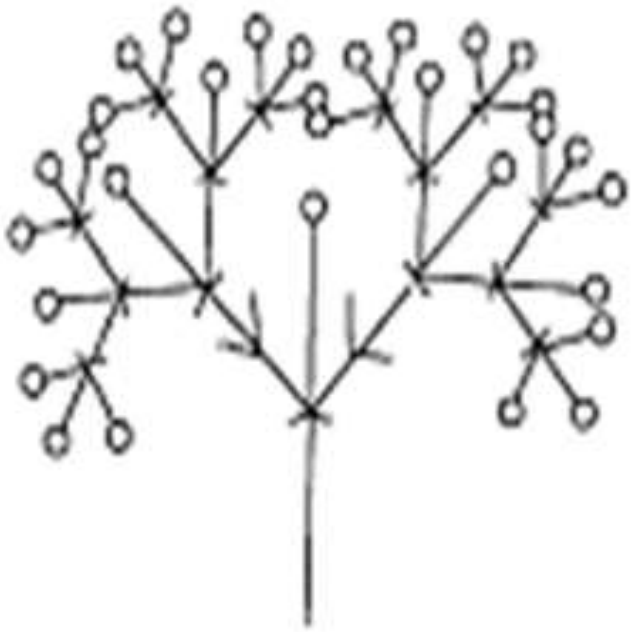
- **It is divided into:**

1. ***Monochasium*: The terminal bud is modified into a flower (the oldest), a lateral bud gives rise to a younger flower, etc…It is either Helicoid (bracts are on one side and flowers are on the other) or Scorpoid (bracts and flowers alternate).**

2. *Dichasium*: The terminal bud is modified into a flower, from the axil of the two opposite bracts arise two younger flowers.

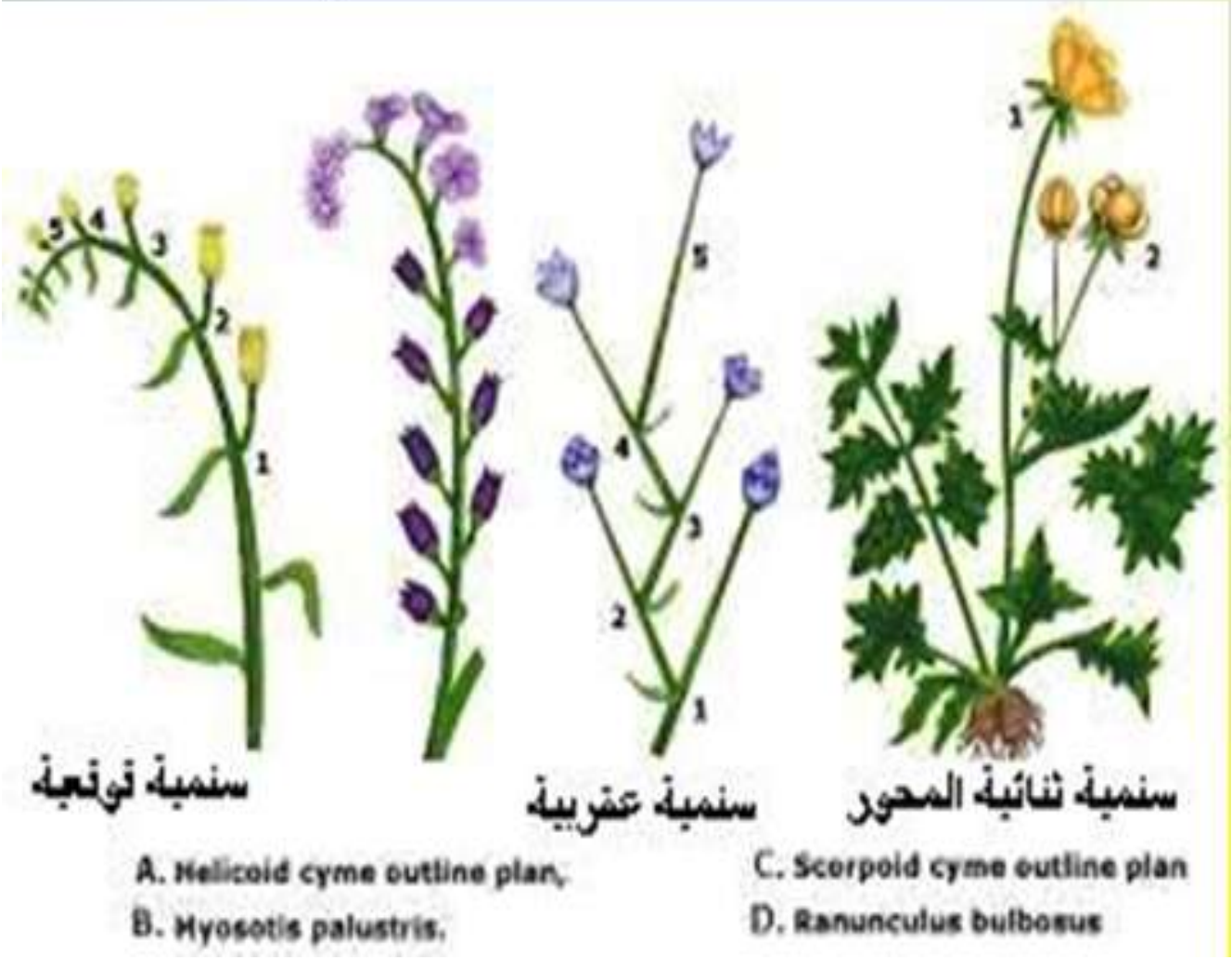
3. *Polychasium* (Determinate Umbel: The middle oldest flower is surrounded by several younger flowers.

