FRUITS;

Fruits are the mature ovaries or pistils of flowering plants plus any associated accessory parts. **Accessory parts** are organs attached to a fruit but not derived directly from the ovary or ovaries, including the bracts, axes *Ficus*, receptacle *Malus domestica*, compound receptacle (in multiple fruits *Fragaria chiloensis* and *Ananas*, or perianth(calyx in *Punica*, and corolla in *Cucurbita moschata*. The term **pericarp** (rind, in the vernacular) is used for the fruit wall, derived from the mature ovary wall. The pericarp is sometimes divisible into layers: endocarp, mesocarp, and exocarp.

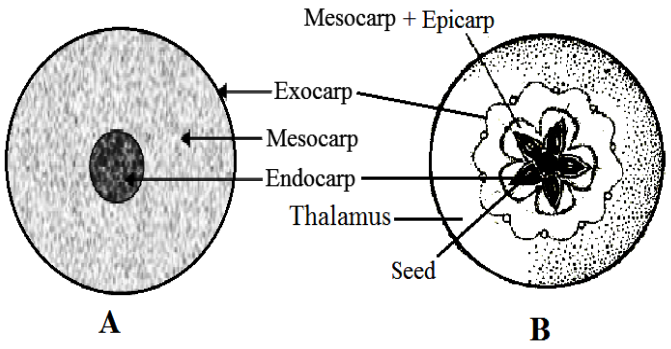
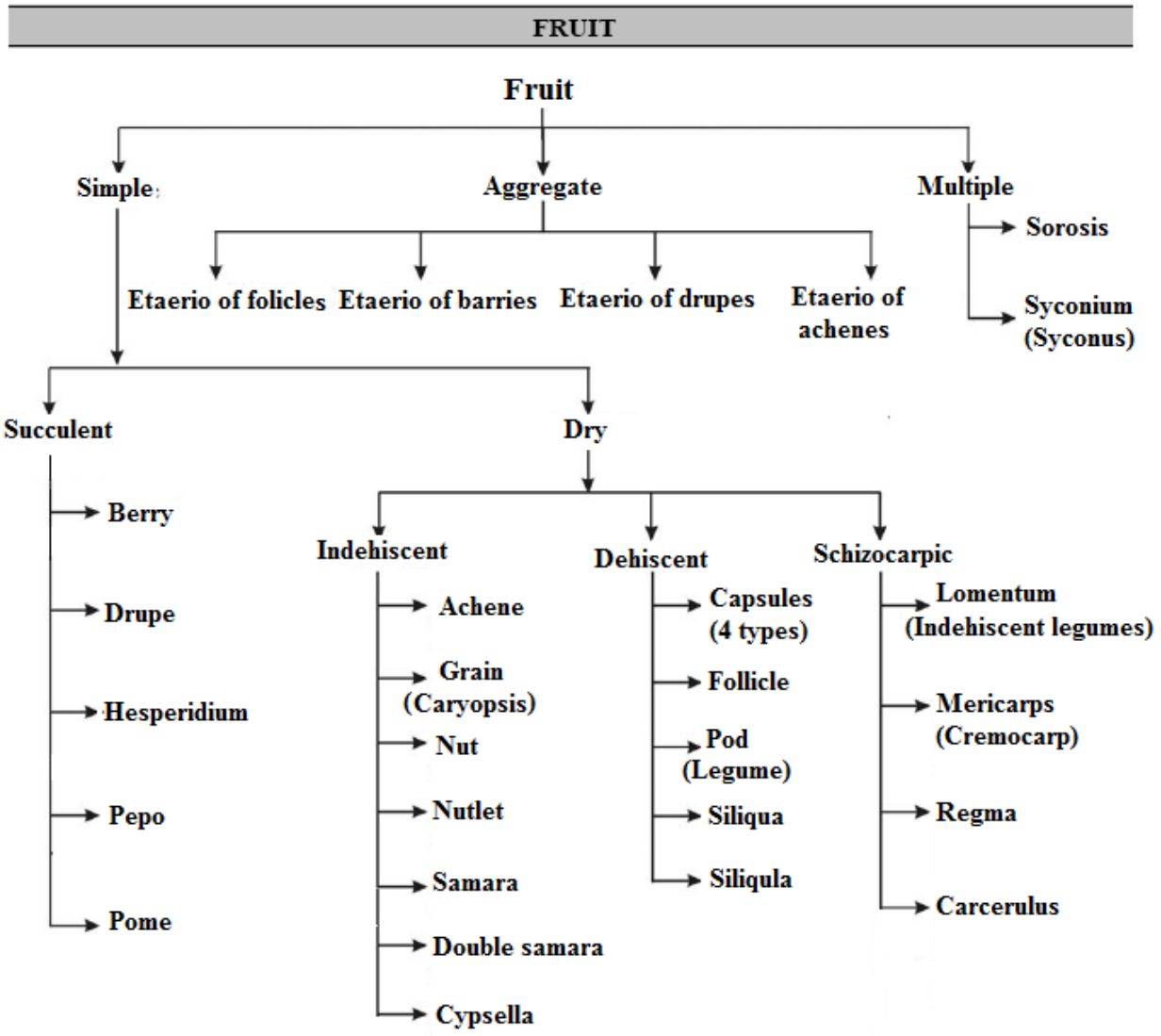


Figure 1.58: Diagram of fruit structures A- pericarp layers, B- fruit with accessory part (thalamus or fleshy receptacle)

Fruit types; are based first on fruit development. The three major fruit developments are:

1. **Simple fruits,** (derived from a single pistil of one flower).
2. **Aggregate fruits** (derived from multiple pistils of a single flower, thus having an apocarpous gynoecium).
3. **Multiple fruits** (derived from many coalescent flowers; see later discussion). In aggregate or multiple fruits, the component derived from an individual pistil is called a **unit fruit**.



1- Simple fruit types:

The simple fruit type, as well as unit fruit types of aggregate and multiple fruits, are classified based on a number of criteria, including:

1'- Fleshy (succulent) simple fruits:

A. **Berry;** is the general, unspecialized term for a fruit with a succulent pericarp, as in *Vitis*, *Phoenix* and *Lycopersicon*.

B. **Drupe;** is a fruit with a hard, stony endocarp and a fleshy mesocarp, as in *Prunus amygdalus*, *P. percicu*, *P. armenica*, *Juglans* spp. *Olea europaeus*, etc.

C. **Hesperidium;** is a septate fleshy fruit with a thick skinned, leathery outer pericarp wall and fleshy modified trichomes (juice sacs) arising from the inner walls, as in *Citrus* spp. (orange, lemon, grapefruit, etc.).

D. **Pepo;** is a nonseptate fleshy fruit with parietal placentation and a leathery exocarp derived from an inferior ovary, the fruit type of the Cucurbitaceae (*Benincasa hispida* and *Cucurbita maxima*).

