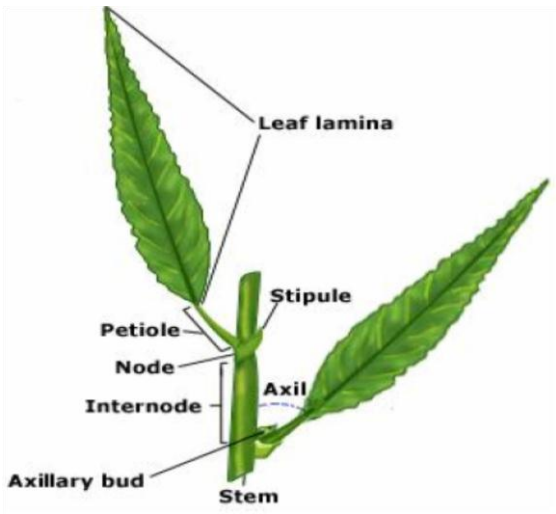
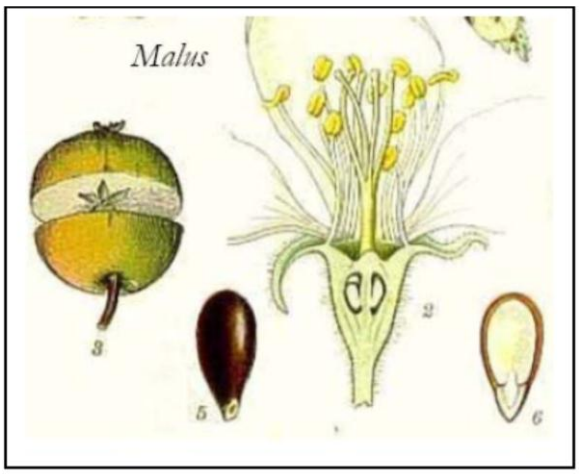
Kurdistan Region - Iraq
Ministry of Higher Education and Scientific Research
Salahaddin University - Erbil
College of Agricultural Engineering Sciences
Field Crops and Medicinal Plants Dept.

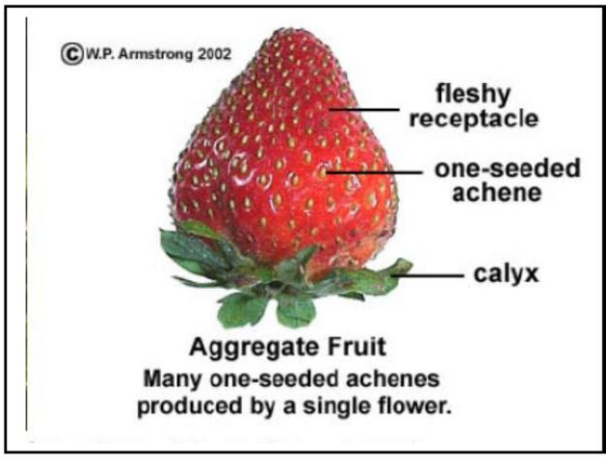
Forage taxonomy
MSc Students

FORAGE TAXONOMY



Serwan T. Al-Dabbagh





Fundamental Components of Plant Taxonomy

For the scientific study of an organism, it is necessary to identify it, have a name for its communication and assign it to a group to which it fits well-the three main functions of taxonomy. Plant taxonomy refers to the classification of plants following certain rules of principles, the term plant taxonomy has synonymous names as systematic botany and plant systematic in general.

As it is known that, the essential fields of botany lie in three primary areas, first: plant classification is concerned with description, identification, nomenclature and classification, secondly: plant morphology deals with plant form and anatomy, and thirdly plant physiology: which is familiar with the functions and reactions of plant cells and tissues.

