Plant Taxonomy

LEC 1

كلية التربية للعلوم الصرفة / قسم علوم الحياة

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Classification of Living things.

Classification is dividing the living things into many groups according to their similarties and differences classification is studied by taxonomy.

Taxonomy: Afield of science dealing with

1. Identification   2. Nomenclature   3. Classification of objects and description of the variation of organisms (plants).

From ancient Greek = Taxo ___ means arrangement

Nomos ____ method or Law

Identification:

   is the recognition of certain characters of plant (flower, fruit, Leaf or stem) and the application of a name of a plant with those particular characters. Recognition occurs when the specimen plant.

   If comparison of the specimen with all similar species reveals that it differs from them. It may be named as a new species.

Nomenclature:

   Is the application of names to taxa in accordance with the International code of Botanic. Nomenclature, (ICBN)

Classification: is the placing of plant (or groups) in categories according to a particular system. The biggest category is <u>a kingdom</u> and the smallest category is <u>a species</u> each kingdom is divided into lower categories as follows.

Kingdom →   Division or Phylum   → Class ↓

 Species   ←   genus ←   family ← order

   From kingdom to species, the following are observed:

1. Number of group decreases.
2. Number of members decreases.
3. Similarities in organisms increase.

The number of Individulus   Similarity

Kingdom
Division or Phylum
Class
Order
Family
Genus
Species

Decreases

increases

Experimental taxonom: or Biosystematic

Is the taxonomic study of organisms from the stand point of population rather than individuals and the evolutionary processes. Within population, it is largely concerned with, genetical, cytological, pollen grains, anatomical and ecological.

Bio = life ___ systematic = an arrangement of things into groups.

Classical taxonomy:

Relies on morphological and anatomical data and can be carried out in the herbarium and laboratory.

<u>Taxon:</u> (Plural Taxa)

Is aterm applies to any taxonomic group at any Rank. For example (species, genus or family …. etc).

<u>Flora:</u>

Is a book or other work describing flora of a given area and usually providing means of Identifying the taxa contained in it.

<u>Monograph:</u>

Is a comprehensive taxonomic treat is normally treating a family or genus on a world-wide basic. A monograph includes a complete synonym description, detailed listing of ecological, geographical, cytological, chemical keys and description maps.

Revisions:

Is differ from monograph, is less comprehensive monograph and the systematic treatment is less complete.

Manual:

Is a book that provides keys and description to aidin Identifying plants.

Relationship of Plant taxonomy with other Sciences

1. Morphology:

The study of External structure characters of the plant. Is The branch of biology that deals with form and Structure of all parts of the plants (root, stem, leaves, flower fruit and seeds).

2. Anatomy:

Is the branch of biology concerned with the study of the structure of organisms and their parts (all parts of the plant).

3. Ecology:

Is the study of the relationship between plants and the physical environment.

4. Palynology:

The study of pollen and spores. The taxonomic characters of pollen grains include cell structure, type, polarity, symmetry, shape and grain size.

5. Embryology

The study of successive stages of sporogensis, gametogenesis, and growth and development of the embryo and seed coat.

6. Cytology

The study of the cells, use chromosome number, Morphology, polyploidy called (cytotaxonomy) chromosomes pairing or behavior at meiosis and Mitosis.

7. Numerical taxonomy

Is a classification system developed for multivariate analysis. Using mathematical formula based on algorithm like cluster analysis.

8. Chemical taxonomy (Chemotaxonomy):

This study deals with the chemical character based on similarities and differences in biochemical composition.

9. Paleobotany:

Is the study of fossil plants which are generally found buried below ground.

10. Genetic:

Is a branch of biology that deals with the study of genes, genetic variation and heredity in plant.

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Plant taxonomy uses Morphological and anatomical characters for the purposes of classification

Structures are observed with the eye, hand lens, or light microscopic or by using scanning electron microscope (SEM).

For classification purposes their is increase use of evidence from fields such as:

Cytology, palynology, paleobotamy, Biochemistry Genetics, Ecology, geographical distribution, Embryology and ultra structure.