E. **Pome;** is a fleshy fruit with a cartilaginous endocarp derived from an inferior ovary, with the bulk of the fleshy tissue derived from the outer, adnate hypanthial tissue, as in *Malus* and *Pyrus*

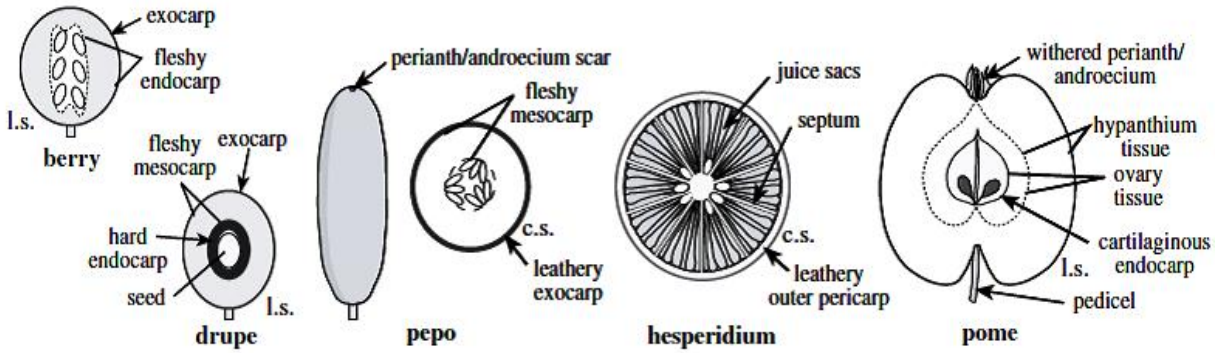


FIGURE 9.42 Fruits: simple, eshy fruit types. (c.s. = cross-section; l.s. = longitudinal section)

1"- **Simple dry at maturity**;

I. Indehiscent (not splitting open at maturity);

A. Achene is a one-seeded, dry, indehiscent fruit with seed attached to the pericarp at one point only, such as the unit fruits of sunflowers.

B. Grain or **caryopsis** is a one-seeded, dry, indehiscent fruit with the seed coat adnate to pericarp wall; grains are the fruit type of all Poaceae (grasses).

C. Nut is a one-seeded, dry indehiscent fruit with a hard pericarp, usually derived from a one-loculed ovary, as in *Quercus* sp., *Corylus* sp.

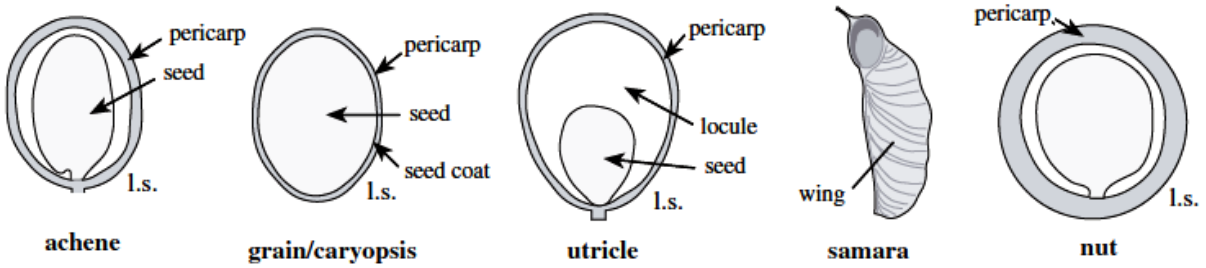
D. Nutlet is a small nutlike fruit; for example, the mericarps of the Boraginaceae and Lamiaceae are termed nutlets.

E. Samara is a winged, dry, usually indehiscent fruit, as in *Isatis*.

F. Double samara, the fruit develops from bicarpellary, syncarpous, pericarp develops into two wings, as in *Acer*.

G. Cypsella, the fruit develops from bicarpellary. Syncarpous, inferior ovary with basal placentation. Fruits are unilocular and single seeded. Persistent hairy calyx (pappus) is found at the apex of fruit, as in fruits of Compositae members (e.g. *Erigeron* sp., *Taraxacum officinale*, *Tragopogon* sp. and *Onopordum*).

H. Lomentum or **indehiscent legumes,** the fruit develops from monocarpellary, unilocular. It's a modification of legume. These are bisutural fruits which are constricted or divided into one seeded mericarps, as in *Mimosa Prosopis* sp., and *Tamarindus* etc.



Fruits: simple, dry, and indehiscent fruit types. (l.s. = longitudinal section)

II. Dehiscent (splitting open along definite pores, slits, or sutures);

Dehiscent, i.e., will open with force (by various mechanisms), functioning to eject the seeds.

A. Capsules are generally dry (rarely fleshy), dehiscent fruits derived from compound (multicarpeled) ovaries. Four types of capsules can be recognized based on the type or location of dehiscence.

i. **Loculicidal capsules** have longitudinal lines of dehiscence radially aligned with the locules (or between the placentae, if septa are absent), as in *Hibiscus esculentus*.

ii. **Septicidal capsules** have longitudinal lines of dehiscence radially aligned with the ovary septa (or with the placentae, if septa are absent). Both loculicidal and septicidal capsules split into **valves**, a portion of the pericarp wall that splits off, but does not enclose the seed(s); valves may remain attached to the fruit or may fall off, depending on the taxon, as in *Linum*.

iii. **Circumscissile capsules** (also called a **pyxis** or **pyxide**) has a transverse (as opposed to longitudinal) line of dehiscence, typically forming a terminal lid or operculum, as in *Plantago* and *Hyoscyamus*.

iv. **Poricidal capsules** have dehiscence occurring by means of pores, as in *Papaver*, (POPPOY-**E**).

B. Follicle is a dry, dehiscent fruit derived from one carpel that splits along one suture, such as in the unit fruits of *Delphinium*.

C. Pod or **Legume** is a dry, dehiscent fruit derived from one carpel that splits along two longitudinal sutures; legumes are the diagnostic fruit type of the Fabaceae, the legume family, e.g.*Vicia faba*.

D. Silicles and **siliques** are dry, dehiscent fruits derived from a two-carpeled ovary that dehisces along two sutures:

i. **Siliqua** is about as broad or broader than long, e.g. *Sinapis arvensis*.

ii. **Siliqula** is longer than broad; both are characteristic fruit types of the Brassicaceae, e.g. *Capsella bursa pastoris*.

E. Schizocarp is a dry, dehiscent fruit type derived from a two or more loculed compound ovary in which the locules separate at maturity.

i. **Schizocarp of mericarps (cremocarp),** is one in which the carpels of a single ovary split during fruit maturation, each carpel developing into a unit mericarp, as in the Apiaceae. **Mericarps** are portions of the fruit that separate from the ovary as a distinct unit completely enclosing the seed(s); in the Apiaceae the two mericarps are typically attached to one another via a stalk-like structure called the carpophore.

ii. **Regma,** the fruit develops from tricarpellary (multicarpellary), syncarpous. The fruit is multilocular, on maturation, after splitting, these divided into as

many parts as the number of carpels, and has one seed, as in *Ricinus*, *Erodium* and *Geranium*.

iii. **Carcerulus,** the fruit develops from bi or polycarpellary, syncarpous, and is multilocular, number of locules may increase due to false septation, on maturation, single seeded mericarp splits away, as in *Althea*, *Ocimum* and *Malva*.

