

## Hydathodes

They are modified pores present on the margin of leaf which excludes the water as drop. The pores are generally called water stomata which facilitate guttation. Guttation is the secretion of droplets of water from the pores of plants. Hydathodes is made up of a group of living cells called epithem with numerous intercellular spaces, vascular bundles of leaves end here. Epithem cells open out into one or more sub-epidermal chambers which in turn communicate with the exterior/ water stomata.

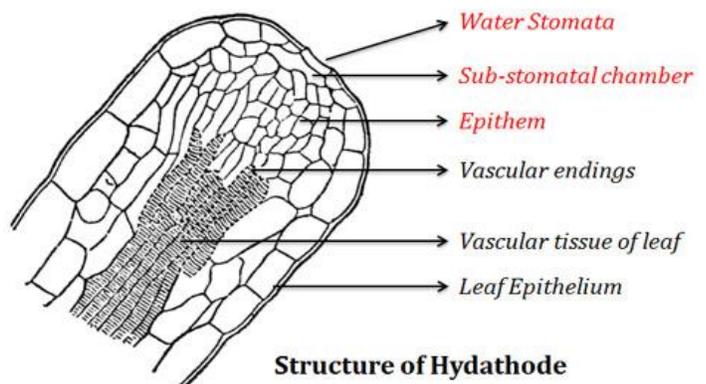
### Hydathode/Water Stomata (Structure and Functions of Hydathodes)

#### Hydathodes

- Hydathodes are specialized pores (openings) particularly present on the leaf margins, which exudes or secretes drops of water.
- The exudation of water as drops from the tip or margin of the leaves is called guttation. The process of guttation is facilitated by the hydathodes.
- They are also called as Water Stomata because they structurally resemble stomata and they facilitate guttation (secretion of droplets of water from the pores of plants).
- Hydathodes are commonly found in Angiosperms, especially in grasses.
- They are also present in some other plants such as water hyacinth, balsam, roses, Hibiscus and rarely in some non-angiospermic plants.

#### Anatomy of Hydathodes

- Hydathode is a type of secretory tissue in leaves that facilitate guttation.
- The water stomata resemble an ordinary stoma in shape and structure.
- However, the water stomata are larger than the ordinary stomata of leaves.
- Most importantly, the water stomata always stay opened since; they do not have opening and closing mechanism
- They are made of a group of living thin walled parenchymatous cells in the leaf with numerous intercellular spaces. These cells are called epithem.
- The epithem lack chloroplasts (sometimes very few stomata are present).
- The tracheids in the vascular bundle of leaves end and opens into the epithem.
- The epithem cells open into one or more sub-epidermal chambers.
- These sub-stomatal chambers communicate with the exterior



through the specialized pores on the leaf epidermis called 'water stoma'.

### **Functions of Hydathode**

- Facilitate guttation
- Also have an indirect role in ascent of sap

### **Secretory Structures in Plants**

The group of cells concerned in secretion of cutin, wax, suberin etc. is generally termed as secretory structures. The term secretion includes excretion and recretion also.

The term secretion implies the act of separation of by-products of metabolism from protoplast. These substances may be stored in insoluble forms within the cell or exuded from it, and have either a special physiological function or no use to the plant and regarded as waste. The removal of waste products of metabolism is defined as excretion.

- i. External Secretory Structures
- ii. Internal Secretory Structures

#### ***Internal Secretory Structure:***

The internal secretory structures may be composed of a single cell or groups of cells. They may occur throughout a tissue (e.g. oils or enzymes) or may be localized in distribution.

Example: castor oil obtained from the endosperm of *Ricinus*; ground nut oil extracted from the cotyledons of *Arachis*; the source of palm oil is the mesocarp of the fruit of *Elaeis guineensis*; the seed of *Carthamus tinctorius* yields safflower oil etc. Sometimes resin or oil secreting idioblasts are formed, e.g. oleo-resin cells are present in the ground tissue of the rhizome of *Zingiber officinale*, the oil cells secreting the aromatic oil occur in the phloem of *Cinnamomum zeylanicum*.

#### ***Glands and Ducts:***

- They comprise a group of cells or sometimes a single cell that is readily distinguishable from the neighbouring cells and secretes a specific substance. These cells are thin walled with dense protoplasm and sometimes occur as layer surrounding a cavity, known as secretory cavity.
- The secretion is discharged and accumulates within the internal cavity. These cavities may be more or less spherical or much elongated like tubes and respectively termed as glands or ducts.