monochasial cymes



dichasial cyme

Cymose Inflorescence



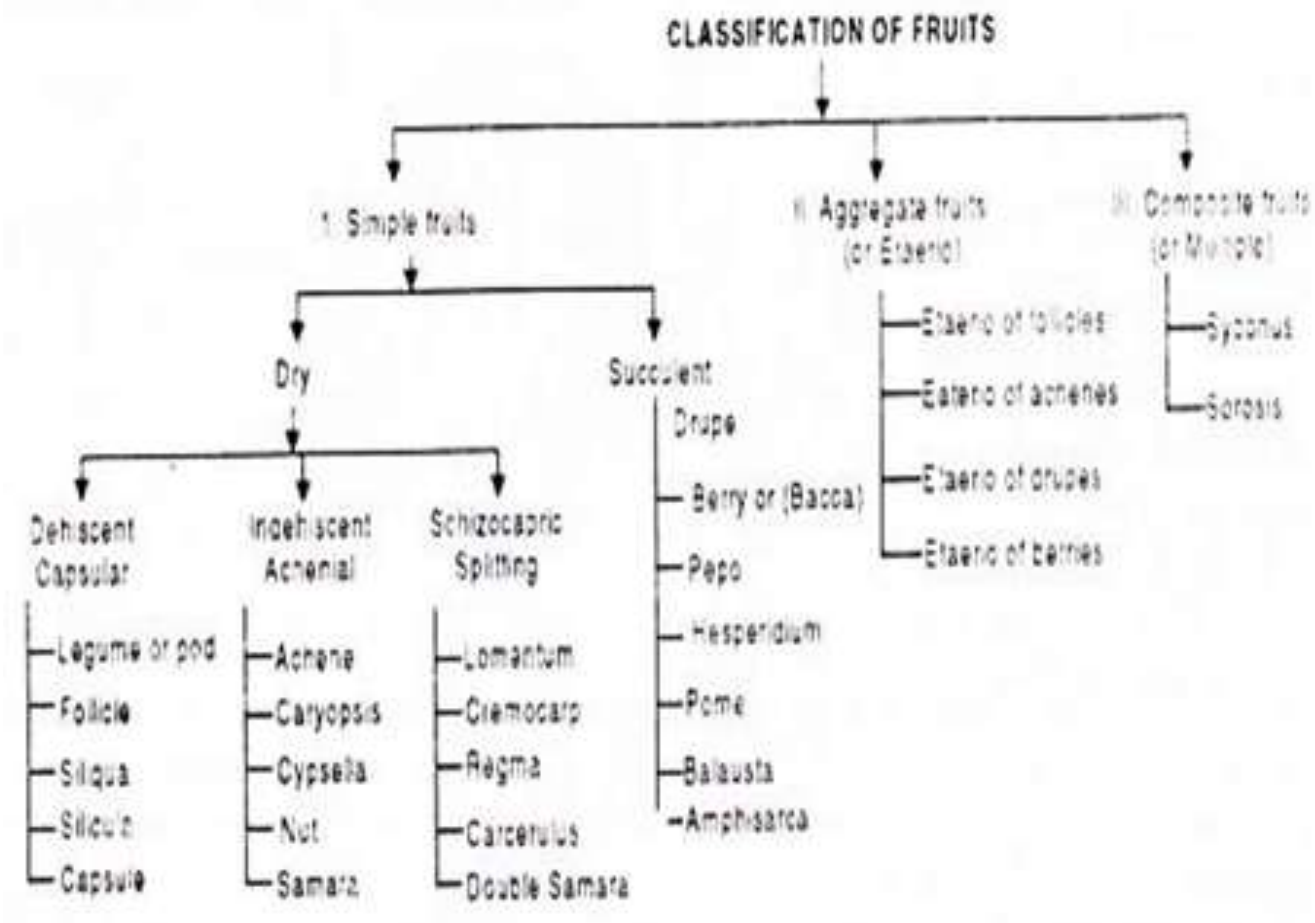
Fruits

<u>Fruit</u>: It is a mature ripened ovary of a flower, including one or more seeds, which are the matured ovules, enclosed by the pericarp.

- **After Fertilization is completed most of the floral leaves *i.e.* Calyx, Corolla, *etc*..., fall although some may remain attached to the fruit.**
- **A fruit has <u>two scars</u> (A grain of wheat, maize and rice are fruits):**

1. **The point of attachment to the <u>receptacle</u>, and.**
2. **The point of attachment the <u>style</u>.**

- **A seed has only <u>one scar</u> which is the point of attachment to <u>the ovary</u>.**
- **<u>True Fruit</u>: A fruit that is only formed from the ovary.**
- **<u>False (Accessory) Fruit</u>: A fruit that is formed from other parts of the flower or the vegetative parts besides the ovary. *i.e.* Strawberry, Pears and Apples.**



- **Fruits are classified into:**

1. **<u>Simple</u>: The fruit is produced from a *single flower*, the gynoecium of which composed of *<u>a single or several united carpels</u>*.**
2. **<u>Aggregate</u>: The fruit is produced from a *single flower*, the gynoecium of which composed of *<u>several free carpels</u>*.**
3. **<u>Composite (Multiple)</u>: A *<u>group</u>* <u>of flowers (inflorescence)</u> *i.e.* Mulberry**

Simple Fruits

- **Simple Fruits are classified into:**

1. **<u>Dry Fruits</u>: The wall of the fruit (pericarp) is dry, thin (or thick) and woody. They are subdivided into:**
    - **Indehiscent (Closed) Fruits: The pericarp remain closed and the seeds liberated after the disintegration of the pericarp. It is generally one-loculed (chamber) and one-seeded.**
    - **Dehiscent (Opened)Fruits: The pericarp opens in many ways for the liberation of seeds or breaking apart.**
    - **Schizocarpic (Split) Fruits: It is composed of more than one carpel fused together in the early stages, but when ripens it splits into an indehiscent dry parts (*Mericarps*) usually one-seeded.**
2. **<u>Succulent Fruits</u>: The wall of the fruit (pericarp) is fleshy and <u>the wall</u> is of three parts:**

