Chemical Coordination in Plants

Movement in Plants

In animals, control and coordination is governed by the nervous system. However, plants do not have a nervous system.

Then, how do plants respond to stimuli?

Plants respond to stimuli by showing movement.

Have you ever seen any movement in plants?

- When you touch a sensitive plant such as *touch- me- not (Mimosa pudica)*, the plant folds its leaves and droops.
- When a seed germinates, the root grows down in the soil and the stem grows up in the air.

In the first example, touch is the stimulus and the plant responds by folding its leaves. Therefore, the plant shows movement by folding its leaves.

In the second example, the seed germinates and shows directional movement.

In the first example, movement is independent of growth i.e. there is no growth involved. However, in the second example, the movement of the seedling is caused by growth. If the seedling is prevented from growing, then it will not show any movement.

Thus, plants exhibit both growth-dependent and growth-independent movements.

Growth-independent movements

In plants (like animals), the information is carried from cells by electro-chemical means. However, there is no specialized tissue for the conduction of information. In fact, plants change their shape by changing the amount of water in them. This results in swelling and shrinking. This change of shape results in movement.

Growth-dependent movements

You must have seen plants such as peas and grapes with tendrils. Movement in these plants occurs in the growing stem of the tendrils. When the tendrils come in contact with a supporting object, they coil and cling around it. Plants respond to stimuli slowly by growing in a particular direction. This type of growth is directional.

Nastic movements in plants

Nastic movements are the movements in plants that take place in response to the environment stimulus. One of the main feature of the nastic movement is that the direction of the movement is independent of the direction of stimulus.

For example, the movement of organs like leaves and petals that are directed by the touch as in the leaflets of touch me not plant, wherein the plant droops when touched from any side.
The various kinds of nastic movements shown by plants are:

Thigmonasty:
It is the movement of a plant in reponse to an external stimuli like touch, vibration etc. For example, *Mimosa* plant responds by "folding up of leaves" when touched. The sensitive part of the plant involved in this type of movement is called pulvinus which is a soft, swollen structure present at the base of the leaf.

Photonasty:
Some plants show movement in plant part in response to the light. For example, flowers of sunflower and lotus open in morning.

Thermonasty:
It is the movement of plant parts in response to the rise and fall in temperature. For example, flower of crocus and tulip open with a rise in temperature and close with a drop in temperature.

Do You Know?

The Venus flytrap is an insectivorous plant, in which leaves act as trap lobes?

The movement of these lobes traps the insects. Hence, it is an example of complex movement in plants.

Tropism in Plants

Tropic movements in plants

Tropism is the response to stimuli that comes from one direction.

Let us perform an activity to understand tropism in plants.

If the movement of the plant part is towards the stimulus, then it is known as **positive tropism**. If the movement of the plant part is away from the stimulus, then it is known as **negative tropism**.

Types of tropisms

Phototropism

The growth movement in plants in response to light stimulus is known as **phototropism**. For example, the flower head of a sunflower is positively phototropic as it moves from East to West, along with the movement of the Sun.

In the above activity, the shoots show **positive phototropism,** while the roots show **negative phototropism.**

Curiosity Corner

Why fruits like groundnuts are formed underground?

The ovary stalk of groundnut is positively phototropic before fertilization, and becomes negatively phototropic after fertilization. This is the reason why fruits like groundnuts are formed underground.

Geotropism

The growth movement in plants in response to the force of gravity is known as **geotropism**. In geotropism, the roots of the plant always grow downwards, while the shoots always grow upwards, away from the earth.

Chemotropism

The growth movement in plants in response to chemical stimuli is known as **chemotropism**. For example, the growth of pollen tube towards the ovule in the ovary (through the stigma and style) is an example of positive chemotropism.

Hydrotropism

The growth movement in plants in response to water is known as **hydrotropism**. For example, the roots of some plants grow towards the water source, even when the water source is not present directly below it.

Thigmotropism

The growth movement in plants in response to a touch stimulus or contact with a solid object is known as thigmotropism. For example, in some plants, the coiling of tendrils occurs when they come in contact with objects for support.

Plant Hormones

Phytohormones

In plants, growth, development, and response to the environment is controlled and coordinated by a special class of chemical substances known as **phytohormones**. These hormones are produced in one part of the plant body and are translocated to other parts. For example, a hormone produced in the roots is translocated to other parts where they are required.

Thus, the growth hormones of plants are known as **phytohormones.** These are naturally occurring organic substances. They are synthesized in minute quantities in one part of the plant body and are translocated to other parts where they are required.

Types of phytohormones

There are five major types of phytohormones: auxins, gibberellins, cytokinins, abscisic acid, and ethylene. These phytohormones are either growth promoters such as auxins, gibberellins, cytokinins, and ethylene, or growth inhibitors such as abscisic acid.

Auxins

When the growing parts of a phototropic plant detect sunlight, auxins (synthesized at the shoot tips) help the cells grow longer. When light falls on one side of the plant, the auxins generally diffuse towards the shaded side of the shoot. This stimulates the cells in the shaded area to grow longer than the corresponding cells of the illuminated region. This results in the curvature of the plant stem tip towards the light.

Gibberellins

They are produced in the roots of a plant. They promote stem elongation by promoting cell division in the inter-nodal region.

Cytokinins

They promote cell division. Therefore, they are present in greater concentration in those areas of the plants where rapid cell division occurs. For example, tip of the shoot.

Abscisic acid

It promotes seed dormancy by inhibiting cell growth. It is involved in the opening and closing of stomata. It is also responsible for the shedding of leaves.

Ethylene

It regulates fruit ripening. It is produced during the ripening of fruits.

Fruit ripening

Ethrel (Ethephon) liquid is sprayed on plants to facilitate fruit ripening. It contains a dilute solution of 2-chloroethylphosphonic acid, which breaks down to release ethylene. It helps in the artificial ripening of commercially grown fruits such as pineapples, mangoes, bananas etc.

How is over ripening prevented?

CO_2 in high concentration prevents over ripening of fruits as it inhibits the production of ethylene.