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Topic- Physiology of tropic movements in plants

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Binod Kumar Pandey

Assistant Professor & HOD, Botany Department,

Ram Ratan Singh College, Mokama, Patna.

[E.mail- binodkp14@gmail.com](mailto:binodkp14@gmail.com)

Physiology of tropic movements in plants

Life is a sense of balance among several activities. These activities include growth, nutrition, reproduction, excretion, etc. Both animals and plants are two different forms of living organisms. Therefore the pathway, which they follow for numerous life processes are also different.

For instance, animals can run away from their predators, but plants cannot. Plants have their own mechanism to counteract the danger they face.

Nervous system and endocrine system are the two different systems in the animal body which is involved in balancing and controlling different types of activities. In the case of plants, they are completely devoid of the nervous system and other special organs. However, plants adapt to retort to various stimuli by few movements. The response can be a slow process such as tropism or a rapid movement, such as semi-monastic movement. Sensitive plants exhibit semi-monastic movement while responding to a touch. Hence, we can categorize plants into two types on the basis of their movements: Tropic movements and Nastic movements.

When a plant exhibits some growth movement in response to a stimulus, it is referred to as tropism. Tropism is specific to the direction of the stimulus. Plants can either display a negative or positive movement in response to a stimulus. It is positive tropism when the movement is towards the direction of stimuli while it is negative tropism when the movement is away from the stimuli.

Types Of Tropic movements

1. Thigmotropism (Haptotropism):

Growth movements made by plants in response to contact with a solid object are called thigmotropism. These are curvature movements and are most apparently seen in tendrils and twiners. In most plants the curvatures of the tendrils which follow contact with a support are mostly the result of increased growth on the side opposite the stimulus (Figs. 7.8 & 7.9).



Fig. 7.8. Hook-Climber of *Uncaria*.

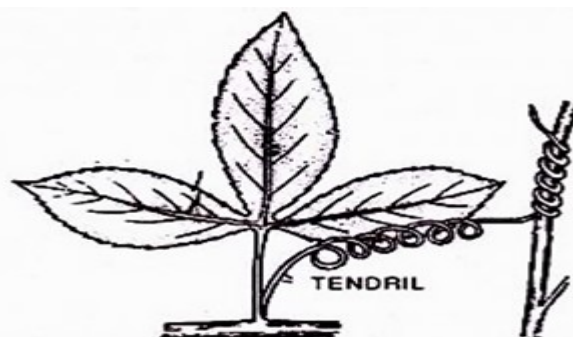
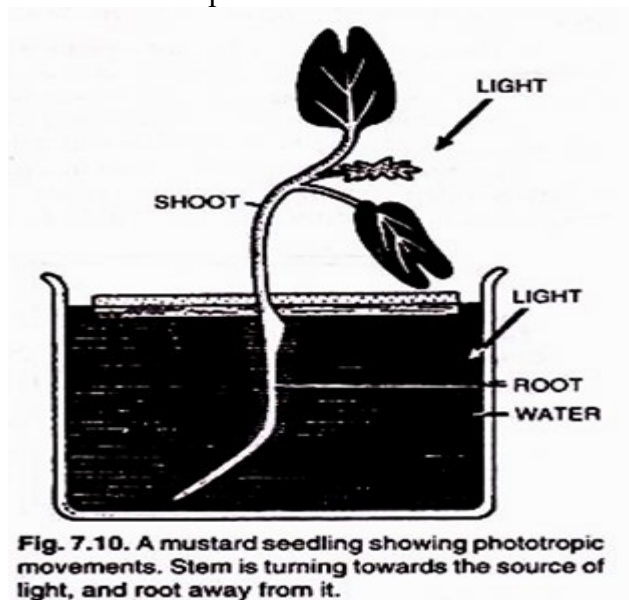


Fig. 7.9. *Passiflora* - a tendril climber.

2. Phototropism:

This kind of movement is induced by light. Not all plants and not all parts respond in the same way to this stimulus. In general, the stem mostly grows and turns towards the source of light, while the roots away from it. As shown in fig. 7.10 the leaves also positively respond toward the source of light. The leaves, however, take up such a position in which the broad surface of the blade is at right angles to the light rays. A stem is, therefore, said to be positively

phototropic, a root negatively phototropic, and a leaf transversely phototropic or diaphototropic. Phototropism is also known as heliotropism.



In certain plants, such as *Arachis hypogea* (ground nut) more complex changes occur within a short period of time. The flower-stalks of this plant initially show positive phototropism until they have produced flowers. Soon after fertilization the stalks curl up and eventually bury the developing pods under the soil, thus showing negative phototropism.

3. Geotropism:

Any reaction to the stimulus of earth's gravity is called geotropism. The effects of gravity on plants are not like those of light and temperature because it is both continuous in action and constant in strength. Primary roots and certain other portions of the root system tend to grow directly toward the centre of gravity and hence called positively geotropic.

Stem mostly grows away from the centre of gravity and is thus negatively geotropic. However, stems in prostrate plants have lost their negative geotropism and even develop into root stock or tubers which behave exactly like roots. Most of the leaves take up their positions at right angles to the centre of gravity and are, therefore, called transversely geotropic or diageotropic. Geotropism is of three types: orthogeotropism (e.g. primary root), plageotropism (e.g., secondary roots) and diageotropism (movement of tertiary roots)

Mechanism of Phototropism:

In this example, the positive and negative curvatures shown by stem and root respectively, is the result of the unequal growth of the illuminated and shaded sides of the apex. In case of stem the growth is more on the shaded side while in the root it is more on the illuminated side. More growth of the stem on the shaded side is due to more accumulation of auxin on the shaded side than on the illuminated side.