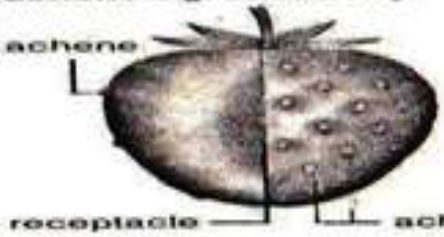
- *Endocarp* - *Mesocarp* -*Epicarp*

Fruit

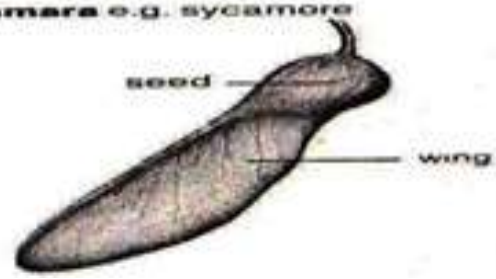
legume e.g. pea

capsule e.g. poppy

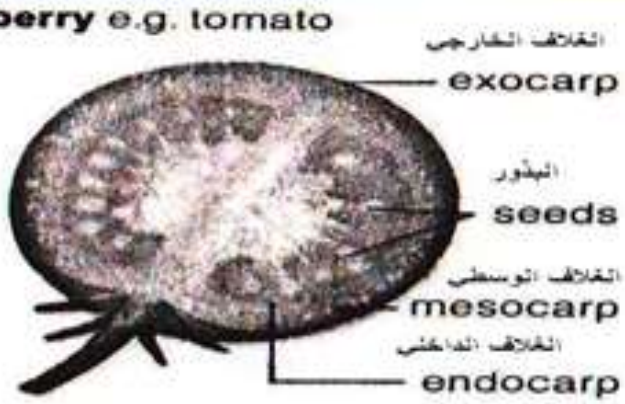
achene e.g. strawberry



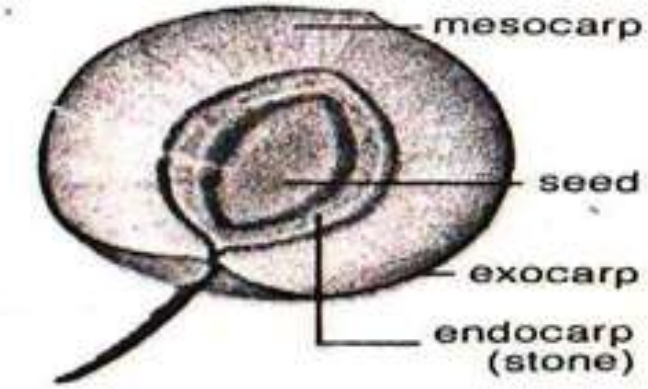
samara e.g. sycamore



berry e.g. tomato



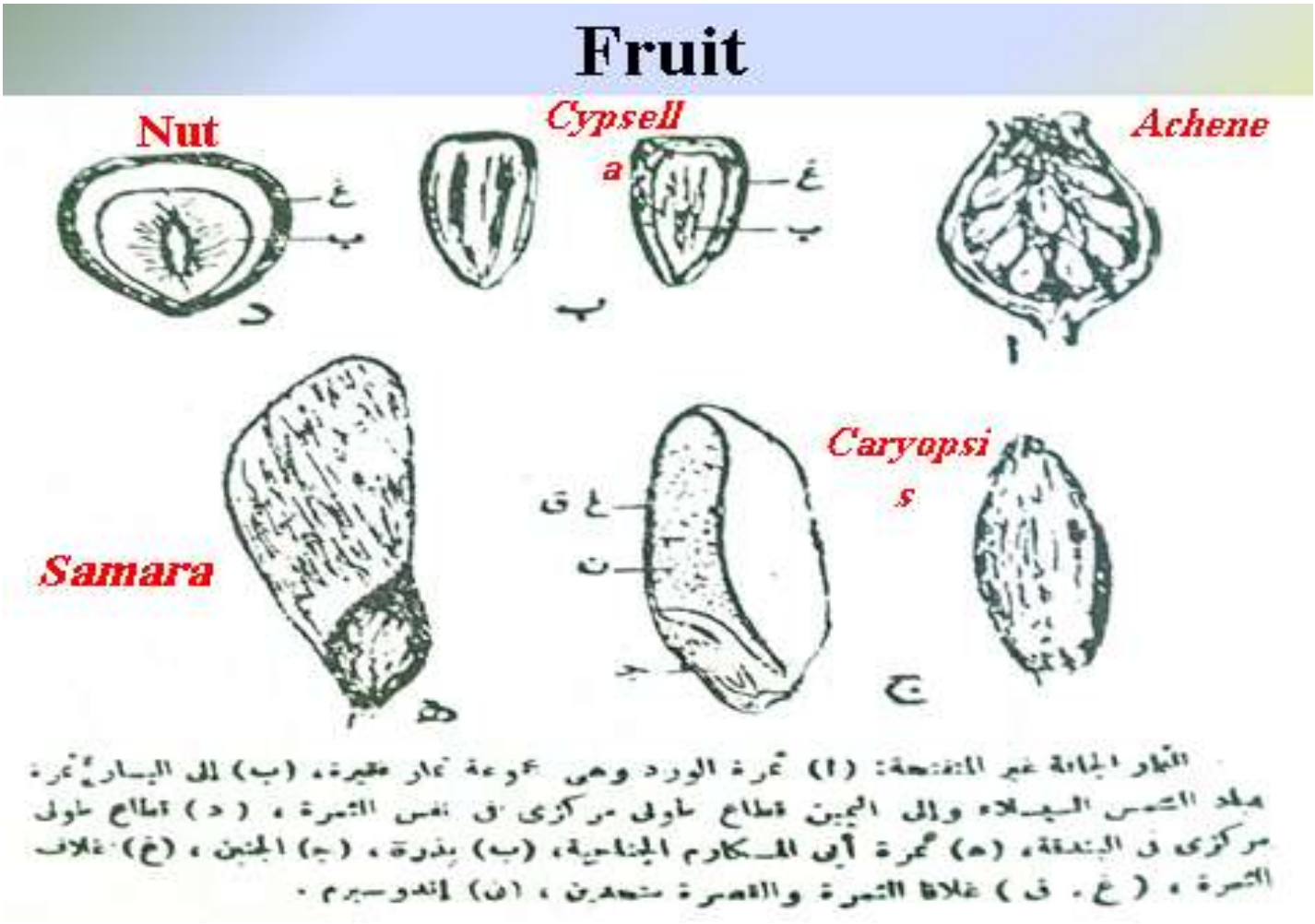
drupe e.g. apricot



Simple Dry Fruits

I. Indehiscent Fruits:

1. **Achene: Produced from a *superior ovary*, usually one-seeded, pericarp leathery not fused with Testa *i.e. Rosa*.**
2. **Caryopsis: It is similar to *achene*, but differs in having the *Pericarp* fused with the seed Testa , all grains *i.e.* grasses**
