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NAAC ACCREDITED 'A' GRADE

Topic: Scope of Plant Anatomy

Course Title: Anatomy

Paper: CC3

Unit: 9

Semester: II

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SCOPE OF PLANT ANATOMY

Application of Plant Anatomy in Plant Systematics:

Since the time of Linnaeus flowers, fruits and other morphological characters helped the identification of plants. However, sometimes situations arose when these characters were not available like in the fragments plant materials, dried herbarium specimens or in dried and powdered medicinal plants used as drugs etc. For any type of botanical research proper identification of plant specimens is necessary. Anyone working with plant materials like plant breeders, geneticists, cytologists, pharmacists and the like need proper identification of their source material. These materials also help identification of parallel specimens if required. Characters that differentiate a species from other species are of great taxonomic significance. Plant anatomy provides identifying characters that may be of great help in plant systematics. For example, trichome anatomy, wood anatomy, node anatomy, nature of fibres, sclereids, cambium, leaf anatomy, leaf surface structures like stomatal types, cuticle, venation etc., provide important diagnostic characters that help in identification of a species, establishing genetic relationships and solving taxonomic disputes. Anatomical studies have the added advantage that they can be carried out even in fragmentary materials like pieces of wood. Moreover, anatomical characterization of a plant specimen does not require sophisticated instruments and is rather simple. Most anatomical investigations are carried out using a light microscope. They have played an important role in establishing phylogenetic relationships. The following are some examples of commonly used anatomical features characterizing a family, genus or species.

Trichomes:

- Stellate hairs of Malvaceae
- Stinging hairs of Urticaceae
- Silica hairs of grasses
- Non-glandular hairs of Lauraceae and Moraceae

Stomata:

- Anomocytic stomata of Ranunculacese
- Anisocytic stomata of Brassicaceae
- Paracytic stomata of Rubiaceae
- Diacytic stomata of Caryophyllaceae
- Dumble-shaped stomata of Poaceae
- Sunken stomata of xerophytes.

Nodal Anatomy:

- Unilacunar single trace node in *Lantana*, *Nerium*, *Calotropis*
- Unilacunar two trace node in *Clerodendron splendens*
- Unilacunar three trace node in *Withania somnifera*
- Trilacunar node in *Azadirachta*
- Multilacunar node in *Rumex, Polygonum. Aralium*

Fibres and scereids:

- Hard fibres of monocots like coir or fibres of *Musa*
- Soft fibres of dicots loke jute fibre
- Star-shaped asterosclereids of Nymphaeaceae
- Branched hair-like trichosclereids of *Olea*
- Columnar macrosclereids in the seed coats of legumes
- Bone-shaped osteosclereids in the seed coat of *Pisum*

Vascular tissues:

- Bicollateral vascular bundles of Cucurbitaceae
- Accessory, medullary and cortical bundles of Nyctaginaceae
- Anomalous secondary thickening in Bignoniaceae

These characters along with many others are of great help to plant systematists.

Application of Plant Anatomy in Pharmacognosy:

A wide variety of medicinal plants provide crude drugs. Drugs are prepared from different parts of a plant. Sometimes the whole plant is the source of the drug but more often parts of a plant like the root, rhizome, stem, leaves, flowers, fruits or seeds act as the source of drugs. Different plant parts have specific anatomical features and are composed of specific tissue types according to their function. These anatomical features are of great value in authentication of drugs.

By studying certain anatomical features adulterants used in crude drugs can be detected. Drugs are mostly used or transported in dry form and in dry powdered form. It is very difficult to identify the true drugs in this form by using macroscopic characters only. Proper authentication of the drugs is a prerequisite for drug importers. They must be sure about the quality, purity of the drugs and the nature of the adulterants as well. Samples to be imported are tested not only with the morphological character but with anatomical characters as well. They can also be authenticated by chemical analysis which is more time consuming than microscopic studies. The following are some examples where adulterants in crude drugs are distinguished from the original source materials using anatomical features.