Characters: one features possessed by the organism that may be compared, Measured, Counted, described or assessed.

quantitative characters:

Are these features that can be counted or measured, example: leaf length, number of stamens,…….etc.

Qualitative characters:

Are such as the colour of the flower, leaf shape, or pubescence…..etc.

The good characters which un affected by the environmental and relatively constant through the population of the taxa.

History of Plant Taxonomy

Classification of organisms have been started from the beginning of human existence basing on their need food and medicine.

Historical taxonomy divided into four periods, each marked by a characteristic principle of the plant.

Periods 1

In this period the scholars of the Greek and Romans were described the plants according to the characters of the plant. The famous scholers of this periods are:

Aristotle (384- 322 B.C)

Was the first man classify all living things, into groups. He classified plants as herbs, shrubs and trees.

Theophrastus (370- 285 B.C).

Was the father of botany, astudent of Aristotle, classified plants only about 480 taxa, using most obvious characters of gross morphology (Tree- shrubs- subs hrubs- herbs) also he recognized differences based on superior and inferior ovaries, and type of fruits…..etc.

Carolus Lunnaeus (1707- 1778).

A swedish naturalist he was professor of medicine and botany. He proposed a system of classification which was published in his system nature "1753" in his system he used characters of stamens: ie.

The number and nature of stamens to distinquish the 24 classes in which he divided the plant kingdom he also used the number and nature of carples to distinguish the order. i. e. subdivision of his class the published many botanical works of the (species- plant arum).

Out lines of the system contains:-

- number of stamen 1,2,3,4…..10.

- didynamous 2+2 stamens.

- Tetradynamos 2+4 stamens.

- Mona adelpha- Diadelpha, polyadelpha.

- Syngenesia.

- Gynandria

- Monecious- Diecious.

- Polygamia.

- Cryptogamia- Non flowers plants.

Dioscorides (40-90 A.C)

Was a Greek physician who interested in the medicinal properties of plants described a bout 600 taxa.

Andrea caselapino (1519- 1603)

Was classified about 1500 species mainly on the basis of growth- habit (Trees, shrubs, herbs), and fruit and seeds, woody, herbaceous.

John Ray (1628- 1705)

Was the first scholars recognize 2 major taxa of flowering plants. He also tried to group the plants in several families which he called classes.

I. Herbae

i) imperfect (non flower plants).

ii) perfect (flowering plants).

1- Mono Cotyledonae (with one cotyledons).

2- Dicotyledonae (with two cotyledons).

2- Arborae

1. Monocotyledon (with one cotyledons).

2. Dicotyledonae (with two cotyledons).

De Jussieu (1748-1836)

Hedevided plants into three groups are:

1) Acotyledons → Non flowering plants.

2) Mono cotyledons

3) Dicotyledons.

Within the last two groups he used many of the familiar characters (Superior, inferior ovaries, stamens free and attachment to corolla, free petals… etc).

De Candolle (1778- 1841).

Out Line System of Classification is:

I- Vasculars (Vascular plants)

   i) Exogenae (Dicotyledons, Coniferales).

   ii) Endogynae (Monocotyledons, Cycadales).

II- Cellulares (Thallophyta, Bryophyta).

   Plant without vascular bundles (absent)

Bentham and Hooker (1800-1884).

Out Lines of System

i- Dicotyledons

a. polypetalous (chori petalous)

b. gamopetalous (synpetalous)

c. monochlamydeae (apetalous)

ii- Gymnospermae

iii- Monocotyledons

August W. Eichler (1829- 1887).

Out Lines of System

1. Cryptogamae

a. Thallophytes
b. Bryophytes
c. Pteridophytes

2. Phanerogamae

a. Gymnospermae
b. Angiospermae

1. Monocotyledonae

2. Dicotyledoae

i) Choripetalous

ii) Synpetalous

Adolph Engler (1844- 1930)

Out Line of the System is:

Division: Embryophytae

Subdivision: Gymnospermae

Subdivision: Angiospermae

Class: Monocotyledonae.