Taxonomy is a major part of systematics that includes four components: Description, Identification, Nomenclature, and Classification (DINC). The general subjects of study are taxa (singular, taxon), which are defined as groups of organisms. Ideally, taxa should have a property known as monophyly and are traditionally treated at a particular rank. It should be pointed out that the four components of taxonomy are not limited to formal systematic studies but are the foundation of all intellectual endeavors of all fields, in which conceptual entities are described, identified, named, and classified. In fact, the ability to describe, identify, name, and classify things undoubtedly has evolved by natural selection in humans and in other animals as well.

1. **Description** is the assignment of features or attributes to a taxon. The features are called **characters**. Two or more forms of a character are **character states**. One example of a character is petal color, for which two-character states are yellow and blue. Another character is leaf shape, for which possible character states are elliptic, lanceolate, and ovate. Numerous character and character state terms are used in plant systematics, both for general plant morphology. The purpose of these descriptive character and character state terms is to use them as tools of communication, for concisely categorizing and delimiting the attributes of a taxon, an organism, or some part of the organism. An accurate and complete listing of these features is one of the major objectives and contributions of taxonomy.
2. **Identification** is the process of associating an unknown taxon with a known one, or recognizing that the unknown is new to science and warrants formal

description and naming. One generally identifies an unknown by first noting its characteristics, that is, by describing it. Then, these features are compared with those of other taxa to see if they conform. Plant taxa can be identified in many ways. A taxonomic key is perhaps the most utilized of identification devices. Of the different types of taxonomic keys, the most common, used in all Floras, is a dichotomous key. A **dichotomous key** consists of a series of two contrasting statements. Each statement is a **lead**; the pair of leads constitutes a **couplet**.

3. **Nomenclature** is the formal naming of taxa according to some standardized system. For plants, algae, and fungi, the rules and regulations for the naming of taxa are provided by the International Code of Botanical Nomenclature. These formal names are known as **scientific names**, which by convention are translated into the Latin language. The fundamental principle of nomenclature is that all taxa may bear only one scientific name. Although they may seem difficult to learn at first, scientific names are much preferable to common (vernacular) names. The scientific name of a species traditionally consists of two parts (which are underlined or Italicized): the genus name, which is always capitalized, e.g. *Calendula*, plus the specific pithet, which by recent consensus is not capitalized, e.g. *officinalis*. Thus, the species name for what is commonly called Scotch marigold is *Calendula officinalis*. Species names are known as **binomials** (literally meaning two names) and this type of nomenclature is called binomial nomenclature, first formalized in the mid-18th century by Carolus Linnaeus.

4. **Classification:** is the arrangement of entities (in this case, taxa) into some type of order. The purpose of classification is to provide a system for cataloguing and expressing relationships between these entities. Taxonomists have traditionally agreed upon a method for classifying organisms that utilizes categories called **ranks**. These taxonomic ranks are hierarchical, meaning that each rank is inclusive of all other ranks beneath it. As defined earlier, a **taxon** is a group of organisms typically treated at a given rank.

There are two major means of arriving at a classification of life: phenetic and phylogenetic. **Phenetic** classification is based on overall morphological similarities, in terms of now till this day we group similar objects together and dissimilar objects

apart in phenetic classification ranks. Many traditional classifications in plant systematics are phenetic, based on noted similarities between and among taxa. **Phylogenetic** classification is that which is based on evolutionary history, or pattern of descent, which may or may not correspond to overall similarity.

The system of nomenclature provides a hierarchical arrangement of ranks and every plant is treated as belonging to number of successively higher taxa, each assigned a particular rank with species as a basic unit. The seven principal-obligatory ranks in descending sequence are: Kingdom, Division, Class, Order (ordo), Family (familia), Genus and Species. The primary taxonomic ranks accepted by the International Code of Botanical Nomenclature (ICBN) for instance:

Major Taxonomic Ranks	Taxa .
Kingdom:	Plantae
Division:	Magnoliophyta (Angiosperms or Flowering Plants)
Class:	Liliopsida (Monocots)
Order:	Asparagales
Family:	Iridaceae
Genus: (plural: genera)	*Iris*
Species: (plural: species)	*Iris germanica*