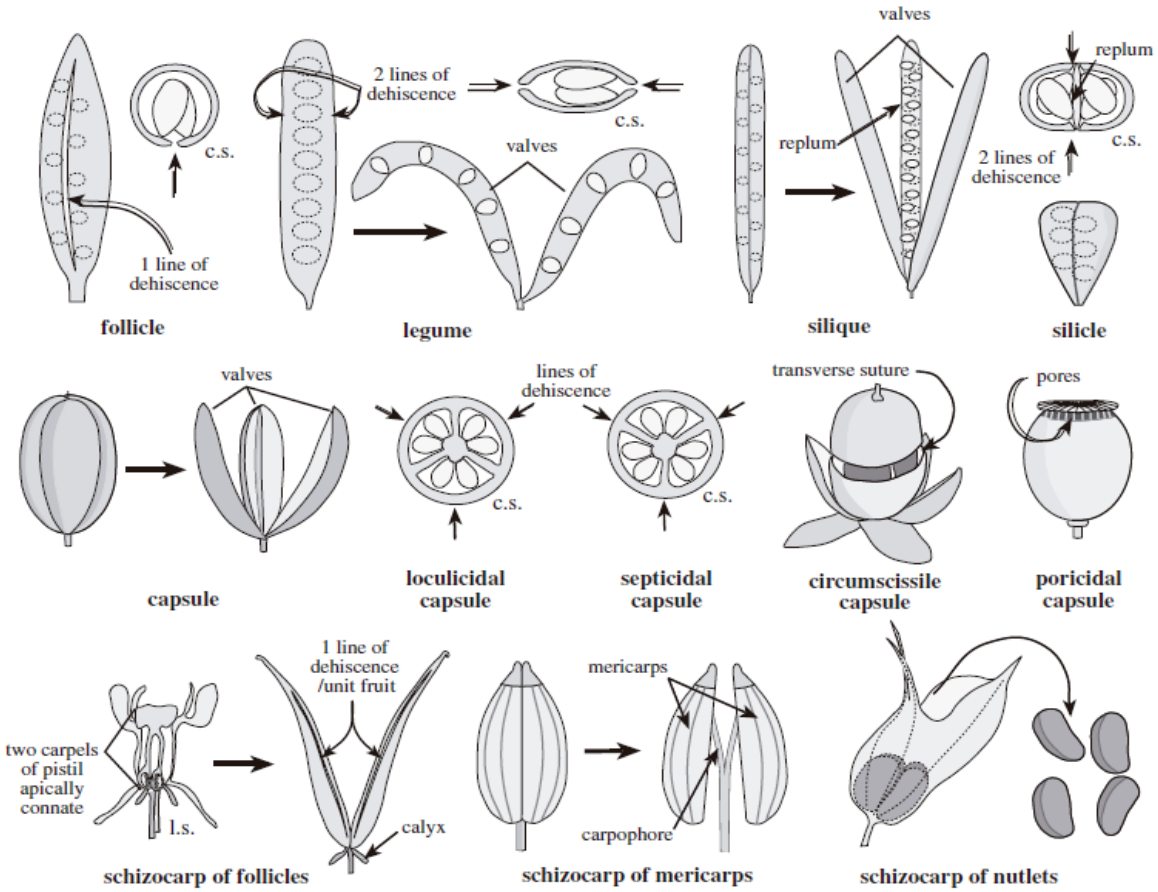


FIGURE 9.41 Fruits: simple, dry, and dehiscent fruit types. (c.s. = cross-section; l.s. = longitudinal section)

2. Aggregate fruit types :

An **aggregate fruit** is one derived from two or more pistils (ovaries) of one flower, as in Ranunculaceae and Rosaceae (e.g. *Rosa*, *Fragaria,* and *Rubus*).

3. Multiple fruit types:

A **multiple fruit** is one derived from two or more flowers that coalesce.

Some specialized multiple fruit types are as follows:

i. **Sorosis** is a multiple fruit in which the unit fruits are fleshy berries and are laterally fused along a central axis, as in *Ananas*, (pineapple) and *Morus*.

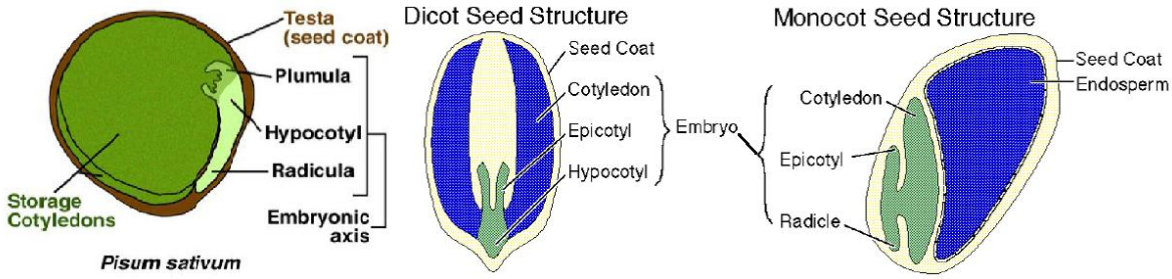
ii. **Syconium** is a multiple fruit in which the unit fruits are small achenes covering the surface of a fleshy, inverted compound receptacle (derived from a hypanthodium), as in *Ficus*.

SEEDS;

Aspects of seed morphology can be important systematic characters used in plant classification and identification.

Some valuable aspects of seed morphology are size and shape, as well as the color and surface features of the **seed coat** or **testa,** the outer protective covering of seed derivedfrom the integument(s). A seed coat that is fleshy at maturity may be termed a **sarcotesta** (although this may be confused with an *aril*, which is separate from the integuments; see later discussion). Also important are the shape, size, and color of the **hilum**, the scar of attachment of the funiculus on the seed coat, and of the **raphe**, a ridge on the seed coat formed from an adnate funiculus. Some seeds have an **aril** (adj. *arillate*), a fleshy outgrowth of the funiculus, raphe, or integuments (but separate from the integuments) that generally functions in animal seed dispersal. Arils may be characteristic of certain groups, such as the Sapindaceae. Similar to the aril is a **caruncle**, a fleshy outgrowth at the base of the seed;
caruncles also function in animal seed dispersal, such as the carunculate seeds of *Viola*, violets, with regard to seed dispersal by ants.

Specific details of the **embryo**, the immature sporophyte, can be studied. These include aspects of the **epicotyl** (the immature shoot), **radicle** (the immature root; not to be confused with a radical position; see later discussion), **hypocotyl** (the transition region between the root and epicotyl), and **cotyledon(s)** (the first leaf/leaves of the embryo, often functioning in storage of food reserves.



Seed endosperm type;

All angiosperms form endosperm, the food reserve tissue derived from fusion of sperm with the polar nuclei of the female gametophyte. The typical angiosperm seed is **albuminous** or **endospermous**, having endosperm as the food reserve in mature seeds. In some angiosperms endosperm develops, but very little to none is deposited in mature seeds, a feature termed **exalbuminous** or **nonendospermous**, as in *orchid* seeds. Finally, some flowering plants are **cotylespermous**, in which the main food reserve is stored in the cotyledons. Cotylespermous seeds are typical of beans and peas.

Seed germination type;

Seed germination type requires observation of young seedlings during germination and describes positioning of the cotyledons. **Hypogeous** [**cryptocotylar**] refers to a type in which the cotyledon(s) remain in the ground during germination.

Epigeous [**phanerocotylar**] has cotyledon(s) elevated above the ground during germination.

General terminology

Many plant morphological terms can apply to a number of different plant organs (or even to features of other types of organisms). These general terms are defined below.

1. Color

Color pattern is a measure of the distribution of colors on an object. Common color pattern terms are **maculate**, spotted, with small spots on a more or less uniform background; **pellucid**, having translucent spots or patches; and **variegated**, with two or more colors occurring in various irregular patterns, generally used for leaves.

2. Size

Of course, measuring the size of plant organs and parts is important in description and identification. Generally, size of parts refers to linear measurements, as in leaf length or corolla width. Metric units should be used throughout.