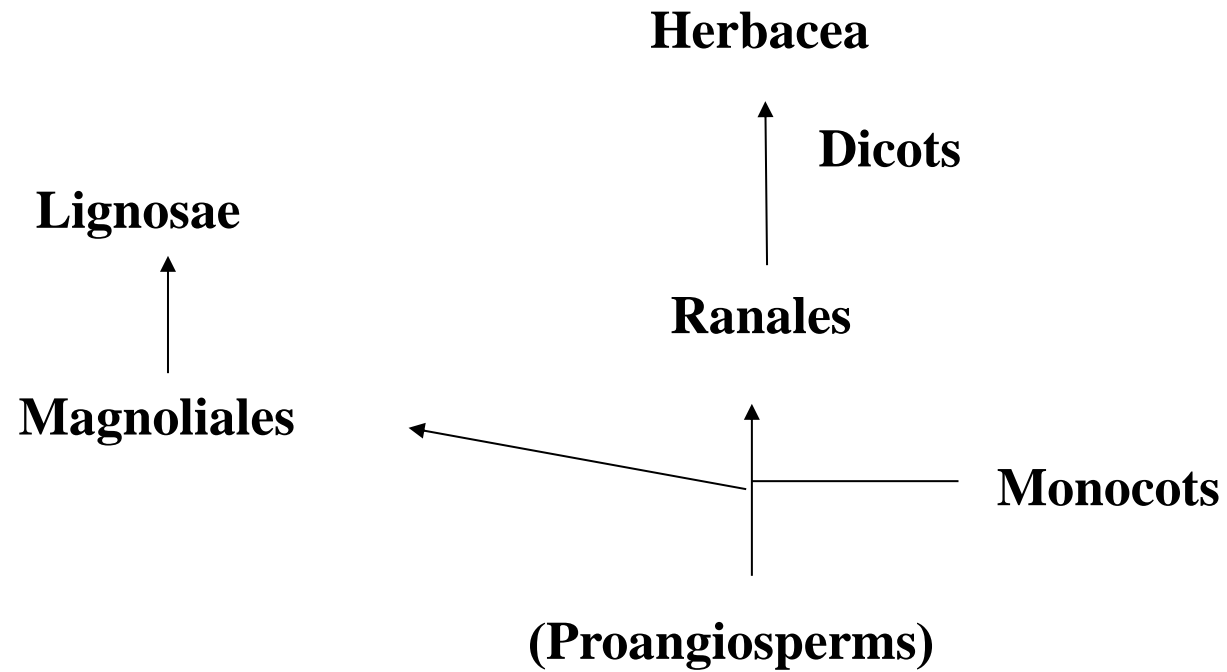Class: Dicotyledonae.

Subclass: Archichlamydeae

i) Apetalae

ii) Choripetalae

Subclass: Metachlamydeae

John Hutchinson (1884-1959)

Outline of the System is:

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Classification System

1- Artificial System

Is on that classifies objects togather on the basis of only single or fewer characters and the characters do not show any relationships to help in establishing evolutionary and phylogenetic.

Some times group plants using color of their flower or their growth form (herbs, shrubs, trees).

This system was used by Aristotle (384-322 BC) Linnaeus (1707-1778), Theophrastus (370-282 BC) and john Ray (1628-1705).

2- Natural System

Group to Plants with many of the diagnostic characters which show relationships among the species and find out the phylogeny among the taxa.

Taxonomic floras for example: Identify Species, genera, and families by listing as many characters as possible concerning, (anatom, Morphology, genetic, ecology, biochemistry, pollen grains, cytology, and geographical distribution).

This System was used by De – Jussieu (1748-1836) and De – Candolle (1778-1841).

3- Phylogenetic System

Is Naturally classification that try to identify the evolutionary history of natural groups.

This system was used by August. W. Eichler (1829-1887), Adolph Engler (1844-1930) and John Hutchinson (1884-1959).