International Code of Botanical Nomenclature. (I.C.B.N.):

The publication of Cod is based on the realization that botany requires a precise and simple system of nomenclature used by botanists in all countries and aims at providing a stable method of naming plants and taxonomic groups, avoiding and rejecting the use of names which may cause error or ambiguity or throw science into confusion. The term taxon (pl. taxa), a taxonomic group of any rank, has been introduced for the first time in the 1956 edition of the Code. The International Code of Botanical Nomenclature emphasized the mention of twelve ranks in the hierarchy for each taxon, including the ends to indicate its rank in the plant kingdom. The term taxon (pl. taxa), a taxonomic group of any rank, has been introduced for the first time in 1956 edition of the Code. The International Code of Botanical Nomenclature emphasized the mention of twelve ranks in the hierarchy for each taxon, including the end of the taxon name, to indicate its rank in the plant kingdom:

The taxonomic ranks hierarchy with taxon name ends which indicates its rank in the plant kingdom.

Rank	Ending	Taxon (Example)
Kingdom ----		Plantae
Subkingdom	-bionta	Embryobionta
Division	-phyta	Magnoliophyta (Tracheophyta)
Subdivision	-phytina	Magnoliophytina (Spermatophytina)
Class	-opsida	Magnoliopsida (Angiospermopsida)
Subclass	-idae	Magnoliidae (Dicotyledonidae)
Order	-ales	Fabales
Suborder	-ineae	**Ô**
Family	-aceae	Fabaceae
Subfamily	-oideae	Faboideae
Tribe	-eae	Vicieae (Adans.) DC.
Subtribe	-inae	**Ô**
Genus	various	us, as, um, es, on etc. ***Pisum* L.**
Subgenus	various	us, as, a, um, es, on, ii etc.…
Section		*Lophotropis*
Subsection		**Ô**
Series		**Ô**
Subseries		**Ô**
Species	various	*Pisum sativum* L.
Subspecies (subsp.)		*P. sativum* subsp. *sativum* L.
Variety (var.)		*P. sativum* var. *arvense* (L.) Poir.
Subvariety (subvar.)		**Ô**
Form (f.)		**Ô**
Subform (subf.)		**Ô**

Ô: certain ranks may be omitted altogether if they have not been mentioned or are not needed.

A special recommendation via ICBN is made for the eight families, these names because of long usage are treated as validly published, and these families alternative names are also permitted ending with (-aceae).

	Old name	New name
1.	Palmae	Arecaceae
2.	Gramineae	Poaceae
3.	Cruciferae	Brassicaceae
4.	Leguminosae	Fabaceae
5.	Guttiferae	Clusiaceae
6.	Umbelliferae	Apiaceae
7.	Labiatae	Lamiaceae
8.	Compositae	Asteraceae

Evidence of plant morphology (Organs structure)

Plant morphology is a scope of study that deals with the gross internal, external and systemic structure of plant organs. Morphology forms the basis of taxonomic descriptions and generally constitutes the most important facts in determining taxa.

The basic structural components, or organs, of plants are delimited by and strongly correlated with their specific functions. The major organs of flowering plants are vegetative and reproduction organs.

Plant forms

On the basis of form, flowering plants can be classified as: **Herbs** are plants that have no persistent parts above the ground. **Shrubs** the short woody plants in which side shoots are well developed so that there is no trunk. **Trees** are tall woody perennial plants, usually with a well-marked trunk (figure 1.1).