3. Shape

Shape terms may be used for stems, leaves, leaflets or other leaf parts, bracts, sepals, petals, stamens, pistils, trichomes, or other plant parts. Shape is an important feature in plant description and identification. The main seed shapes as follows:

a. **Globoid:** is spherical shaped, as in wild species of *Vicia* and *Hibiscus esculentus* seeds.
b. **Ovoids:** egg shaped, wide base with a gradually tapering to acute apex, as in *Salvia* and *Pyrus* seeds.
c. **Oblate:** one extended perpendicular to the point of attachment is **oblate**, as in many *Lathyrus* seeds.
d. **Ellipsoid:** Margins curved, widest at the midpoint, as in *Phoenix* seeds.
e. **Angular:** three-sided, length, as in *Phaseolus aureus* seeds.
f. **Reniform:** Kidney-shaped; wider than long with a rounded apex, as in *Phaseolus vulgaris* seeds.
g. **Lenticuler:** means lens-shaped, disk-shaped with two convex sides, as in *Lens esculenta* seeds.
h. **Discoid:** is disk-shaped, as in many *Medicago* species and *Malva* seeds.
i. **Clavate:** means club-shaped, cylindrical with a gradually tapering, thickened and rounded end.
j. **Capitate:** is head-shaped, spherical with a short basal stalk.

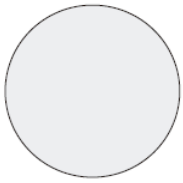
ovate

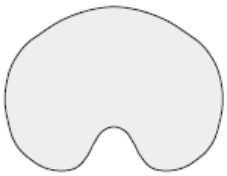
elliptic

Angular

oblate

discoid





reniform

lenticular

ENVIRONMENT and GEOGRAPHICAL DISTRIBUTION

Analysis of biogeographic data can give insight into the direction of change in biogeographic distribution. A change from one distribution to another can occur by dispersal. **Dispersal** is the movement of an organism or propagule from one region to another, such as the transport of a seed or fruit (by wind, water, or bird) from a continent to an island.

Analyses such as this may yield insight into the adaptive significance of evolutionary changes in anatomy, morphology, or physiology relative to differing habitat requirements. Finally, data management of natural collections has become invaluable in biodiversity studies. The data information system allows for the tabulation of presence, range, and distribution of taxa, especially important for studying rare or endangered species or sensitive habitats.

FLORAS

Herbaria are particularly essential important activities in plant systematics floristics treatments. **Floristics** is the documentation of all plant species in a given geographic region. Floristics may also entail documentation of plant communities and abiotic factors as well. Floristic studies may be published in taxonomic journals or may result in the publication of a **Flora** or **plant manual** of a given region, Floras such as: *Flora of Iraq, Flora of Turkey, Flora Iranica, Flora orientalis, Flora of Syria, Palestine and Sinai, Flora of USSR* and *Flora of North America*. Floristic studies are vital in the documentation of plant biodiversity. **Plant manual**s such as:

Flora of Iraq:

Flora of Iraq was first planned to extensive herbarium, and the resources of Iraqi library, and should be made freely available to those engaged on the project, and that members of the Kew staff should co-operate in the compilation of the taxonomic data to be included in the Flora.

The topography of Iraq:

The territory of the Republic of Iraq lies between (38º 42' E and 48º 23' E longitudes) and between (29º 27' N and 37º 23' N latitudes). The geographic position of Iraq in relation to the neighboring countries, it is located between West of the long Persian frontier, South of short Turkish frontier, East of long Syrian and short of Jordan frontiers, East and North of long Saudi Arabian frontier and North of short Kuwaiti frontier, at the Middle East Region of West of Asian continental.

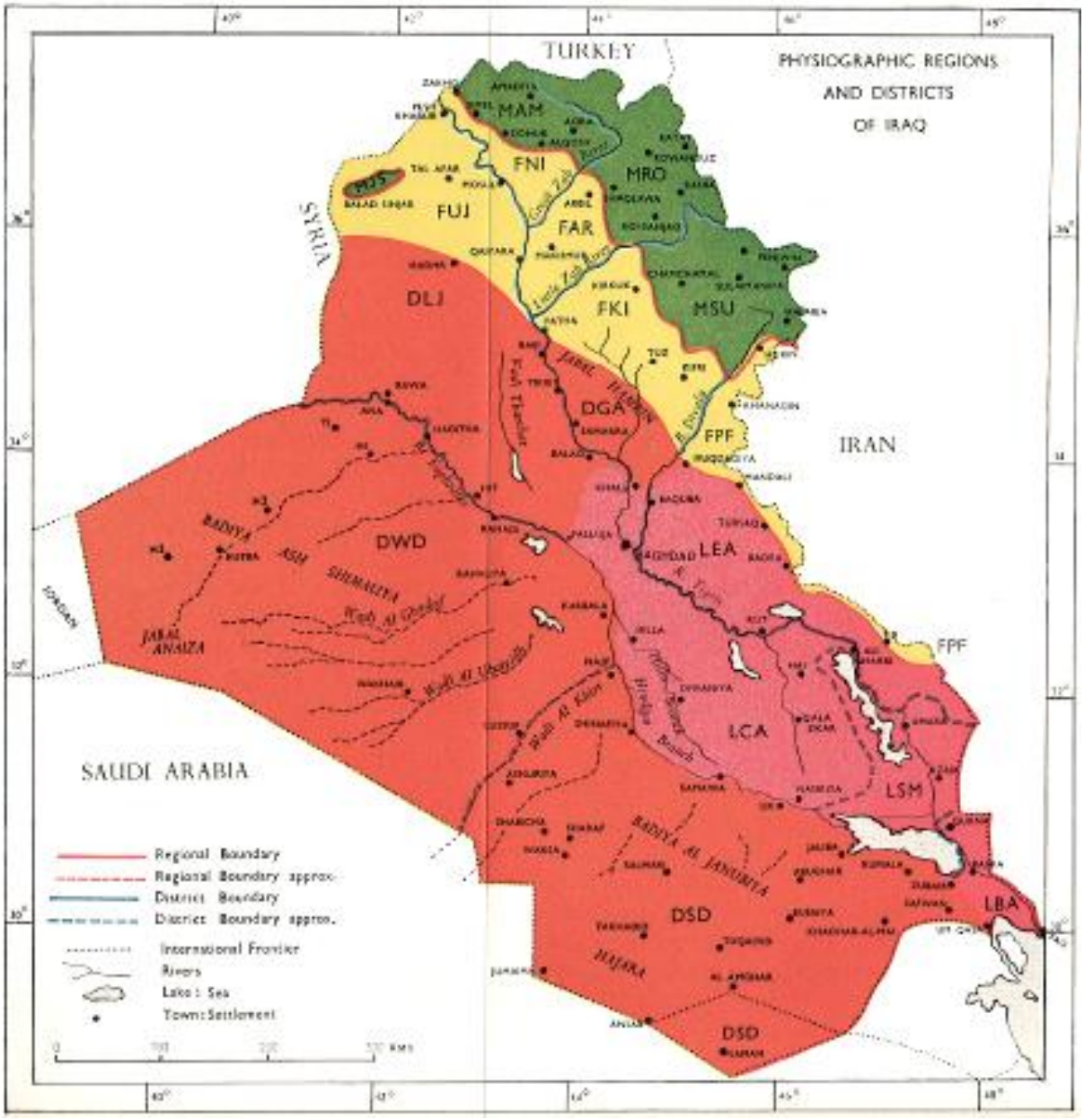
The Kurdistan Region includes four Kurdish nationalism governorates, located at the north of Iraqi federal, it is rich in vegetation diversity due to the widespread temperate climate in mountain and steppe regions, these conditions contribute to the distribution of most Iraqi vegetations in the Kurdistan region. In *Flora of Iraq*

Volume one, Evan Guest divided Iraq into four regions and seventeen physiographic districts according to the topography and prevailing climate in the regions. The Kurdistan region shared two of them, the M (Mountain) and F (Upper Plains and Foothills regions).