3. **Samara: It is similar to *achene*, but the *Pericarp* extends into a *wing i.e. Macharium tipa***
4. **Cypsela: Produced from an *inferior ovary*, *Pericarp* is leathery not fused with the Testa *i.e. Helianthus***
5. **Nut: It is formed of an ovary, *Pericarp* is *woody* or *leathery i.e. Corylus.***



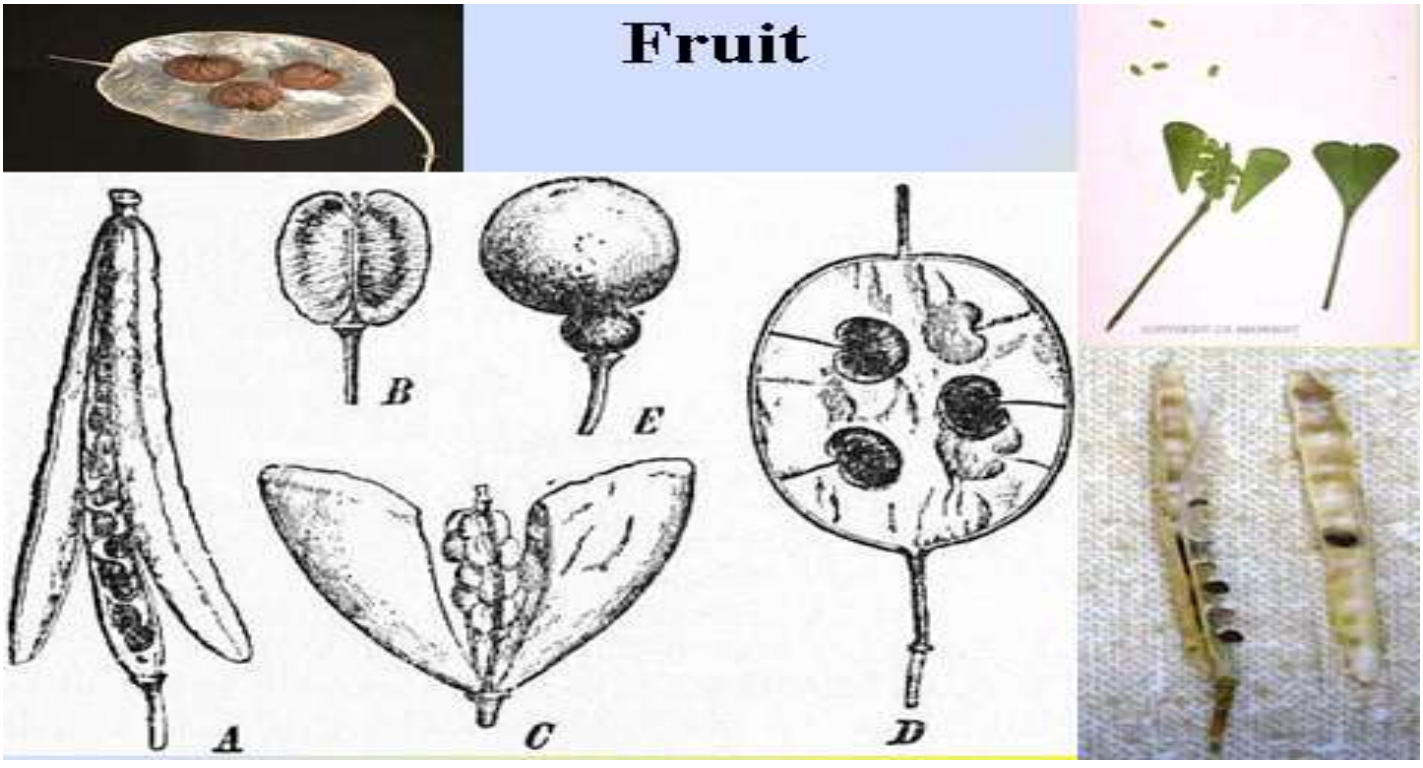
الثمار الجافة غير المتفتحة: (أ) ثمرة الورد وهي مجموعة ثمار صغيرة، (ب) إلى اليسار ثمرة عباد الشمس السيلاء وإلى اليمين قطاع طولى مركزى فى نفس الثمرة ، (د) قطاع طولى مركزى فى البندقة، (هـ) ثمرة أبى المكارم الجناحية، (ب) بذرة ، (ج) الجنين ، (غ) غلاف الثمرة ، (غ . ق) غلاف الثمرة والقصرة متحدين ، (ن) إندوسبرم .