This system based on morphological characters, Natural affinities and evolutionary sequence and genetic in addition to fossil records.

Nomenclature

Nomenclature: is a system of names, or the rules for forming these terms in a particular field of arts or sciences.

Types of Nomenclature:

1- Common Names:

The earlier day common or vernacular names were used which generally changes with change language, and gires great trouble to a plant collector in foreign country, there he feels the local name to be more difficult than the botanical names.

Advantages:

It is easy of usage and common understanding in certain geographical areas.

Disadvantage:

1. A single species of plant might nave a several extra common names.

2. Many species that are rare or lack economic importance don't have a common name.

3. Don't give clear idea a bout the relation ships of the plant with other plants.

2- Polynomial Names

In the late sixteenth century, the science of scientific name started, plants and animals were given long descriptive names in Latin language.

Polynomial in clouded a single word for a plant; as genus to nowed by lengthly list of descriptive terms in Latin.

For example: tomato was give the long latin polynomial Solanum, Caule inermi herbaceo, foliis pinnatis incises.

Which means the solanum with the smooth stem which is herbaceous and has incised pinnate leaves.

Polynomial nomenclature was dis carded for two reason. 1- It was lengthly and difficult to remember. 2- It often differs from scholar to scholar based on the characters chosen by them.

3- Binomial Nomenclature

Carolos Linnaeus devised binomial System of Nomenclature – The scientific name of an organism composed of two Latin words. The first words is called genus (= generic name) followed by the second words called species (Specific Epithet)

For example: *Vicia Faba* L.

1. These names should be in italics when printed or separately under lined when hand written.
2. The genus starts with capital letter, while species in small letter.
3. The name of the author written at the end of the scientific name.

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Genus (Plural Genera)

Is a class of similar things especially a group of plants or animals that includes several character closely related species.

Species: A group of individual plants that is fundamentally a like is generally treated as species.

Species should be separated by distinct morphological differences From other closely related species.

Generic Name

Monotypic : for example *Ginkgo,Cocos,Amaryllis.*

Polytypic : for example *Vicia,Brassicca,Solanum.*

Deveration of Generic Name :

- From Authors :example

- *Theophrasts*   نسبة الى العالم ثيوفراستس

- *Caeselpinia*   نسبة للعالم الايطالي سيسلبينو

- *Linnaea*   نسبة الى العالم لينايوس

- *Nicotiana* نسبة الى جين نيكوت اول من ادخل نبات التبغ الى اوربا

- From Characters of plant :example

- *Xanthoxylum* معناها الخشب – اصفر اشارة الى لون الخشب في نباتات هذا الجنس

- *Trifolium*   ثلاثي الوريقات

- *Calypso* اشارة الى زنبق البحر المعروف كما ورد في قصة قيصر

- From Language :example

- *Tsuga*   من اليابانية
- *Ginkgo*   من الصينية
- *Catalpa*   من لغة الهنود الحمر
- *Saccharum*   من العربية

Deveration of specific Epithet

From country :example

Coffea arabica   نسبة الى البلاد العربية

Syriaca   نسبة الى سوريا

Chinensis   نسبة الى الصين

Japonica   نسبة الى اليابان

Canadensis   نسبة الى كندا

Africana   نسبة الى افريقيا

From characters of plant: example

rubra

alba

nigra

latifolia

angustifolia

grandiflora

nana

gigantea

crassa

tenuis

repens

aquatic

vulgaris

rara

sativus

hortensis

tomentosa

spinosa

toxicaria

Major and Minor Categories

Major Categories

1. Division or phylum

2. Subdivision

3. Class

4. Order

5. Family

Minor Categories

Genus

Subgenera

Section

Subsection

Series

Subseries

Species

Subspecies

Variety

Sub variety

Form

Sub form

Clone

The Spermatophytes which means seed plants are some of the most important organisms on earth seed plants have true roots, stem ,leaves and flowers: They also contain vessels which allow movement of fluids., carrying water and nuterients to the different parts of the plant.