- The internal cavities originate by three ways and accordingly the following three types of glands are recognized:

**(i) Schizogenous glands:**

These are formed by the dissolution of middle lamella, thus separating apart the cells to form cavity. Example: oil glands of *Eucalyptus*, the secretory ducts of *Rhus glabra*, resin duct of *Pinus* etc. This cavity remains surrounded by a ring of intact parenchyma cells, termed epithelium, which forms a well-defined boundary of the gland.

**(ii) Lysigenous glands:**

These glands originate by lysis of a few cells thus forming the cavity (ex. glands present in the leaves and fruits of *Citrus* sp. that are also formed schizogenously).

**(iii) Schizolysigenous glands:**

These glands arise by both phenomenon schizogeny and lysis, i.e. the middle lamella and some of the adjoining cells disintegrate to form cavity. Example: *Eugenia caryophyllata* where the glands are present in the floral parts that are the source of oil of clove. In contrast to schizogenous gland the lysigenous and schizolysigenous gland have no clear-cut boundary.

**Laticifers (Fig. 11.3):**

Laticifers can be defined as a specialized cell or a row of such cells that secrete the milky fluid termed latex. The word laticifer is used as a general term to denote the various latex-secreting structures — latex cell, latex vessel, latex duct, latex tube and laticiferous duct. The laticiferous duct is a cavity into which latex is secreted.

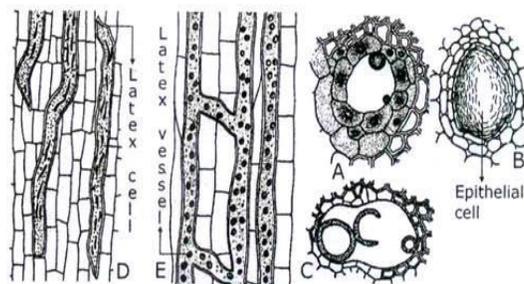


Figure 11.3

Diagrams showing D. latex cell of *Euphorbia pilulifera* (non-articulate), E. latex vessel of *Carica papaya* (articulate) and intercellular spaces : A. Resin duct of *Pinus* (schizogenous), B. oil-cavity of *Citrus* fruit (Lysigenous) and C. Protoxylem lacuna of maize (schizo-lysigenous).

- The latex cell may be simple or branched and is derived from the enlargement of a single cell. The latex ducts are elongated, branched and aseptate. The latex vessel is simple or branched tube that usually anastomoses with similar tubes; it is formed as a result of

enlargement and union of chain of cells. The latex tube usually means either a latex cell or the latex vessel.

- The borderline between the different terms of latex secreting structures (i.e. latex cell, -duct, -vessel, -tube etc.) is ill defined and so the word laticifer is introduced as a general term. The laticifers may be simple or compound on the basis of origin. The simple laticifer is derived from a single cell whereas the compound laticifer originates from a longitudinal file of cells.
- Latex is fluid produced in the latex vessels or cells. It is usually white and milky (ex. *Euphorbia*, *Asclepias*, *Lactuca* etc.), yellow and brown (e.g. *Cannabis*), orange and sometimes colourless and clear (e.g. *Morus*, *Nerium* etc.). It contains a number of substances including sugars, proteins, alkaloids, oils, mineral salts, organic acids, terpenes, resins, rubber etc.
- The latex of *Euphorbia milii* contains starch grains that are dumb-bell shaped. The proteolytic enzyme papain is present in the latex of *Carica papaya*. The latex of *Asclepias syriaca* contains the enzyme pectinase. The latex of some *Euphorbia* species is rich in vitamin B<sub>1</sub>.
- The cell wall of laticifers is thick and may be thicker than the adjacent cells. They are not lignified. The growth of cell wall occurs through apposition process. The tip of latex cell is thin walled. The walls are composed of cellulose, hemicellulose and pectin.
- The laticifers may occur throughout the plant body or their distribution is restricted to certain tissues.
- Laticifers are grouped into two: non-articulate and articulate. The former is derived from the enlargement of a single cell. This cell has the potentiality of unlimited and rapid growth, and elongates to form long latex tubes. The tubes may remain unbranched termed non-articulate unbranched laticifer (e.g. *Vinca*, *Cannabis*, *Urtica* etc.).
- In some plants (e.g. *Euphorbia*, *Nerium* etc.) the tubes may branch called non-articulate branched laticifers that seldom anastomose with similar types. The non-articulate laticifers are coenocytic and multinucleated, and also termed as laticiferous cell.
- There is continuity of laticifers between the shoots and branches. Laticifers grow through the intercellular spaces and the enzyme pectinase helps in the process. Pectinase is secreted by the growing tip of laticifers and dissolves the middle lamella.