Regions:

The primary division of our territory is into four main regions, designated by initial symbols M, F, D, and L respectively and delimited as follows:

1. M- Mountain region, this contours irregularly through the margin of the mountains, which comprises the main mountain mass of Iraqi Kurdistan. This region is sub-divided according to physiographic features into four districts as follows:
   i. MAM = Amadya District
   ii. MRO = Rowanduz District
   iii. MSU = Sulaimaniya District
   iv. MJS = Jabal Sinjar District
2. F- Upper Plains and Foothills Region, the steppic sub-mountain and the margin of the lower plain at the foot of the Jabal Hamrin, This region is sub-divided according to physiographic features into five districts as follows:
   i. FUJ = Upper Jazira District
   ii. FNI = Nineveh District
   iii. FAR = Arbil District
   iv. FKI = Kirkuk District
   v. FPF = Persian foothills District
3. D = Desert Plateau Region, bounded to the north and north-west by the lower boundary of Upper Plains and Foothills Region and to the east and south-east by the right bank of the river Euphrates. This region is sub-divided according to physiographic features into four districts as follows:
   i. DLJ = Lower Jazira District
   ii. DGA = Ghurfa Adhaim District
   iii. DWD = Western Desert District
   iv. DSD = Southern Desert District
4. L = Lower Mesopotamian Region, the great alluvial plain comprising the remainder of the territory of Iraq as follows:
   i. LEA = Eastern Alluvial Plain District
   ii. LCA = Central Alluvial Plain District
   iii. LSM = Southern Marsh District
   iv. LBA = Basra Estuarine District.



M = Mountain Region

MAM = Amadya District
MRO = Rowanduz District
MSU = Sulaimaniya District
MJS = Jabal Sinjar District

F = Upper Plains and Foothills Region

FUJ = Upper Jazira District
FNI = Nineveh District
FAR = Arbil District
FKI = Kirkuk District
FPF = Persian foothills District

D = Desert Plateau Region

DLJ = Lower Jazira District
DGA = Ghurfa Adhaim District
DWD = Western Desert District
DSD = Southern Desert District

L = Lower Mesopotamian Region

LEA = Eastern Alluvial Plain District
LCA = Central Alluvial Plain District
LSM = Southern Marsh District
LBA = Basra Estuarine District

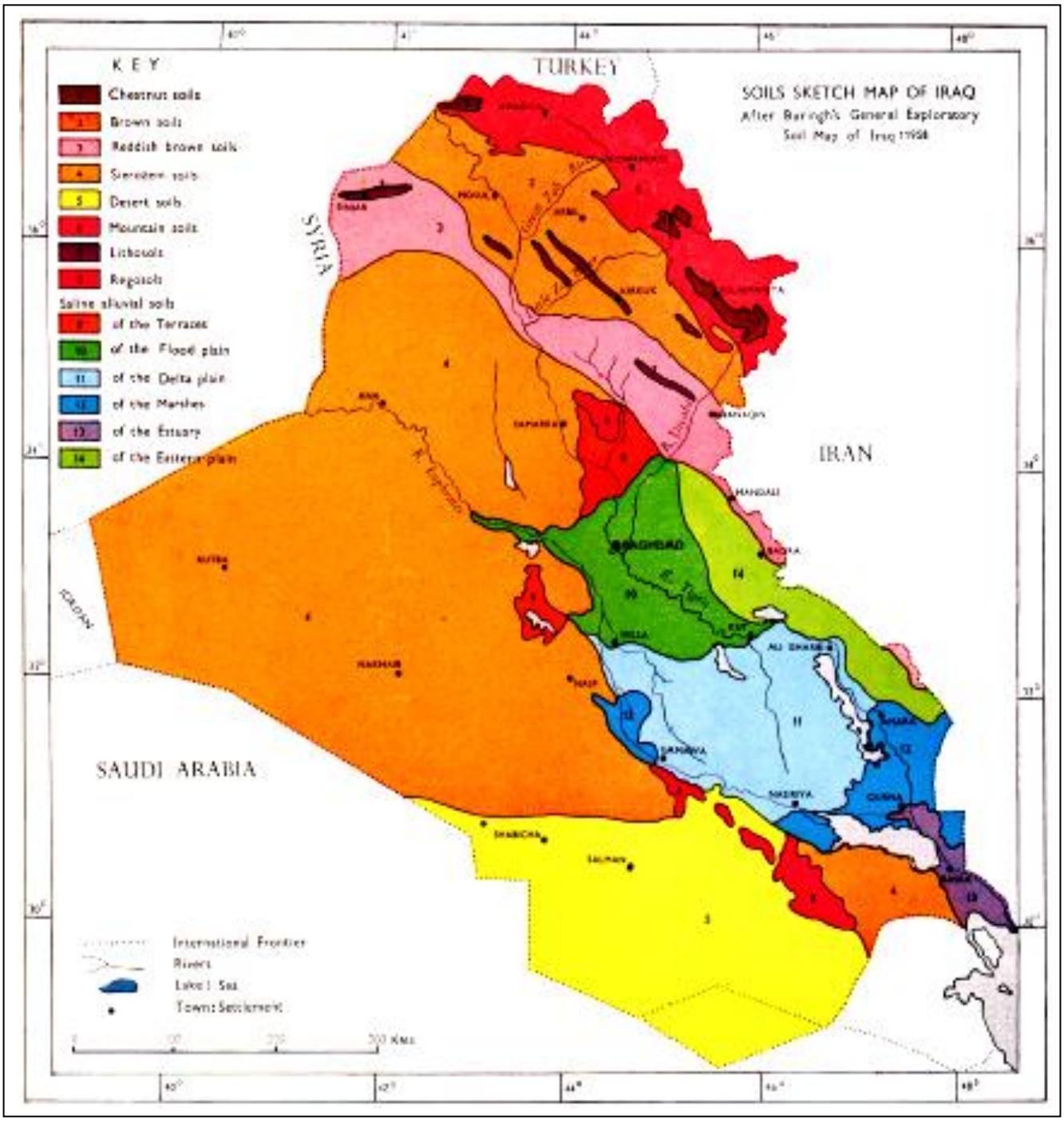
SOILS IN IRAQ

Dr. Buringh divided the forty types of soil distinguished in his book (Soil and Soil Conditions in Iraq) in more detailed map into fourteen major soil groups corresponding with the main processes of soil formation, these being generally related to the differences in climate and vegetation in different parts of Iraq as:

1. **Chestnut Soils.** A group of soils with a dark-brown friable surface, usually containing 1-4% organic matter and rainfall between 400-800mm.
2. **Brown Soils.** A group of soils with a brown surface may contain 1-2% of organic matter and rainfall between 300-500mm.
3. **Reddish-Brown Soils**. A group of soils with a lighter or darker reddish-brown surface layer grading into a red or reddish heavier sub-soil. These soils occur in areas with a very hot and dry summer climate and a winter rainfall of 200-400mm. Biological activity and chemical weathering are low.
4. **Sierozem Soils** (Grey Desert Soils). A group of soils with a grey or palish-grey calcareous surface which is very low in organic matter. These soils occur in areas with a very hot and dry summer climate and a winter rainfall of 150-200mm. Biological activity and chemical weathering are low.
5. **Desert Soils.** A group of light brownish soils with a very low organic matter. These soils occur in areas with a very hot and dry summer climate and very low winter rainfall, usually 750-100mm. or less.
6. **Mountain Soils.** The processes of soil formation vary in different places mainly as the result of differences in topography, elevation, slope and exposure. Most of these soils are truncated Chestnut Soils, very dark-brown to almost black granular surface layer, usually with a content of 4-8%organic matter. These soils occur where the winter is cold and the rainfall relatively high upwards of 800mm.
7. **Lithosols.** A group of soils consisting of a very thin surface layer overlying stony material, mostly limestone or gypsum.
8. **Regosols.** A group of soils consisting of loos, dry parent material of unconsolidated sediments, generally sand dunes.

