

Applications of Plant Anatomy

The applications are:

1. Enables to Identify Fragmentary Plant Materials
2. Enables to Detect Adulterants in Crude Drugs
3. Enables to Identify Wood
4. Enables to Identify Archaeological Plant Remains
5. Applied Aspects of Meristem Culture
6. Provides Evidences in Forensic Investigation
7. Provides Characters of Taxonomic Significance

1. Enables to Identify Fragmentary Plant Materials:

- Since the time of Linnaeus, flowers and fruits provided the characters of identification. Sometimes situation arises where fragments of herbarium specimens, leaf, dried and powdered medicinal plants etc. are available. These characters will identify parallel specimens. Apart from vegetative and reproductive organs plant anatomy provides characters that are of taxonomic significance. Trichome anatomy, wood and leaf anatomy, leaf epidermis and cuticle etc. provide valuable characters in differentiation between species. As for example the different species of *Rhododendron* and *Ficus* can be differentiated by means of trichome characters.

2. Enables to Detect Adulterants in Crude Drugs:

- Drug can be obtained from all parts of a plant (ex. *Swertia chirata*), leaves (ex. *Adhatoda vasica*, *Andrographis paniculata* etc.), roots (*Cephaelis ipecacuanha*), rhizome (ex. *Zingiber officinale*, *Rauwolfia serpentina* etc.), or bark (*Alstonia scholaris*).
- In this condition it becomes difficult to identify the materials by macroscopic appearance only. For this reason the microscopical along with morphological characters of drug materials are studied.

Example:

- Identification with the study of microscopical examination is much easier and quicker than that of chemical analysis.
- Mention may be made of a few drug plants with their uses and adulterants that can be detected microscopically. *Swertia chirata* (Family: Gentianaceae), commonly known as chirata is an indigenous drug of India. The root is used as a substitute of *Centiana lutea*,

which is used as gastrointestinal tonic, because the root of chirata does not constipate the bowels. The most common adulterant is *Swertia angustifolia* commonly known as pahari chirata.

3. Enables to Identify Wood:

- The anatomy of a wood sample reveals many characters that help in the identification of plant from which the wood comes.

4. Enables to Identify Archaeological Plant Remains:

- The wood-anatomy of present- day-plant provides characters to identify the fragmentary wood.
- These characters also enable to identify the wood and charcoal preserved in sites from antiquity.
- Microscopic slides are prepared and examined thoroughly. The wood anatomy of archaeological sample is compared with that of present-day-wood and thus their identity can be detected.

5. Applied Aspects of Meristem Culture:

Meristems may be apical, intercalary and lateral. Each of the meristems is exploited in the improvement of plants.

i. Apical meristem:

- Apical meristems occur at the tips of root, leaf and shoot. The shoot apical meristems are particularly used in culture.

Example:

Manihot esculentus, which is usually infected by Mosaic virus or Streak virus. A single meristem tip of *Manihot esculentus* provides a number of virus-free plants.

ii. Intercalary meristem:

- A large number of plants have meristem adjacent to and just above most nodes. This meristem is derived from apical meristem. In many plants adventitious roots are formed at nodes from this meristem.

iii. Lateral meristem:

Lateral meristem occurs on the lateral sides of a plant.

Example: Phellogen or cork cambium, fascicular cambium that is present between xylem and phloem of a vascular bundle of dicot stem and the inter-fascicular cambium that develops at the time of secondary growth from the tissues present between the two vascular bundles.

6. Provides Evidences in Forensic Investigation:

- Forensic botany encompasses many sub- disciplines, which include plant anatomy, plant systematic (taxonomy and species identification), palynology (the study of spores and pollen) etc. They refer the use of plant materials in solving crimes or resolving other legal problems.

7. Provides Characters of Taxonomic Significance:

- It is the prime importance to know exactly to which species a plant specimen belongs. This is necessary for a natural and reliable classification.
- The sources may be from anatomical features, palynology, biochemistry, embryology, cytogenetics, phytogeography, physiology etc. It is now realized that alpha taxonomy can form a natural, accurate and reliable classification.
- **The following important anatomical features those are often good indicators of the family, genera and sometimes species are discussed below:**

Trichomes:

- Trichomes are the collective term of hairs and papillae. They occur on all organs of a plant. There exists much morphological diversity among them.
- There are two major categories of hairs-the glandular and non-glandular. Each of the categories is sub-divided according to their gross structure, cellular constitution, nature of branching etc. There exist much diversities and varied forms in non-glandular hairs than the glandular hair. A few types of hair are illustrated in Fig 32.4.

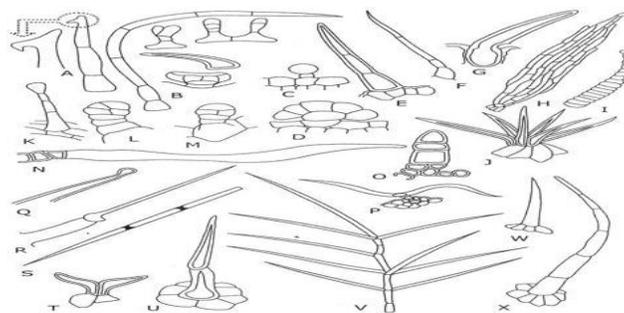


Figure 32.4
A. Hair of *Aphelia cyperoides*; B. Different hair types in *Monarda spicata*; C. Bicellular hair of *Salvia officinalis*; D. Multicellular hair of *Salvia officinalis*; E. Non-glandular hair of *Salvia officinalis*; F. Hair of *Centropogon*; G. Hair of *Thamnochortus*; H. Surface view of hair of *Centropogon*; I. Glandular hair of *Centropogon*; J. Denticulate hair of *Centropogon*; K. Glandular trichome of *Helianthemum*; L & M. Glandular trichomes of *C. triflorus*; N. Hair of *Loxocarpus*; O. & P. Hair of *Centropogon*; Q. & R. Glandular hair of *Dracaena*; S. Glandular hair of *Hydrocotyle* containing irritant oil droplets; T. Hair of *Trigonobalanus*; U. Non-glandular hair of *Justicia*; V. Non-glandular hair of *Verbascum*; W. Non-glandular hair of *Coldenia*; X. Hair of *Origanum*.