- *Swertia chirata* (family Gentianaceae) is an indigenous drug in India, used widely as a stomachic, bitter tonic, antihelmintic and in skin diseases. The extensive collection of this plant has lead to its reaching the endangered category. *Swertia angustifolia* (pahari chirata) is a common adulterant of *Swertia chirata*. The anatomical differences existing between the two species of *Swertia* is enlisted in the table given below.

Swertia chirata	***Swertia angustifolia***
Stomata are present on the lower surface of the leaf	Stomata are present on both surfaces of the leaf
Palisade cells are poorly developed	Palisade cells are well developed
Cortical parenchyma of stem is 3-5 layered and most cells contain calcium oxalate crystals	Cortical parenchyma of stem is 3-7 layered and only few cells contain calcium oxalate crystals and resins
Internal phloem is well developed	Internal phloem is less developed

Sometimes *Andrographis paniculata* is mixed with *Swertia chirata. Andrographis* can be anatomically identified as its leaves have characteristic cystoliths, diacytic type of stomata and presence of phloem on the dorsal side of xylem.

- *Zingiber officinale* (family Zingiberaceae) is widely used as a rhizome drug. Other than being used as a condiment, it is widely used as a carminative and digestive. It dilates the blood vessels giving a warm feeling. It increases the rate if perspiration and lowers body temperature. The rhizome of *Zingiber officinale* contains abundant starch grains, either singly or in clusters. Each grain is round, oval or oblong and flattened. The hilum is small and terminal. The striations are very faint. *Zingiber mioga* is commonly used as its adulterant. However, it can be easily identified anatomically as its starch grains are compound type.

- *Cephaelis ipecacuanha* (Family Rubiaceae) yields a root drug used in cough mixtures. It contains abundant compound starch grains with 2-8 parts. The individual granule are round or oval and very small, <15 µm in diameter. The vessels are thick walled with narrow lumen and have numerous bordered pits on their walls. *Ionidium* (Family Violaceae) is used as an adulterant. It has vessels with wide lumen and lacks the characteristic starch granules. The other adulterant is *Cephaelis acuminata* which has bigger starch granules up to 22 µm in diameter.

Application in Forensics:

Forensic science is indispensible for the investigation of crimes. Forensic botany (including plant anatomy, plant systematics and palynology etc.) is a part of forensic science. Forensic botany deals with the use of plant materials for solving crimes and other legal problems. Most often this means, using clues from plants in order to help in the solution of serious crimes such as murder, kidnapping and finding out the cause of death of a victim. Anatomical features like different types of trichomes, stomata, cuticular pattern, leaf venation, wood anatomy, growth rings etc. help in species identification and in matching evidences. In a criminal case for example the identified plant specimens help to relate the criminal to a crime scene. It may indicate the season in which the crime was committed. Also, anatomical features like starch grains, raphides, sclereids, silica bodies found in edible plants help identification of the contents of the gut and stomach of a victim. Since plants cell walls are not easily degraded and remain intact in the victim's digestive tract long after death, taxon-specific cell wall thickenings in food particles may of great help in species identification. These clues may lead to tracing the movements and actions of the victim before death. Forensic Botany is a new field of study and is growing in popularity in the present time. Forensic botanists often act as private consultants in criminal matters and may be asked to testify in court to help solve complicated cases.

Many dicotyledonous roots show growth rings or annual rings which can be counted to find out the age of the tree. They may be used in forensic studies to find out how long the skeletal remains have been in their present location. The number of growth rings in the root which is in contact with the bones can indicate the time passed since death.

Plants are often the cause of fatalities due to the inappropriate use of herbal medicines or the use of misidentified plants (or sometimes intentionally used in homicide and suicide). Anatomical characters can be useful as supportive evidence in forensic work to help identify the plant species in question and anatomical evidence may often give additional clues as to the identity of the plant when medical diagnosis and chemical forensic studies turn out to be inconclusive.