

MOVEMENTS IN PLANTS

**B.Sc. (Hons.)
Part III
UNIT V**

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Parts of the plants, their roots, their leaves, their stems all are capable of movements and in fact move continuously. The movement in plants is mostly seen as bending, turning, twisting or as elongation of plant parts.

Locomotion i.e. movement from one place to another as seen in animals is absent in larger and complex plants, as they remain fixed to the substratum with their roots. But certain lower plants like unicellular forms (*Chlamydomonas* etc.) or spores/ gametes of bryophytes and pteridophytes etc., show locomotion.

Many of plant movements are mostly overlooked because of their slow- rate.

Thus, the capacity of plants of to change their position in response to external (environment) or internal stimuli is known as plant movements.

Most of movements exhibited by plant can be classified as -

A) MOVEMENT OF LOCOMOTION

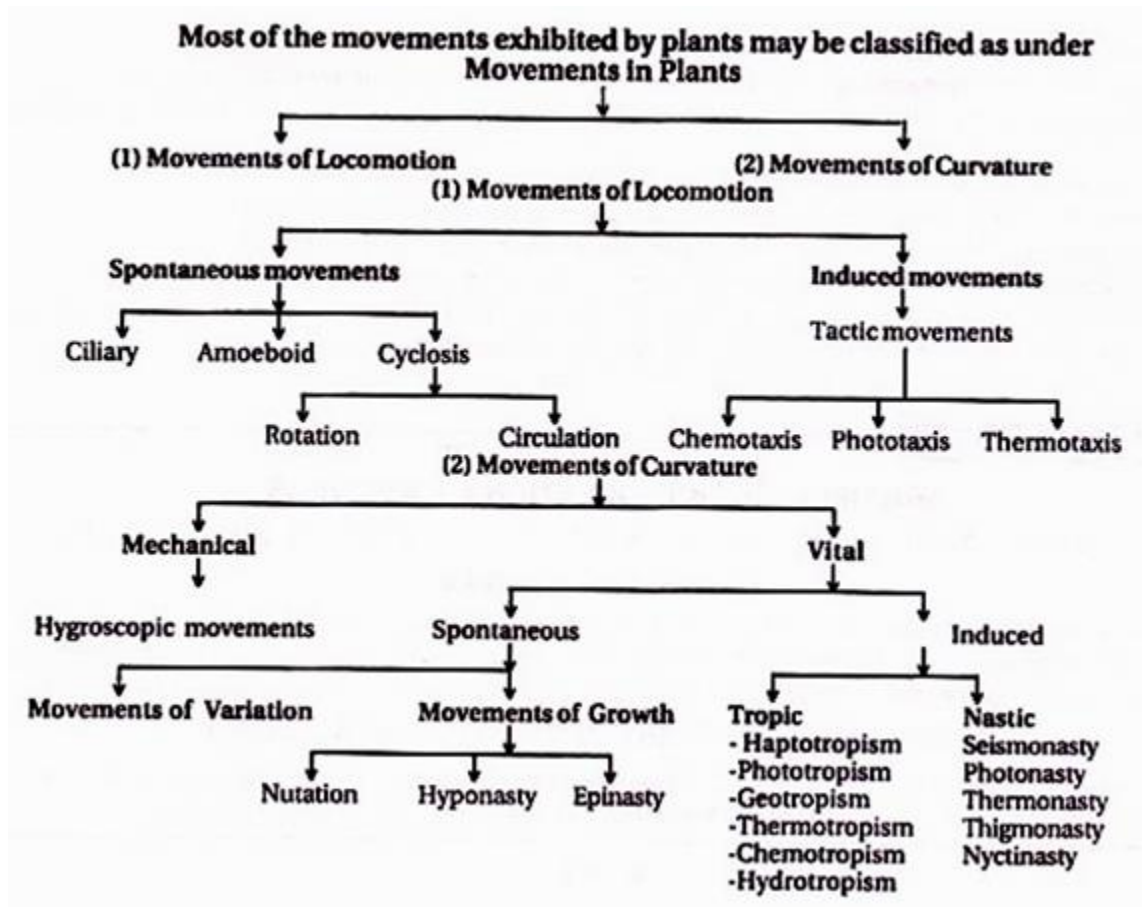
B) MOVEMENT OF CURVATURE

A) MOVEMENT OF LOCOMOTION

- Plant moves physically from one place to another.
- It involves movements of the whole plant body, of an organ or of material within the plant cell.
- The movements of locomotion are of two types-
 - a) **Autonomic (spontaneous)**
 - b) **Paratonic (induced by external stimuli).**

a) **Autonomic movement of locomotion:** These movements of locomotion are due to internal stimuli and external stimuli have no role in these locomotions. They are of following types:

- i. **Ciliary/ Flagellar movements:** Certain motile algae (*e.g., Chlamydomonas, Volvox*, etc)., Zoospores and gametes of lower plants move from one place to another by means of locomotory organs like cilia or flagella.
- ii. **Amoeboid movements:** In members of Myxomycetes (slime fungi) naked mass of protoplasm locomote by producing pseudopodia like process. Tapetal cells also show amoeboid movements.
- iii. **Cyclosis:** These are movements of cytoplasm within a cell (also called protoplasmic streaming). These are of two types:



- **Rotation:** When the protoplasm moves around a single central vacuole in either clockwise or anticlockwise direction *e.g* in leaf cells of *Hydrilla*, *Vallisneria*.
- **Circulation:** In it the movement of protoplasm occurs around different *vacuoles* in different directions within the cell *e.g.*, staminal hair of *Tradescantia*.

iv. **Oscillatory movements:** Movement of Apical part of *Oscillatoria* is like a pendulum.

b) **Paratonic movement of locomotion (Tactic movement):** These movements are influenced by external stimuli like light, temperature or chemicals and are of following types:

- i. **Phototactic movements/ phototaxis:** It is the movement of free living organism towards or away from light. *Chlamydomonas*, *Volvox*, *Ulothrix*, *Cladophora*, etc. locomote towards suitable light intensity.

- ii. **Chemotactic movement/ chemotaxis:** It is the movement of plant or plant parts from one place to another towards or away from chemical substance. *e.g.*, male gametes of bryophyta and pteridophyta move towards archegonia that secrete sugars, malic acid to attract male gametes.
- iii. **Thermotactic movements/ thermotaxis:** *Chlamydomonas* move from cold water to medium warm water and from very hot water to medium temperature.

B) MOVEMENT OF CURVATURE

In these cases, plants are fixed, thus they fail to move from one place to another and somehow, movement is noticed in the form of bend or curvature on any part of the plant.

By means of curvatures these organs may change their positions according to their requirement in order to carry on their functions more effectively.

Movement of curvature can be classified into-

I) MECHANICAL

II) VITAL MOVEMENTS

I) MECHANICAL OR HYGROSCOPIC MOVEMENTS: These movements occur in non-living parts of plants and depend upon the presence or absence of water. These are mechanical movements, which have nothing to do with protoplasm.

It is of two types.

- i. **Xerochasy :** This movement occurs due to the loss of water. Example: When water is lost from the annulus of the sporangia of fern, it burst from stomium and spores are liberated out. The explosive movements or catapult actions of certain fruits like *Lupinus perennis* and *Iris versicolor* take place when certain fruit tissue dries up. *Ruellia* fruit ruptures after absorbing moisture from outside.
- ii. **Hydrochasy:** This movement occurs due to the absorption of water. Example: Peristomial teeth of moss protrude out when the capsule is dry and curve when capsule is wet. Elaters of the *Equisetum* coil and uncoil in the presence and absence of water.

II VITAL MOVEMENTS: Irritability of protoplasm brings these movements. These movements are of two types:

a) **Autonomic movement** and b) **Induced movement**

a) **AUTONOMIC MOVEMENT** include

i) Growth movements and ii) Variation movements

(i) **Autonomic growth movements:** These movements are due to unequal growth in different parts of an organ and are irreversible. They are independent of the surroundings of plants or external stimuli.

They are further divided into types

- **Nutation:** These movements occur in the growing stem of twiners (peas or beans). The stem exhibits a kind of nodding movements in two directions. As, the stem apex shows more growth on one side at one time and a little later there is a greater growth on the opposite side. It is called nutation. This circular movement of growing stem takes place always in the same direction for the same plant species. Since, the more rapid rate of growth travels around the tip which, as it grows upwards must therefore rotate.
- **Circumnutation:** In spirally growing stems and tendrils, the region of greater growth passes gradually around the growing point resulting in the spiral coiling of stem and tendrils. Such a movement is called **circumnutation**.
- **Epinasty and Hyponasty movements:** They are non-directional movements in which the response is determined by the structure of the responsive organ and not the direction of the stimulus.
This kind of movement is exhibited mostly by young leaves, organs having dorsiventral symmetry.
Epinasty is caused due to rapid growth on the upper surface (abaxial side), such as occurs at the time of the opening of leaves.
Hyponasty is greater growth on the lower side (adaxial side) *e.g.*, circinate coiling and closed sepals and petals in a floral bud.