Alluvial Soils of Iraq. Almost all soils in central and southern Iraq are more or less saline. Buringh is divided it into six sub-division based principally on soil morphology in relation to sedimentation and hydrology as follow:

9. **Saline Alluvial Soils of Terraces.**
10. **Saline Alluvial Soils of Flood Plain.**
11. **Saline Alluvial Soils of the Delta Plain.**
12. **Saline Alluvial Soils of the Marshes.**
13. **Saline Alluvial Soils of the Estuary.**
14. **Saline Alluvial Soils of the Eastern Plain.**


SOILS SKETCH MAP OF IRAQ
After Buringh's General Exploratory Soil Map of Iraq 1958
KEY
Chestnut soils
Brown soils
Reddish brown soils
Sierozem soils
Desert soils
Mountain soils
Lithosols
Regosols
Saline alluvial soils
of the Terraces
of the Flood plain
of the Delta plain
of the Marshes
of the Estuary
of the Eastern plain
TURKEY
SYRIA
IRAN
SAUDI ARABIA
KUWAIT
BAGHDAD
International Frontier
Rivers
Lake / Sea
Town / Settlement

VEGETATION STRUCTURE IN IRAQ

Vegetation: includes all plants of an area. All plants growing in terrestrial as well as aquatic ecosystems are considered in this.

Frequency: gives the idea of degree dispersion of individual in an area and is expressed in term of percentage occurrence.

Density: represents numerical strength of a species in the community and gives an idea of the number of individuals per unit area.

Xerophyte: Plants that have adapted to life in dry places are called xerophytes. The living baseball plant (*Euphorbia obesa*) is a xerophyte. It has deep roots that search out moisture, and fleshy stems that store water and keep the plant alive in a drought. Many xerophytes lack leaves-their stems collect the sunlight that they need to grow.

Halophyte: Sea heather (*Limonium carolinianum*) is a widespread halophyte, or salt-tolerant plant. It grows close to the sea and can survive being soaked by salty spray. Halophytes also grow inland-for example in salt marshes or next to salt lakes. Road verges are another halophyte habitat, because there is a buildup of salt that has been used to thaw ice.

Hydrophyte: Plants that live in water, such as water lily (*Nymphaea* sp.) are called hydrophytes. Plants are very common in fresh water, such as ponds and rivers. Some root on the bottom, while others float in the water or on the surface. Far fewer plants live in sea water. Instead, the oceans are home to plantlike seaweeds and other algae.

Segetal and Ruderal Vegetation:

A. **Segetal plants.** Common weeds are growing in fields of crops, the spring and early summer weeds of the cultivated steppe, sub-mountain plains, orchards and mountain regions of Dohuk, Erbil, Sulaimaniya, and Kirkuk from a brave and colorful show-serious as their effect on reduction of crop yields. Among the many bulbous plants such as; *Gladiolus segetum, Muscaria longipes, Ixiolirion tataricum* and *Allium* sp. Among the other conspicuous weeds as; *Salvia spinosa, Hyoscyamus reticulatus*, and *Anchusa azurea*.

B. **Ruderal plants.** Ruderal plants are growing on waste places or rubbish heaps, such as most wild plants are growing naturally in steppes and mountains as; *Gundelia*, *Veronica* sp., *Eryngium* sp., *Vitex agnus-castus*, and *Asphodellus microcarpa*.

The latitude & altitude effects on vegetation:

A. **Latitude:** Soil temperature is the result of heat gained by the absorption of solar heat energy, and soil temperatures are greatly influenced by the latitude (distance from the equator) of the particular place. Obviously, the temperature values are maximum at the equator, decreasing gradually towards the poles.

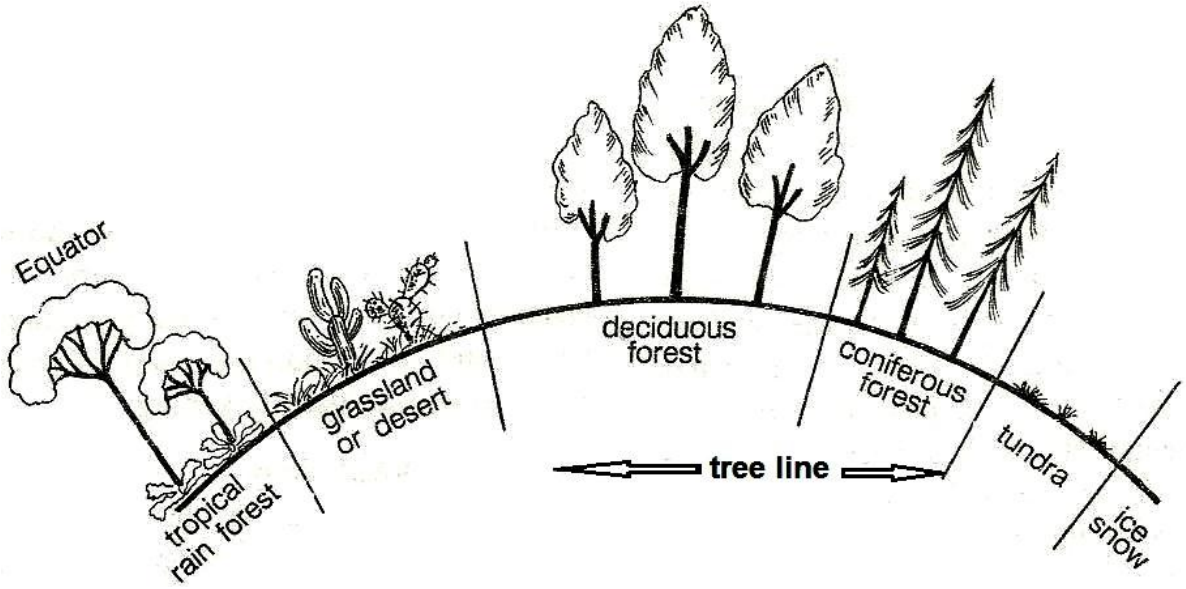


Fig. 1 Latitudinal zonation of vegetation. Note the different types of vegetation from equator towards poles (increasing latitud)

B. **Altitude**: High above the sea level, such physiographic factors as the steepness of slope, and exposure of slope, and direction of mountain chains, affect greatly the temperature conditions. We generally experience a decrease in temperature with increasing altitude, and thus vegetations at different alt. is different, showing distinct zonation.