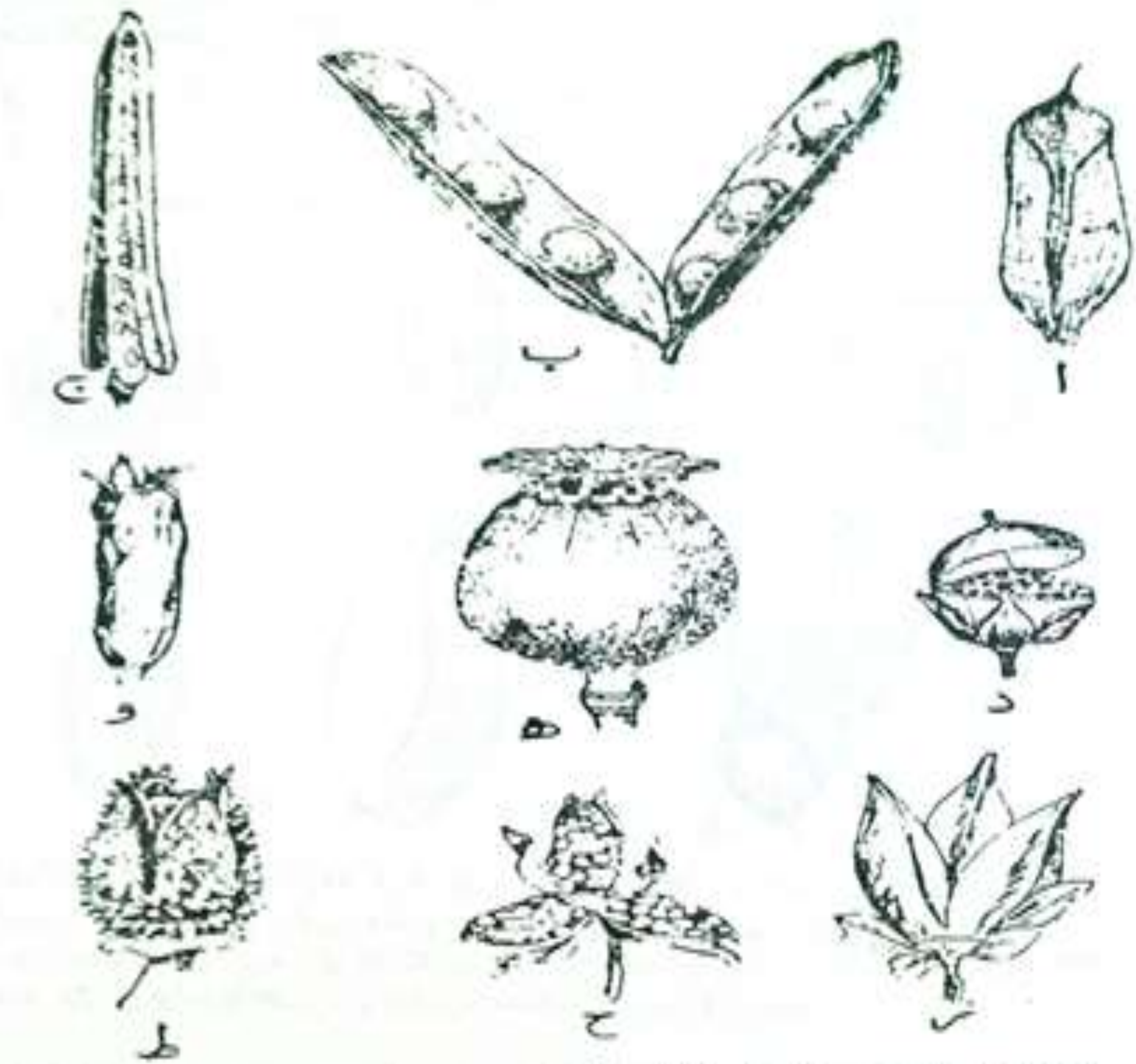
II. <u>Dehiscent Fruits</u>:

1. **Follicle: The fruit is composed of a single carpel that opens along <u>a single ventral suture</u>.**
2. **Legume: The fruit is composed of a single carpel (one to many seeded) and dehiscens along the <u>ventral and dorsal sutures</u>. The dehiscence starts at the top of the fruit and proceeds downwards leading to the formation of valves which becomes twisted to release the seeds by force. *i.e. Lathyrus* and *Vicia* fruits**
3. **Siliqua: The fruit is composed of two carpels separated by a false septum. It is <u>usually long and narrow</u>, but <u>when it is short and flat</u> it is called "Silicula".**
4. **Capsule: The fruit is generally composed of more than one carpel. According to the way of dehiscence, they are divided to capsules opened by:**

- Lid (*Pyxis*) - Pore (*Porocidal*) - Teeth (*Denticidal*) - Valve: which is divided into:

1. ***Septicidal*: Splitting from the septa**
2. ***Loculicidal*: Splitting between the septa and into the locules**
3. ***Septifragal*: Splitting from both the septa and the locules.**



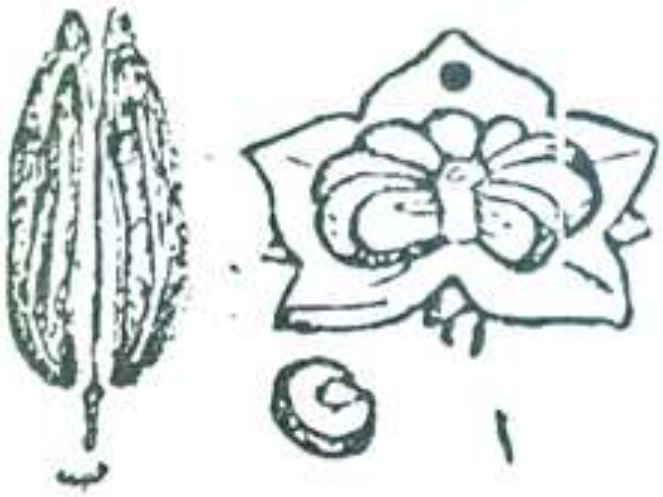


الثمار الجافة المتفتحة (أ) ثمرة العايق الجرابية ، (ب) ثمرة الفول القرنية ، (ج) ثمرة المنثور الخردلية ، (د) ثمرة عين القط ، وهي ثمرة تتفتح أفقيا على امتداد خط دائري ، (هـ) ثمرة الخشخاش وهي علبة تتفتح بالثقوب ، (و) ثمرة القرنفل وهي علبة تتفتح بالأسنان (ز) ثمرة القطن وهي علبة انفتاحها مسكني ، (ح) ثمرة البنفسج ، وهي علبة انفتاحها حاجزي ، (ط) ثمرة الداتورة وهي علبة انفتاحها صمامي.