- The articulate laticifers, also termed laticiferous vessel, consist of longitudinal files of cells. The transverse end walls of the individual cell either remain intact or break down partly or wholly to form a continuous tube —the latex vessel. So the articulated laticifers are always compound in origin. They occur in primary or secondary phloem and may be present in cortical parenchyma.
- They may remain either as a single chain of cells without any anastomosis termed articulated non-anastomosing laticifer (e.g. *Convolvulus*, *Allium*, *Musa* etc.), or they may anastomose with similar file of cells to form a complex anastomose system called articulated anastomosing laticifer (e.g. *Lactuca*, *Papaver*, *Carica papaya* etc.).
- The enzyme cellulase is found in the latex of articulated laticifers and it is absent from non-articulated laticifers. So it is suggested that cellulase is involved in the lysis of common transverse walls during the formation of articulated laticifers.
- Latex occurs in 900 genera distributed in 20 families of mostly in dicotyledons ( e.g. Apocynaceae, Asclepiadaceae, Compositae, Euphorbiaceae, Papaveraceae etc.) and in a few families of monocotyledons (e.g. Araceae, Musaceae and Liliaceae).
- They are very much economically important, a few of which are mentioned below: The opium, a medicinally important alkaloid is obtained from *Papaver somniferum*. The most important latex is rubber whose principal source is *Hevea brasiliensis*. The species of *Palaquium gutta* yields gutta-percha. The latex of *Achras sapota* yields chicle, from which chewing gum is made.

#### **Function of laticifers:**

**Regarding the function of laticifers different views were expressed since 1877, a brief account of which is mentioned below:**

- (1) It is a vital sap vessel and similar to the blood vessels of animals.
- (2) It takes part in translocation of assimilates as it is associated with phloem.
- (3) It stores food materials.
- (4) It is now considered as secretory tissues where the secretory substances do not re-enter the plant metabolism.
- (5) Sen and Chawan (1972) suggested that laticifers regulate the water balance in plants.
- (6) It has role in the transport of oxygen.
- (7) It has role in healing up of wounds.

(8) It acts as a defense against herbivores and microorganisms. [The human ocular tissues are damaged by the latex of *Calotropis procera*].

(9) McCay and Mahlberg (1973) reported the absence of bacterial activity from laticifers of *Asclepias* in vivo.

***Myrosin Cell:***

- It is a special type of secretory cell where the enzyme is produced and stored. Myrosin cells are idioblasts, which contain the enzyme myrosinase ( $\beta$ -thioglucosidase). They are reported from Cruciferae, Capparidaceae, Moringaceae, Tropaeolaceae etc.
- They are more or less similar in shape to the neighbouring cells and may be elongated or assume various shapes. They occur in the integument of seeds, in the exocarp and endocarp of fruits, in the cotyledons, in the cortex of stem, in the leaf lamina, spongy parenchyma etc.
- The enzyme myrosinase hydrolyses thioglucosides to produce mustard oil and other substances. The enzyme and substrate occur in different cells, i.e. the enzyme is produced in myrosin cells and thioglucosides are present in the other parenchyma cells.
- The reaction between the enzyme and substrate is brought about only when the tissues are damaged and thus mustard oil is released. When insects feed on such plants mustard oil is released in the insect gut. It is demonstrated that mustard oil is toxic to a number of insects.

Three main types of cavities are:

**Lysigenous cavity:** This type of the cavity arises by the disintegration of the cells like loosening and lysis. The main function of this cavity is to store water and gases. This is present in the monocotyledon plants.

**Shizogenous Cavity:** This type of cavity arises by the separation of the cell walls. The walls are separated from each other in the extended areas by the cells contact.

**Shizolysigenous Cavity:** This is a modified form of the shizogenous cavity when the stored space initiates. The cells of the glandular epithelial undergoes the process of autolysis and causes the enlargement of the storage cavity.

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