This unequal distribution of auxins on the two sides may be due to following two reasons:

- (i) Translocation of auxins from illuminated side to the shaded side.
- (ii) Inhibition of auxins synthesis in the illuminated side.

Mechanism of Geotropism:

Geotropism too can be explained on the basis of differential (unequal) distribution of auxins. In a horizontally placed plant the auxin accumulation on the lower side of the stem and root apices due to gravity. In the stem higher concentration of auxin on the lower side of the apex stimulates its growth on that side. This results in growth of the stem in upward direction showing negative geotropism.

On the other hand, in case of root, the higher concentration of auxin on the lower side inhibits the growth on the upper side than on the lower side. As a result the root apex grows downward (i.e, Positive geotropism).

Demonstration of Phototropism and Geotropism:

1. Demonstration of Phototropism in Stem:

Take a potted seedling of a plant. Place it in heliotropic (phototropic) chamber with a small hole on one side (Fig. 7.11). Close the top of the chamber. Place it in a position that allows sufficient light to pass through the hole. Keep it there for a couple of days. Open the chamber and observe the seedling. It shows a bending (curvature) of the stem towards the hole (direction of light stimulus). This response is positive phototropism.

2. Demonstration of geotropism in a plant:

Take a potted seedling. Place it horizontally within a dark wooden chamber (Fig. 7.12). Open the chamber after one day. The stem will be seen bent upwards, i.e., in a direction opposite to the pull of gravity. This is negative geotropism. Take the roots out of the pot. They will show a curvature or bend opposite to the bend of the stem. This curvature is in the direction of the pull of gravity. It is positive geotropism.

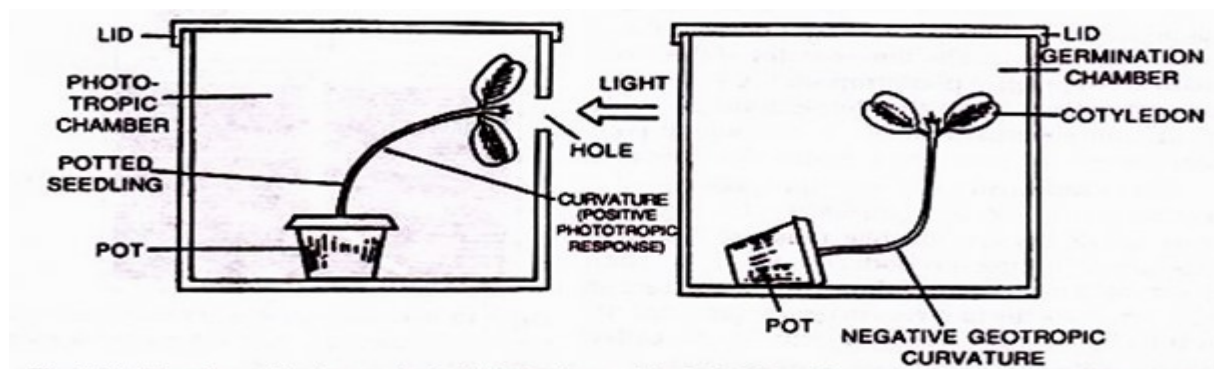


Fig. 7.11. Experiment to demonstrate phototropism. Fig. 7.12. Experiment to demonstrate geotropism.

4. Thermotropism:

Some of the plant organs markedly respond towards fluctuating atmospheric temperature. In response to this kind of stimulus plant parts exhibit curvature movements in order to take some advantageous position. Such movements are called thermotropism.

5. Chemotropism:

Certain chemical substances are responsible to bring about curvature movements in plant organs. For instance, movement of Pollen tube towards ovary due to absorption of

calcium and borate from style of carpel; movement of tentacles in *Drosera*, closing of lid of *Nepenthes* due to nitrogenous food, and penetration of haustoria of parasite into host body etc.

6. Hydrotropism:

The paratonic curvature movements of growth in relation to the stimulus of water are called hydrotropic movements. The tropic response to the stimulus of water is called hydrotropism. The roots show positive hydrotropic response, i.e., they bend towards the water (Fig. 7.13). Hydrotropism is stronger in roots compared to geotropism.

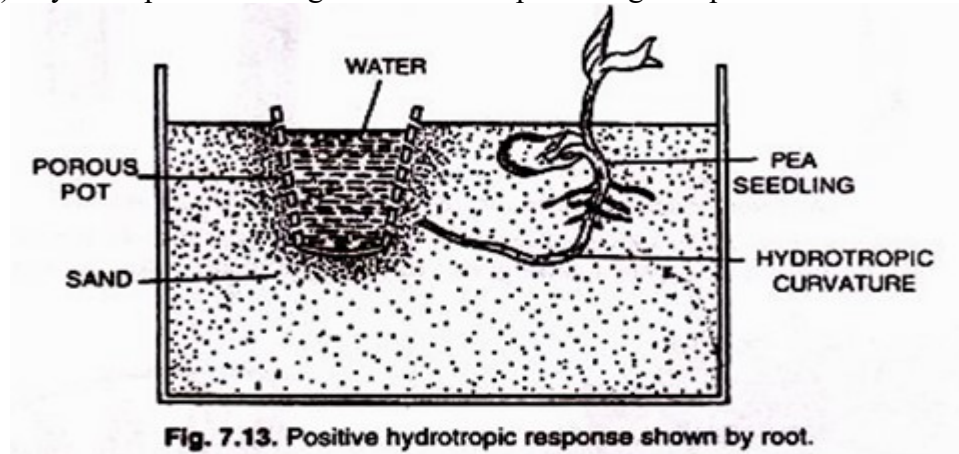


Fig. 7.13. Positive hydrotropic response shown by root.

The exact mechanism of hydrotropic response is not known. Probably roots detect and react to differences in the concentration of water.