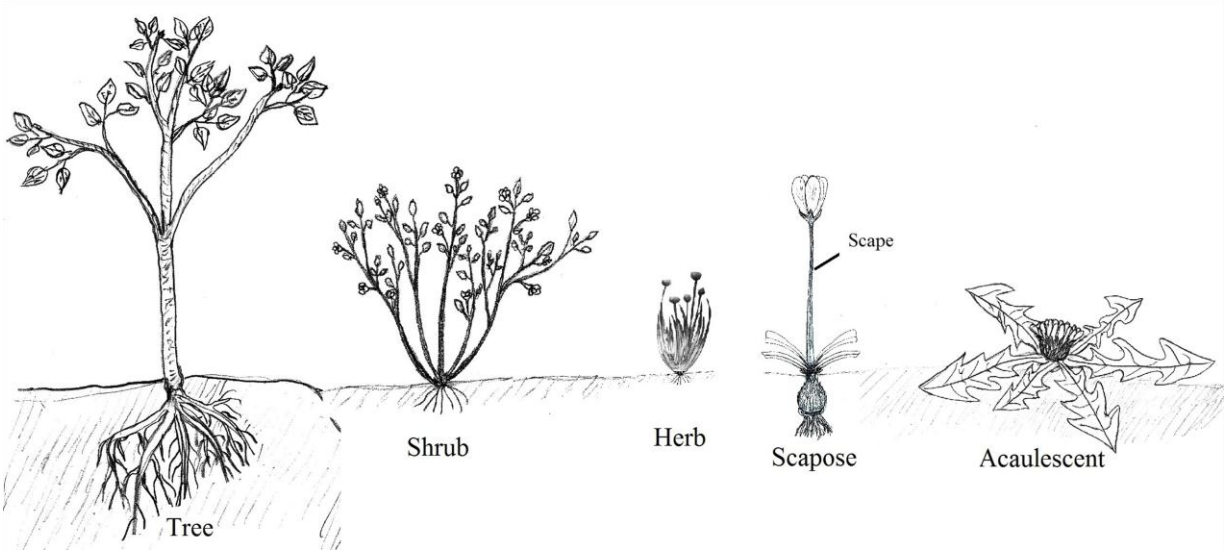


Figure 1.1: Plant form types

Plant parts

1. Roots

Roots are found in almost all vascular plants and normally function in the absorption of water, salt and mineral substances. The roots consist of apical meristematic tissue (calyptrogen) producing a protective root cap, a vascular system surrounded by a central endodermis, epidermis with absorptive root hairs, and internally developed lateral roots. Some roots are modified to carry out specialized functions of mechanical and physiological nature. Whereas some adventitious and tap roots are modified for food storage as fleshy or succulent taproots, others are modified for other functions also (figure 1.2).

1. I. Root types

A. Primary root & **Lateral roots**: Formed by radicle, as in most Dicots. Taproot system, also called (**Allorrhyzy**, Dicot roots).

B. Adventitious roots: Formed by any other part of a plant except radicle, as in Monocots. Also called (**Homorrhyzy**, Monocot roots).

C. Contractile roots: The second root form consists of contractile roots that function to adjust the depth of the bulb or corm in the soil. These thickened roots expand and contract to pull the bulb or corm down to its proper soil depth.