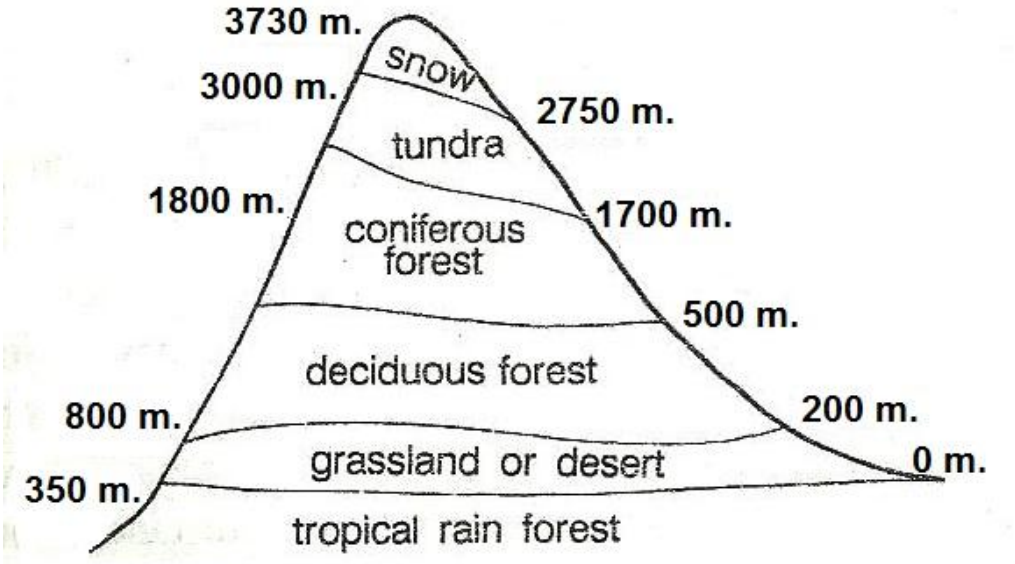


Fig. 2 Altitudinl zonation of vegetation on mountains. Note the different types of vegetation with increasing altitude. If compared with Fig. 1 the vegetational types are more or less similar in both.

Vegetation zones in Iraq:

1. **Desert zone:** Annual rainfall probably well below 75 mm. alt. 250-400m. in the Southern desert to the south west of Iraq, the vegetation may be almost lacking.
2. **Sub-desert zone**: Annual rainfall 75-150 mm. alt. 50-150 (940)m. the whole plain of Lower Iraq. The typical natural vegetation consists of more or less scattered perennial shrublets. In spring the open spaces between the bushes are generally occupied by a relatively sparse crop.
3. **Dry steppe zone**: Annual rainfall 200-350 mm. alt. 100-350m. stretches of the upper plains to the north and north–east of the Jabal and the lower foothills along the eastern frontier between lower Iraq and Iran. This zone forms a belt of short sparse grassland with scattered shrublets.
4. **Moist steppe zone**: Annual rainfall 350-500 mm. alt. 300-500 (800)m. a zone running across the upper plains, foothills and lower mountain slopes. The vegetational climax of this zone may well be an open savannah dominated by *Pistacia* and other small trees.
5. **Mountain forest zone**: Annual rainfall 700-1400 mm. alt. 1750-1800 (800)m. the whole of the northern territory of Iraq. The characteristic vegetation of this zone is *Quercus* forest and a few small isolated areas of a fourth forest formation dominated by *Pinus*, the forest trees may be scattered sparsely as open forest, and the typical summer crops of the zone being tobacco and rice; but the vine is cultivated without irrigation.
6. **Thorn-cushion or sub-alpine zone**: Annual precipitation may exceed 1000 mm. alt. 1750 to 2750-3000m.this formation occupies a clearly marked zone in the mountains above the timber-line towards the lower limits of the zone erect shrubs characteristic of the higher parts of the Forest Zone. Various species of *Cousinia* and dwarf species of *Astragalus* and *Onobrachis* are also typical of this zone.
7. **Alpine Zone**: A discontinuous zone comprising the higher mountain summits above altitudes of 2750-3000m.where aromatic perennial herbs, mainly belonging to the families Brassicaceae, Asteraceae and Lamiaceae hold sway.

   No rainfall records are available but annual precipitation on the mountain tops, largely in the form of snow, is probably in the region of 1000mm. or more.

PLANT IDENTIFICATION:

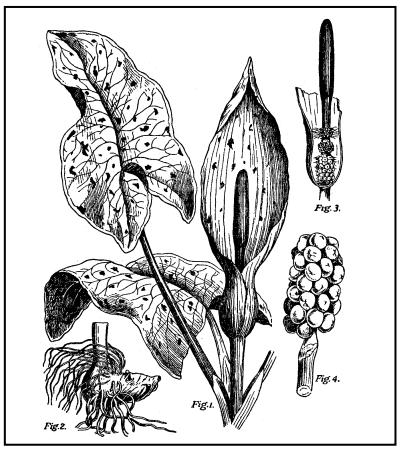
Identification of unknown plant is one of the basic components of plant taxonomy. A plant specimen can be identified with already known herbarium specimen utilizing the available literature and comparing the description of unknown plant with published description or taking the help of botanical gardens.

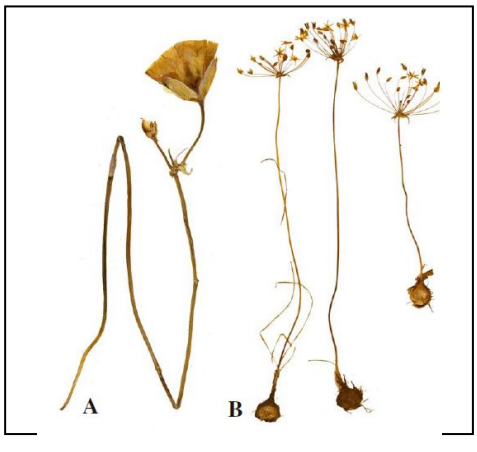
Taxonomic keys prove an ideal aid for rapid identification of unknown plants.

Construction and Use of Keys

First step for Identification of unknown plant is to determine whether the plant is a dicotyledon or monocotyledon. If a plant is woody or herbaceous, has taproot system, leaves with reticulate (netted) venation, floral parts in multiple of 5 whorls (or 4 or 2 whorls), it is assigned as a **dicotyledonous plant**. Of course, anatomical characters like vascular bundles arranged in a ring, secondary growth present and two cotyledons also provide supportive evidences. And if a plant herbaceous, has adventitious root system, leaves with parallel venation, floral parts in multiple of three whorls (rarely less or more), it is assigned as a **monocotyledonous plant**. Anatomical characters like scattered vascular bundles in the stem, absence of secondary growth, and cotyledon one, further support the assignment.

Then comes assignment of the plant to its specific category. Initial identification has to be at the **Family** level and subsequently up to **Genus, species, sub-species, variety, form** etc. Keys based on comparative characters, are quite helpful in plant identification.





Types of keys:

Based on the arrangement of characters and their utilization, keys are mainly of two types; **single-access (dichotomous, diagnostic** or **sequential)** keys or **multi-access (poly-claves)** keys.