The end of Major Taxa:

Order-ales

Sub order- ineae

Family-aceae

Subfamily-oideae

Tribe-eae

Subtribe-inae

The name of the Common Families:

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

ICBN

I-International

C-Code

B-Botanical

N- Nomenclature

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Type

Type: Is a particular specimen of an organism to which the scientific name of that organism is formally attached.

Type specimen:Generally species are described by taxonomists based on type specimen and the details published in a scientifically recognized publication. A type specimen might be dried and is usually kept in museum or herbarium.

There are several kinds of type specimen:

Such as:

Holotype:A specimen designated by the author in the original publication(nomenclatural type).

Isotype:A dublicate specimen of the holotype collected at the same time and place(may be in other herbarium).

Paratype:A paratype is any of one or more specimen other than the holotype listed as representative and used for the development of the original description of a species or subspecies.

Syntype: The specimen which is the basis of new taxon when no holotype is designated by author is known as syntype.
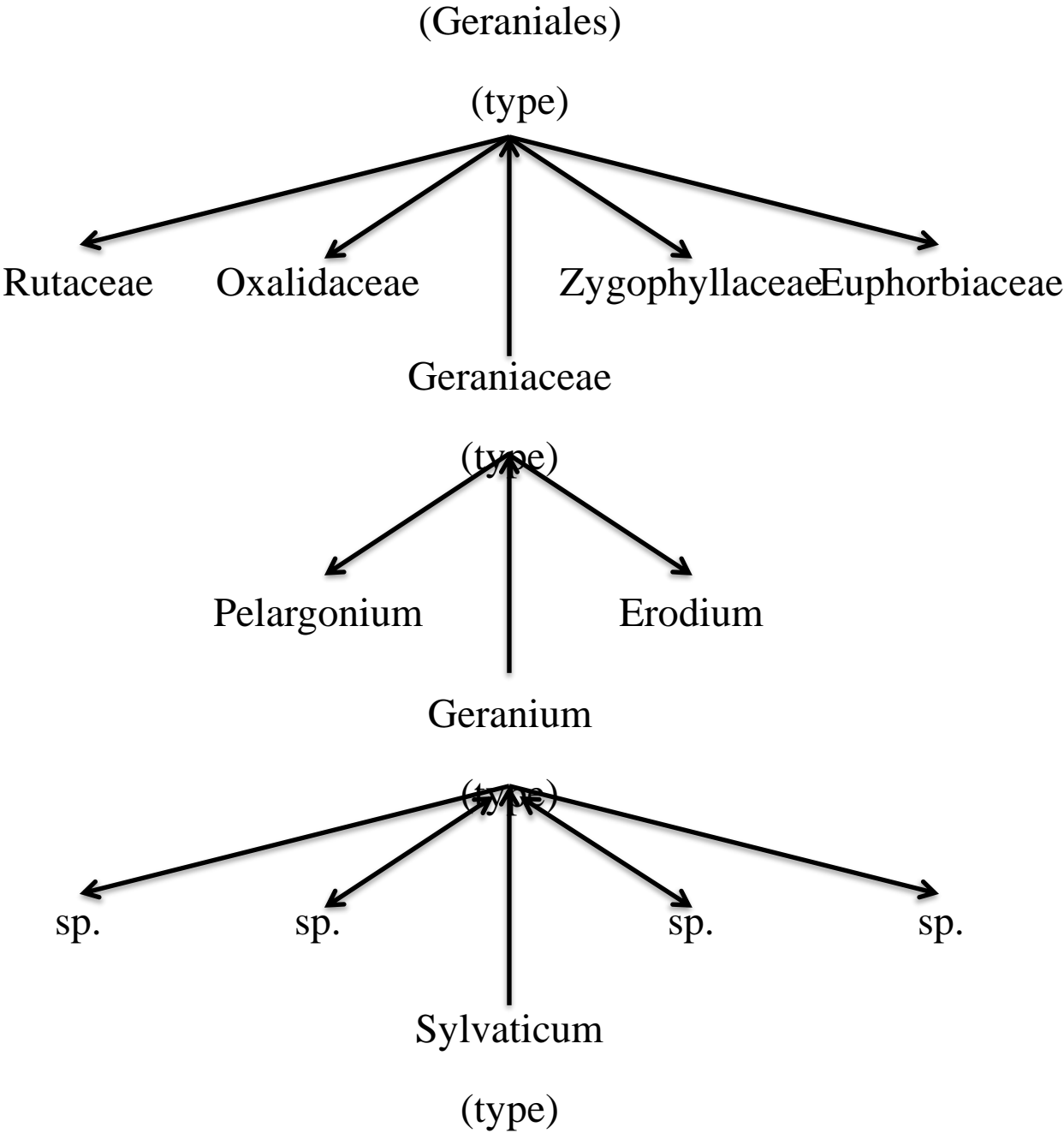
Lectotype:A specimen chosen from the authors original material when no holotype has been designated.