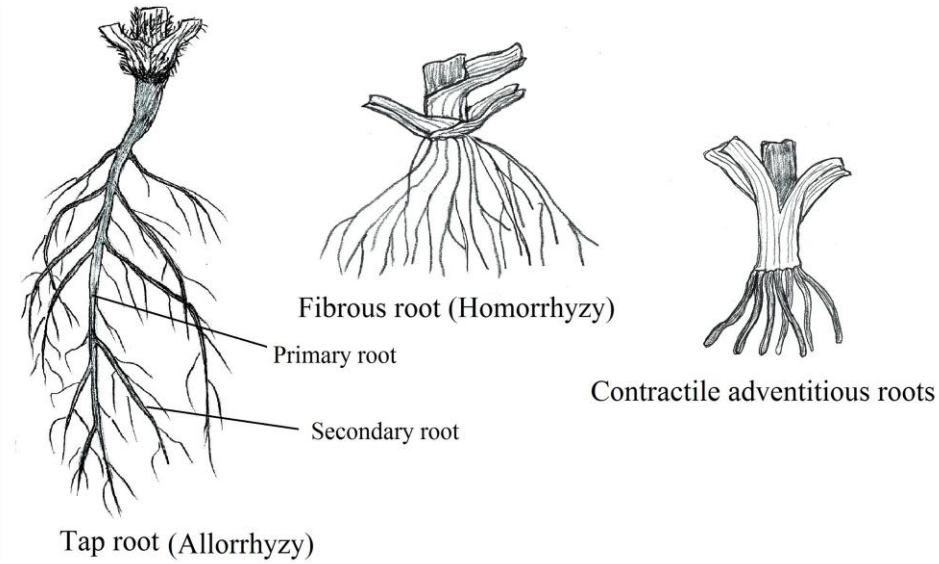


Figure 1.2: Major types of roots

1. II. Modified root structures

Some roots are modified to carry out specialized functions of mechanical and physiological nature (figure 1.3).

Modified roots;

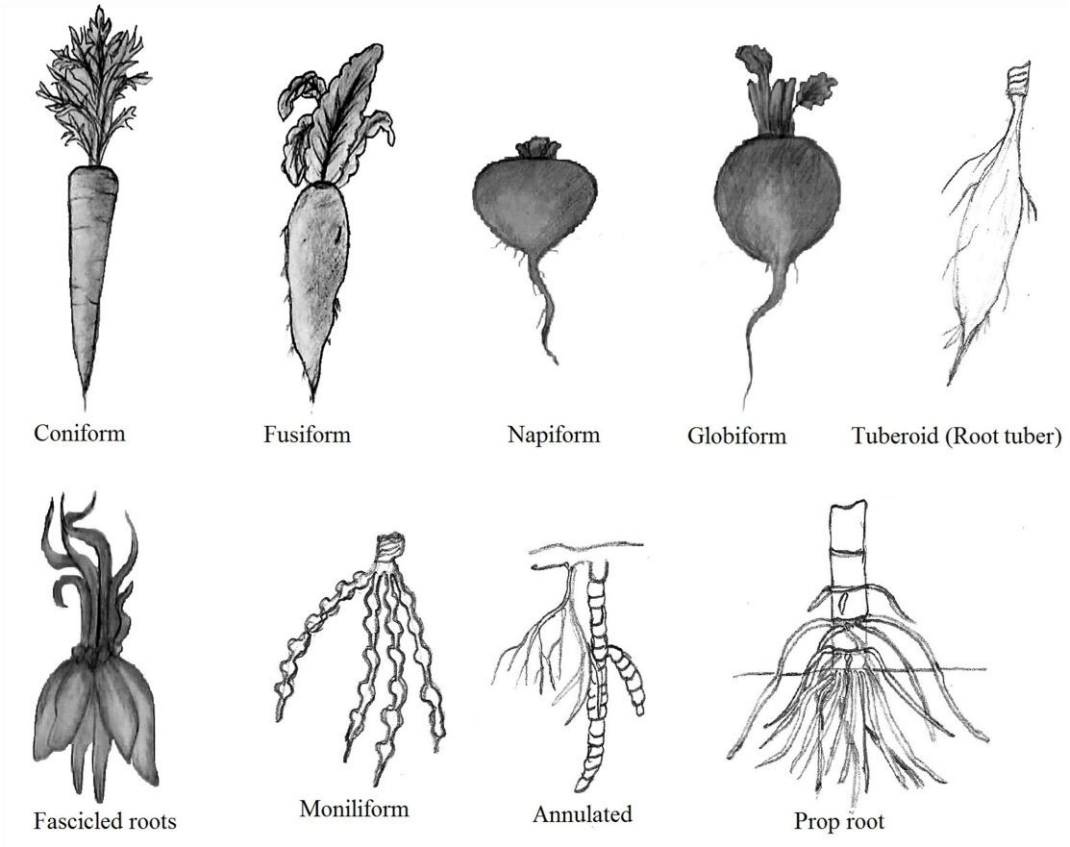
Some taproots are modified for food storage. These are classified on the basis of their shape, as follow;