Simple Dry *Schizocarpic* fruits

- ***Schizocarpic* (Split) Fruits:** It is composed of more than one carpel fused together in the early stages, but when ripe it splits into an indehiscent dry parts (*Mericarps*) usually one-seeded. *i.e. Coriandrum*

(شكل ٢٨٨)



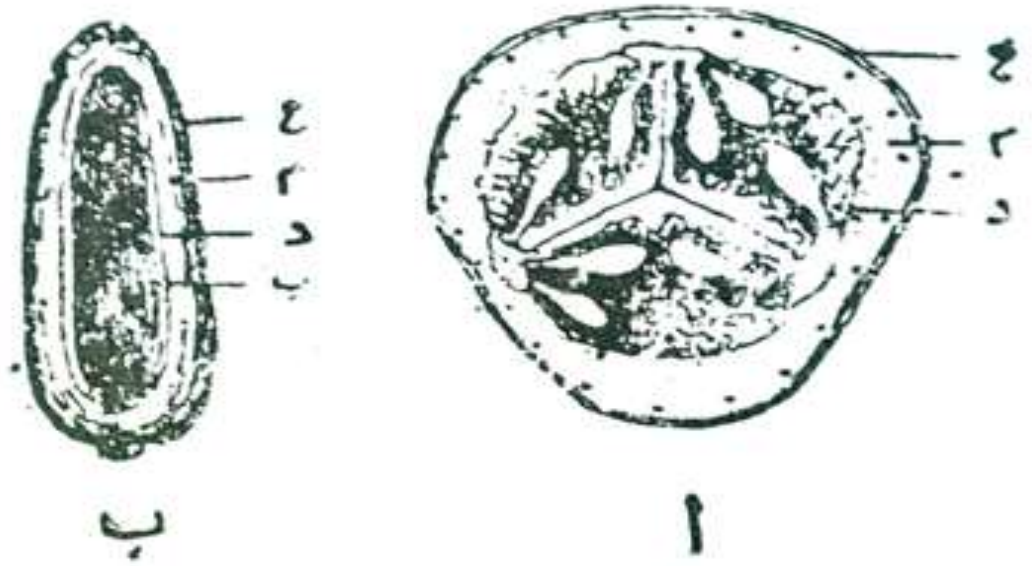
الثمار المشقة (أ) ثمرة الحلبة وبأسفلها ثمرة جرثيلة ، (ب) ثمرة البقدونس

Simple Succulent Fruits

- **Succulent Fruits are classified into:**

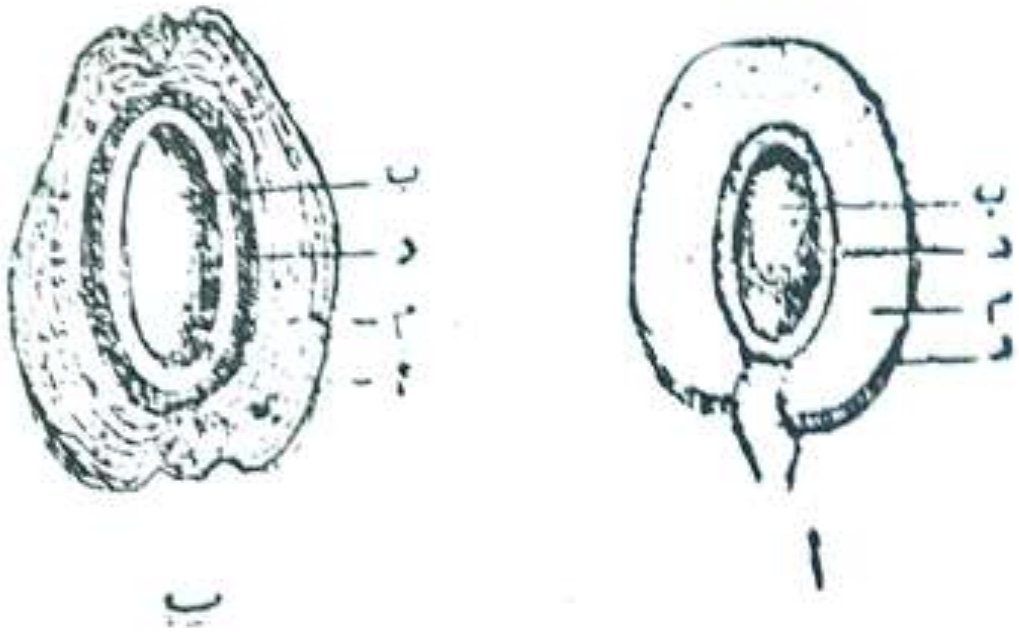
1. **Berry: Fleshy fruits with one or more seeds. The *Epicarp* may be hard, firm or leather, while the *Meso-* and *Endocarp* are soft and maybe separated or homogenous. *i.e.* Tomato and Orange**
2. **Drupe : Fleshy fruits in which the *Endocarp* is woody. *i.e.* Apricot and Olives**
3. **Pome : Fleshy fruits in which the *Epicarp* is soft and the center contains a papery cartilaginous structure enclosing the seeds. The receptacle is fleshy concave while the ovary inferior (False fruit) *i.e.* Apples, Pears and Figs**

(شكل ٢٩٠)



الثمار الطرية طبيعية ، ويرى إلى اليمين المماع مستعرض فى ثمرة للخيار وإلى اليسار
ع طولى فى ثمرة البلح . (ب) بذرة ، (خ) الطبقة الخارجية من الغلاف الثمرى ،
الطبقة الداخلية منه ، (م) الطبقة الوسطى .