Single-access (dichotomous, diagnostic or **sequential) keys**:

1) Indented or **Yoked keys;**

These are the most commonly used in floras and manuals, especially when they are of smaller size. In them, the statements (leads) and the taxa identified from them are arranged in usual groups or yokes. Additionally, the subordinate couplets are indented below the primary one at a fixed distance from the margin, the distance increasing with each subordinate couplet. An example of indented or yoked keys for taxa under consideration is given:

1. Fruit achene
    2. Calyx differentiated from corolla
        3. Petal with basal nectary . . . . . 1. *Ranunculus*
        ′3. Petal without basal nectary . . . . . 2. *Adonis*
    ′2. Calyx not differentiated from corolla
        4. Plants woody . . . . . 4. *Clematis*
        ′4. Plants herbaceous . . . . . 3. *Anemone*

′1. Fruit follicle
    5. Spur present
        6. Number of spur 1 . . . . . 6. *Delphinium*
        ′6. Number of spur 5 . . . . . 7. *Aquilegia*
    ′5. Spur absent . . . . . 5. *Caltha*

2) **Bracketed** or **Parallel keys:**

These have been used in large floras (as in Flora of USSR, Plants of Central Asia and Flora of British Isles). In them, the two leads of a couplet are always together and the distance from the margin is always the same, thus saving the page space.

1. Fruit achene 2
′1. Fruit follicle 5
2. Calyx differentiated from corolla 3
′2. Calyx not differentiated from corolla 4
3. Petal with basal nectary . . . . . 1. *Ranunculus*
′3. Petal without basal nectary . . . . . 2. *Adonis*
4. Plants woody . . . . . 4. *Clematis*
′4. Plants herbaceous . . . . . 3. *Anemone*
5. Spur present 6
′5. Spur absent . . . . . 5. *Caltha*
6. Number of spur 1 . . . . . 6. *Delphinium*
′6. Number of spur 5 . . . . . 7. *Aquilegia*

SOME IMPORTANT (ANGIOSPERMS) FAMILIES

(1) DICOTYLEDONS

The traditionally defined group Dicotyledons, the Dicotyledonae or Dicots, have been defined in the past by their possession of embryos with two cotyledons, two cotyledons is an ancestral feature for the taxa of the flowering plants. Thus, dicots as traditionally delimited (all angiosperms other than monocots), and must be abandoned as a formal taxonomic unit.

The choice of these exemplars is very limited in the context of the huge diversity of the angiosperms. Only major, general features of these examples of families are intended as an introduction to some of the common or important groups for the beginning student. Finally, the family descriptions end with a floral formula.

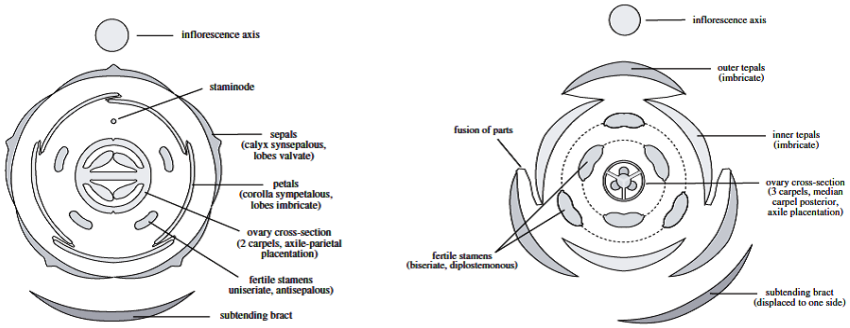
The **Floral formulas** are used to summarize the number and fusion of floral parts. In these formulas, **P** refers to perianth parts and is used where the perianth is undifferentiated into a typical outer calyx and inner corolla. If the perianth is differentiated into a distinct calyx and corolla, **K** represents the number of sepals or calyx lobes and **C** the number of petals or corolla lobes. The androecium is denoted by **A** and represents the number of stamens and ⌒ (the stamens are fused with). The gynoecium is denoted by **G**, showing the number of carpels in the gynoecium, followed by superior or inferior to denote ovary position. Connation, the fusion of similar parts, is illustrated with parentheses ( ) that enclose the number. Numbers that are enclosed by brackets [ ] represent a less common or rare condition. If there are more than about 10-12 parts, the ∞ sign is used for numerous, examples of floral formulas are:

K (5) [(4)] **C** 5 [4] **A** 5+5 [4+4] **G** 5 [4]

P (3+3) **A** 3+3 **Ḡ** (3) (often for Monocots)

K (5) **C** 5 **A** 5+5 **G** 5 [4]

Floral diagram: These represent a diagrammatic cross-sectional view of a flower bud, showing the relative relationship of perianth, androecial, and gynoecial components. Floral diagrams may show fusion of floral parts as well as things such as stamen position, placentation, and perianth, calyx, or corolla aestivation.



Floral diagrams, illustrating relative relationships among the components of the perianth, androecium, and gynoecium.

ROSALES

The Rosales, contain nine families are; Barbeyaceae, Cannabaceae, Dirachmaceae, Elaeagnaceae, **Rosaceae**, **Moraceae**, Rhamnaceae, Ulmaceae and Urticaceae, three of which are described here. Of these, the large family Rosaceae is of particular economic importance. Notable among the other families are the **Cannabaceae** (containing the euphoric and fiber plant *Cannibis sativa*, marijuana/hemp, and the beer-flavoring agent *Humulus lupulus*, hops), **Ulmaceae** (the elm family, source of important cultivars), and **Urticaceae** (stinging nettles and relatives).

Rose family (Rosaceae)

Latin for various roses, the family comprises 2800 species within 95 genera.

The Rosaceae consist of trees, shrubs, or herbs. The **leaves** are spiral (rarely opposite), simple or compound, undivided to divided, usually stipulate, the stipules often adnate to the petiole base. The **inflorescence** is variable. The **flowers** are bisexual (usually), actinomorphic, perigynous or epiperigynous; the receptacle is sometimes expanded or sunken. The **perianth** is biseriate and dichlamydeous, usually pentamerous, imbricate, a hypanthium present. The **calyx** is aposepalous with 5 [3 10] sepals. The **corolla** is apopetalous with 5 [0, 3 10] petals. The **stamens** are 20 ∞ [1,5], whorled, arising centripetally, usu. apostemonous. **Anthers** are longitudinal or rarely poricidal in dehiscence and dithecal. The **gynoecium** is syncarpous or apocarpous, with a superior or inferior ovary, 1 ∞ carpels, and 1 ∞ locules. The **style(s)** are terminal or lateral. **Placentation** is axile, basal, or marginal; **ovules** are 1 ∞. **Nectaries** are often present on the hypanthium. The **fruit** is a drupe, pome, hip, follicetum, achenecetum, or capsule. The **seeds** are usually without endosperm.

The Rosaceae is traditionally classified into four subfamilies:

1. Spiraeoideae, with an apocarpous gynoecium forming a follicetum.
2. Rosoideae, with an apocarpous gynoecium forming an achenecetum or drupecetum, the receptacle varying from expanded and fleshy (e.g., *Fragaria*) to sunken (e.g., the hips of *Rosa*).
3. Prunoideae, with a single, superiorovaried pistil bearing one ovule, the fruit a drupe
4. Maloideae, with an inferior ovary, forming a pome.

Members of the family have mostly worldwide distributions, but are more concentrated in north temperate regions. The family is very economically important as the source of many cultivated fruits, including *Fragaria* (strawberry), *Malus* (apples), *Prunus* (almond, apricot, cherry, peach, plum), *Pyrus* (pear), and *Rubus* (blackberry, raspberry), as well as essential oils (e.g., *Rosa*), and numerous