A particular type of hair is constant in a species. This property is used as an aid to identify the different species of Oleaceae,

ii. Stomata:

- Stoma has been shown to have great value in the taxonomy of several taxa. The distribution, morphology and ontogeny of a stoma are of taxonomic significance. Stoma is absent in roots. In exceptional cases it is reported from *Ceratonia siliqua* and *Pisum arvense* seedling roots.

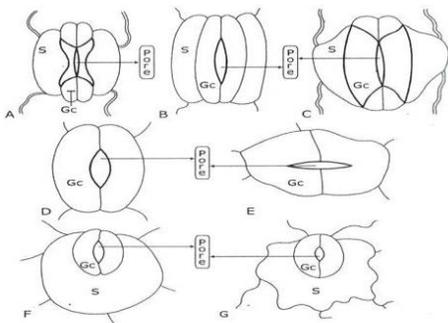


Figure 32.5
Diagram illustrating the types of guard cell and polycytic stoma. A. Dumb-bell type: The cell wall of guard cell is thinner at the polar ends than the other walls. Each guard cell is much narrowed in the middle and so it has dumb-bell like appearance in surface view. B. Rectangular type-A: The cell wall of guard cell is uniformly thick. Each guard cell is of uniform breadth in surface view. C. Rectangular type-B: The cell wall of guard cell is thinner at the polar ends than the rest of the walls. Each guard cell is of uniform breadth. D. Elliptic type: Each guard cell is as broad as long or longer than broad. The cell is reniform or more or less uniformly wide. Pore of stoma occurs parallel to guard cells. E. Right-angle type: Each guard cell is shaped like U or V. The contiguous wall of guard cells determines the stomatal axis, also referred to as polar axis of stoma. The pore of stoma occurs approximately at right angles to stomatal axis. The polar axis is frequently shorter than the equatorial diameter. F. Polycytic stoma (diagrammatic). G. Polycytic stoma of *Dipiazium polypodoides*.

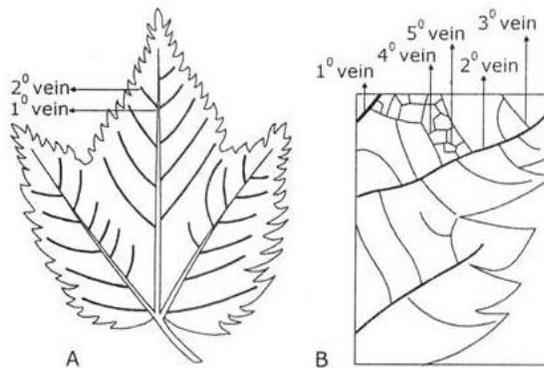


Figure 32.6

A. Diagram of a leaf of *Acer argutum* showing 1^o and 2^o veins. B. A portion of A enlarged showing 1^o, 2^o, 3^o, 4^o and 5^o vein.

The surface view of guard cells of a stoma can be of taxonomic significance.

iii. Veins:

- The veins and their innumerable variations in leaf venation pattern provide various characters of taxonomic importance.
- The different categories of vein provide many characters that are very useful in leaf identification.
- The spacing between 2^o veins is also of taxonomic significance. It may be uniform, irregular and increasing or decreasing towards the base.
- Usually four square millimetre area of a leaf is considered as a unit in counting the vein-islet numbers. The ultimate free endings of vein-lets have diagnostic value. They may be unbranched, linear or curved 1-branched, 2 or more branched etc. The following features of veins provide taxonomic information.

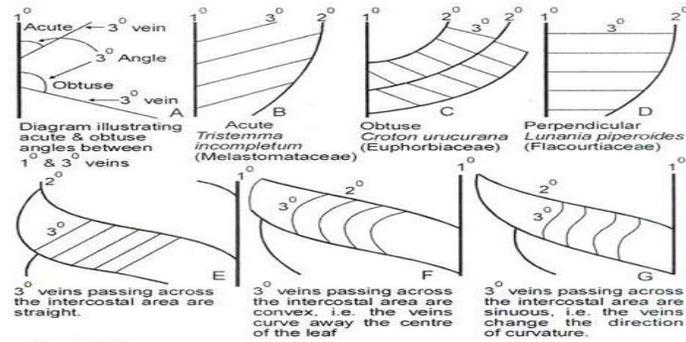


Figure 32.7

Diagram illustrating the angles formed between 1° and 3° veins (A, B, C, D) with terminology and the course of 3° veins in the intercostal areas (E, F, G).

Examples where anatomical features solved taxonomic problems:

- The ultra-structure of sieve tube plastids was used in circumscribing taxa. Sieve tube plastids are broadly of two types-starch accumulating (S-type) and protein accumulating (P-type). The S-type occurs in Polygonaceae, Plumbaginaceae, Batqceae, Theligoniaceae etc. whereas the P-type is found in Phytolaccaceae, Molluginaceae etc.
- There are certain families like Rafflesiaceae, Crassulaceae, and some species of Moraceae etc. where the sieve tube plastids accumulate neither starch nor protein.

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