ii) Movements of variation:

- They are autonomous curvature movements and are independent of external stimuli.
- They are not growth movements hence are reversible.
- These movements are also known as turgor movements because these are brought about by changes in the turgor pressure of certain sensitive cells of the plant organs. Such movements are exhibited by lateral leaflets in *Desmodium gyrans*.

b) PARATONIC/ INDUCED MOVEMENTS

These movements are affected by various external stimuli. And they are of two types

i) Tropic and ii) Nastic movements

- i. **Tropic movements:** These are movements of curvature brought about by more growth on one side and less growth on the opposite side of plant organ induced by some external stimuli.
- ✓ Thus they are not reversible as they are growth movements.
 - ✓ They are directional movements and direction of stimulus influences the orientation of responding plant organ. Stimulus is therefore directional and not diffuse.
 - ✓ There is a directional relationship between the response and stimulus. Response occurs either towards it (positive) or away from it (negative response).
 - ✓ They are slow movements unlike nastic movements.
 - ✓ These movements are present in all plants and not restricted to specialized plant or plant part.
 - ✓ Tropism is typically shown in plant organs having radial symmetry like shoot, root.
 - ✓ Depending upon the nature of stimuli these movements are of the following types:
- **Phototropism (Heliotropism):** When a plants organ curves due to unilateral light stimulus it is called phototropism. Some parts of the plant *e.g.*, stem moves towards light thus is positively phototropic. Roots move away from light and they are called negatively phototropic.
 - **Geotropism (Gravitropism):** Growth of movements induced by the stimulus of gravity is known as geotropism. The secondary lateral roots and shoots show a weaker response to gravity and thus take up a position at an angle to the gravitational stimulus and are called diageotropic.
 - **Hydrotropism:** Growth movements in response to external stimulus of water are termed as hydrotropism. Roots are positively hydrotropic (*i.e.*, bend towards the source of water).
Stems are either indifferent or negatively hydrotropic. Positive hydrotropic movement of the roots is stronger than their geotropic response. As if there is scarcity of water, roots bend towards the sewage pipes and other sources of water in disregard to the stimulus of gravity.
 - **Chemotropism:** When a curvature takes place in response to a chemical stimulus. The growth of pollen tube through stigma and style towards the embryo sac occurs with the stimulus of chemical substances or growth of fungal hyphae towards sugars and peptones are examples of chemotropism.

- **Thigmotropism (Haptotropism):** The movements which occur are due to contact with a foreign body. It is most conspicuous in tendrils which coil around support and help the plant in climbing.
- **Thermotropism:** Curvature of plant parts towards normal temperatures from very high or very low temperatures is thermotropism.

(ii) **Nastic movements:** These movements of variation or turgor movements are affected by some external stimuli such as light, temperature or contact but the direction of response is prefixed and not determined by the direction of stimuli.

- ✓ In nastic movement the stimulus is diffuse, i.e., it does not affect the organ from any definite direction and the movement, thus induced by the stimulus, is determined exclusively by the properties of the irritable cells.
- ✓ The response of the organ is independent of the direction of the stimulus.
- ✓ These are faster movements when compared to tropic movements.
- ✓ These are more specialized movement in function.
- ✓ They are typically shown in plant organs having dorsiventral symmetry.
- ✓ Nastic movements are shown by specialized plant and plant organ.
- ✓ Nastic movements are of the following types:

- **Nyctinastic (sleeping) movements:** The diurnal (changes in day and night) movements of leaves and flowers of some species which take up sleeping position at night are called nyctinastic movement. *Maranta* (Prayer plant), an ornamental house plant provides most common examples of nyctinastic response.

Depending upon the stimulus they may be photonastic (light stimulus) or thermonastic (temperature stimulus).

- ❖ **Photonastic movements:** Leaves of *Oxalis* take up horizontal position in sunlight and droop down during night.
- ❖ **Thermonastic movements:** Flowers of tulips and *Crocus* open during high temperatures of day and close down during low temperatures of night.

- **Thigmonastic (Haptonastic) movements:** The movements of plant in response to touch stimulus is called thigmonastic movement. Insectivorous plants show thigmonasty. e.g. when marginal glandular hair of *Drosera* come in contact with some foreign body *i.e.* body of insect, they show haptonastic movements.
- **Seismonastic movements:** This type of movement is brought about in response to external stimulus of shock or touch. The best example of seismonastic movement is depicted by the leaves of sensitive plant *Mimosa pudica* (Touch- me- not).