Neotype:A specimen selected when all original specimens have been lost.

Topotype: When no original type material is available and a specimen is collected from type locality is chosen to serve as type it is called Topotype.

Example: for the Type

Plant: *Geranium sylvaticum*

(Geraniales)

(type)

Rutaceae   Oxalidaceae   ZygophyllaceaeEuphorbiaceae

Geraniaceae

(type)

Pelargonium   Erodium

Geranium

(type)

sp.   sp.   sp.   sp.

Sylvaticum

(type)

Spermatophyta

The Spermatophytes which means seed plants" are some of the most important organisms on earth seed plants have true roots, stem, leaves and flowers: They also contain vessels which allow movement of fluids., carrying water and nutrients to the different parts of the plant.

Characteristics of Seed Plants

1. Seed Plants are the most complex group of plants.
2. They have root, stem, leaves and cones or flowers.
3. They reproduce sexually and a sexually.
4. They produce seeds.
5. Their size ranges from a few millimeters to 100 meters.
6. There are 260,000 existing species which belong to spermatophyta.

Seed Plants Divided into Two Groups

1. Class: Gymnospermae.

2. Class: Angiospermae

3. Gymnospermae:

   Gymnosperm mean "naked seed". This is because the seeds do not develop enclosed within an ovary but are usually exposed on the surfaces of reproductive structures, such as cones, Gymnosperms have seed but not fruits or flowers. This group includes all the conifers, such as pines .

Characteristics of Gymnosperms

1. Gymnosperms produce seed that develop in cones instead of a flower.
2. Most of them have needle like leaves.
3. They are evergreen, trees or shrubs, perennial.
4. They are woody plants.
5. Root Tap roots.
6. Seed have 2- or many 2-14 cotyledons.
7. Ovules naked not enclosed in carpel.
8. They are pollinated by the wind.
9. Have vascular tissue, xylum, doesn't have vessels and the phloem have no companion cells and sievetubes.
10. The seed contain endosperm that stores food for the growth.

2- Angiosperms (Flowering Plants)

Angiosperms are vascular flowering plants, They have stems, roots, and leaves, All flowering plants produce flowers. Maybe herbaceous plants as well as woody plants. Pollination take place by insect, wind, water and animals.

The angiosperms are classified in to (2) groups. These are monocotyledons (monocots) and dicotyledons (dicots).

	Dicotyledons		Monocotyledons
1	Seed embryo with two cotyledons	1	Seed embryo with one cotyledons
2	Flowers parts usually in 4 or 5 or multiples thereof	2	Flowers parts usually in (3) or multiple thereof
3	Veins of leaf usually Reticulate	3	Veins of leaf usually parallel
4	Primary vascular bundles of stem in ring	4	Primary vascular bundles of stem in scattered
5	Vascular cambium for secondary growth present	5	Vascular cambium for secondary growth absent
6	Root system characterized by a large tap root with branch roots growth from it	6	Root system characterized by adventitious roots (fibrous roots)
7	Pollen grains usually having 3 or more pores or furrows	7	Pollen grains having only one pore furrow bundle

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