(شكل ٢٨٩)



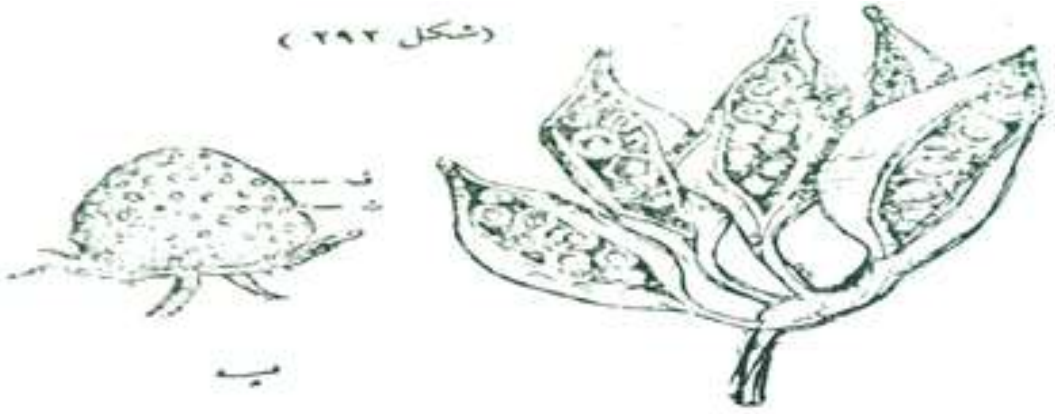
ا ب

اثمار الطرية المحلية : (ا) قطاع طولى فى ثمرة المشمش ، (ب) قطاع طولى فى ثمرة الدوم . (ب) بذرة ، (خ) الطبقة الخارجية من الغلاف الثمرى (د) الطبقة الداخلية من ذلك الغلاف ، (م) الطبقة الوسطى.

Aggregate Fruits

- **Aggregate Fruits are classified into:**

1. **Aggregate of Follicles: The fruit is composed of a number of follicles grouped together and produced by a single flower. Each follicle represents a mature carpel.**
2. **Aggregate of Achenes: The fruit is composed of a number of achenes inserted on a fleshy receptacle *i.e.* Figs, Strawberry.**

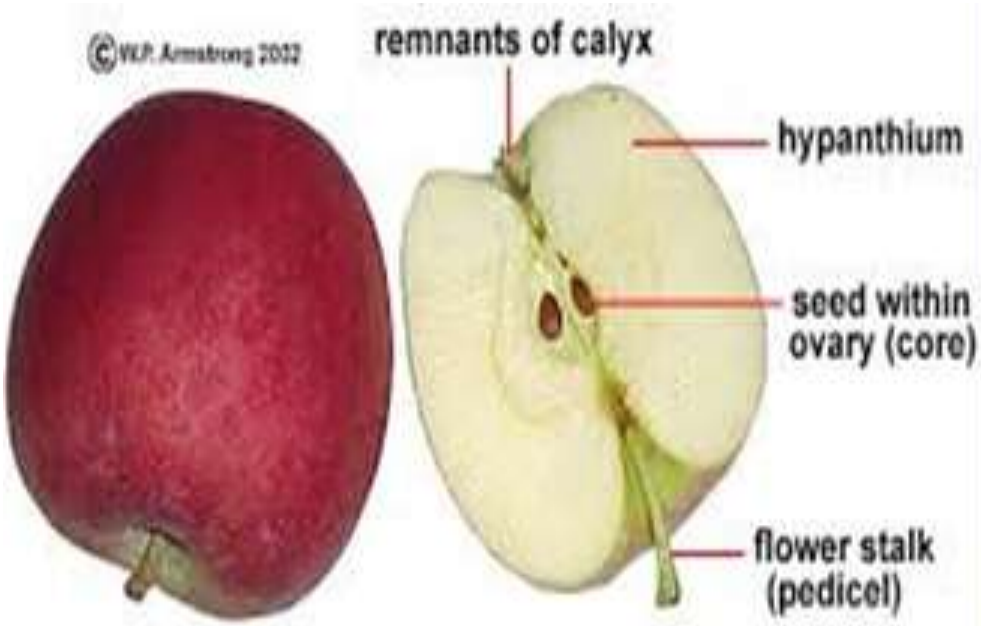


(شكل ٢٩٢)

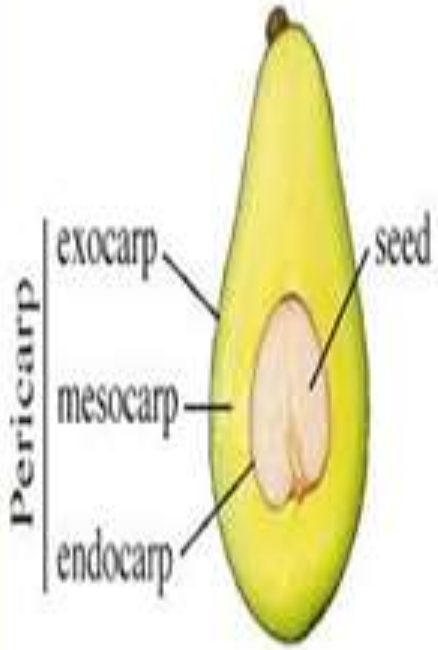
الثمار المجتمعة : (أ) ثمرة يوجرة العقربت وفيها الوحدات جرابية ، (ب) ثمرة الشقلك وفيها الوحدات فقيرة (ث) الأنف ، (ب) ثمرة مفردة .