1- Fleshy or Succulent taproots:

i. **Conical roots:** broad at the upper end and gradually tapering towards the lower end, as in carrot ***Daucus carota***.
ii. **Fusiform roots:** swollen in the middle and tapering at the two ends, as in ***Raphanus sativus*.**
iii. **Napiform roots:** almost spherical at the upper end which abruptly tapers at the lower end, as in ***Brassica rapa* L.**
iv. **Globform:** A spherical storage food roots, e.g. ***Beta vulgaris***.
v. **Root tubers:** arising from the node. These swell like tubers for food storage, e.g. ***Ipomoea batatas*.**
vi. **Fasciculated roots:** The cluster of tuberous roots, as found in ***Asparagus*** and ***Dahlia*.**

2- Adventitious roots: although some adventitious roots are modified for other functions.

vii. **Moniliform roots:** Moniliform or beaded roots are fleshy adventitious roots that are swollen at regular intervals like beads e.g., ***Basella ruba*** (Indian spinach) and some grasses.
viii. **Annulated roots:** Annulated root appears to be made up of a series of discs stacked one on top of the other e.g. ***Carapichea ipecacuanha*** (Ipecac).
ix. **Pneumatic roots or Pneumatophores:** Pneumatophores are specialized root structures that grow out from the water surface and facilitate the aeration necessary for root respiration in hydrophytic trees such as many mangrove species e.g., ***Avicennia germinans*.**
x. **Prop roots:** as in ***Zea mays*** and ***Saccharum officinarum*.** Or strong, woody and sunken the soil, these aerial roots arise from horizontal branches (stem) to provide stem-like support as in ***Monstera deliciosa***.
xi. **Parasitic** or **haustorial roots:** These absorb nutirition by sending out haustoria into the tissue of hosts, as found in parasitic plants like ***Orobanche*** and ***Cuscuta*.**
xii. **Assimilatory roots:** These are hanging green aerial roots which have a power of assimilation, as found in ***Tinospora cordifolia.***



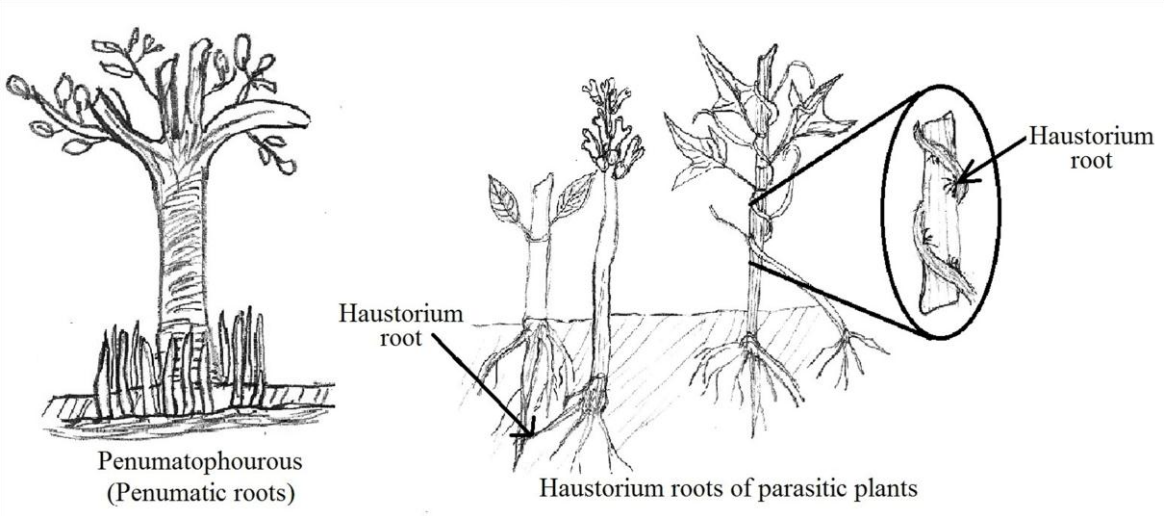


Figure1.3: Modified root types