(شكل ٢٩٣)

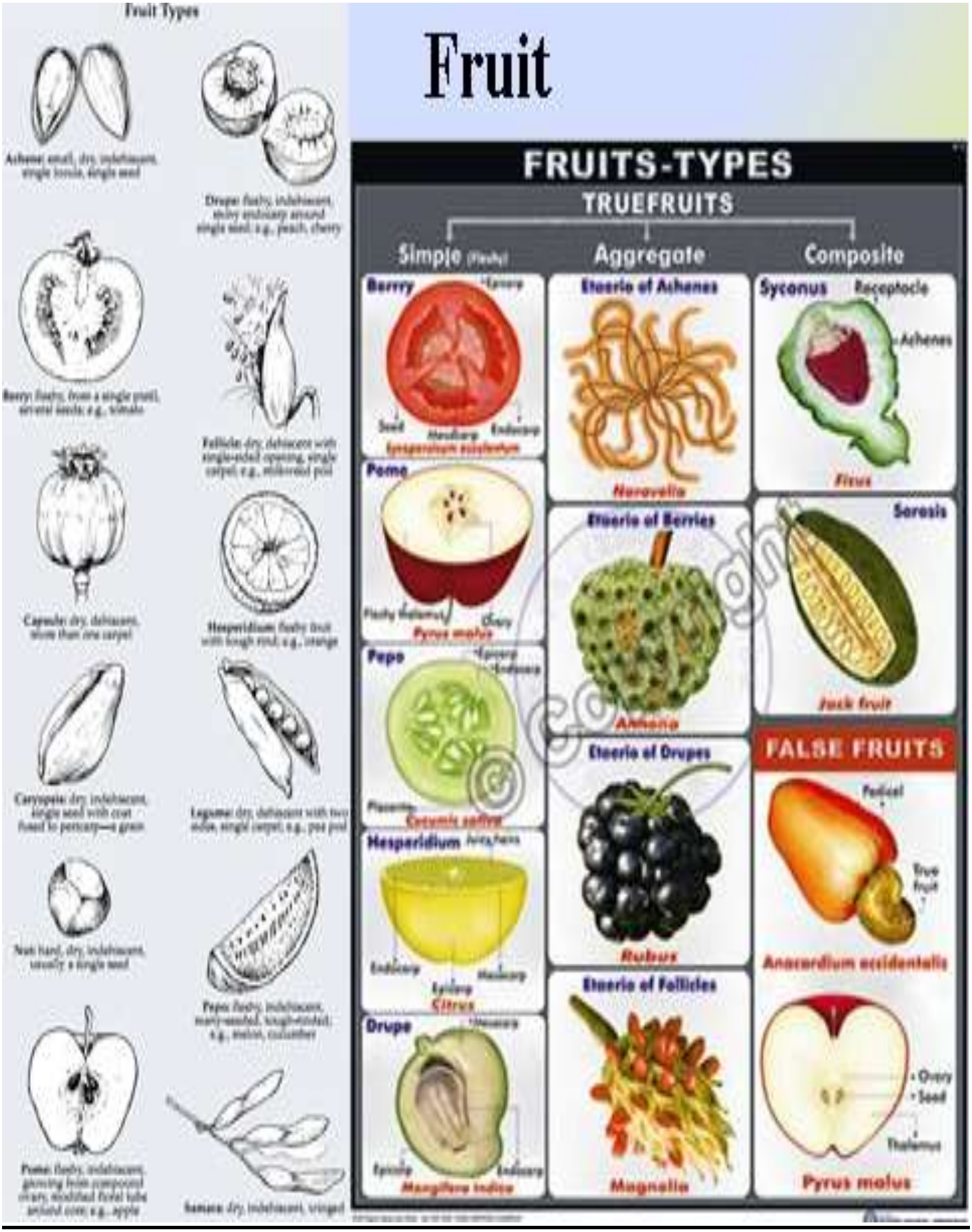
الثمار المركبة : (أ) قطاع طولى فى ثمرة التين البرشومى ، (ب) سنكارب ثمرة التوت .



Pome (ovary surrounded by fleshy hypanthium)
e.g. apple (*Malus domestica* cv. 'gala')



Types of Fruit


Fruit Types
Fruit
FRUITS-TYPES
TRUEFRUITS
Simple
Aggregate
Composite
Berry
Pome
Pepo
Hesperidium
Drupe
Etaerio of Achenes
Etaerio of Berries
Etaerio of Drupes
Etaerio of Follicles
Syconus
Receptocle
Achenes
Sorosis
FALSE FRUITS
Anacardium occidentalis
Pyrus malus
Mangifera indica
Magnolia
Rubus
Citrus

REFERENCES

1. **Khalil *et al.* (1975). General botany. Cairo Univ. Press.**
2. **Sinnott andWilson (1983). Botany Principles and Problems Mc Graw-Hill Company 6th edition.**
3. **Eskarous *et al.*(1987). Practical Botany. Cairo Univ. Press.**
4. **Megahed *et al.*(1996). General Botany. Anglo Press. 7th edition.**
5. **Afiffy *et al.* (2004). General Botany. Dar El Fikr El Araby Pub.**
6. **Kamel *et al.* (2005). Basics of Plant Sciences. Dar El Fikr El Araby Pub. 2nd edition.**
7. **Plant Atlas (2010).**

GRADING

1. **Student activities & attendance (5 marks): 2 lab notebook+2quiz+1attendance**
2. **Practical exam: 10 marks**
3. **Final written exam: 60 marks**

TEACHING HOURS

1. **Lectures: 2 hours**
2. **Lab: 2 hours**