**College of Science Al-Mustanseryea University Dep.: Biology**

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**Lecture:6**

**Plant Hormones**

**Plant hormones:** are a group of naturally occurring, organic substances which influence physiological processes at low concentration.

**Characters of plant hormones:**

**1-**integrate many different plant parts.

**2-**natyrally occurring organic substances.

**3-**affects plant growth and development.

**4-**opreats in a very low concentration.

**5-**actions may involve sites far removed from hormones origin.

**6-**hormones elicit a wide range of responses from growth to dormancy.

**\*\*\*Hormones may classified into these classes:**

**A/Promote hormones:**

**1-Auxins 2-Gibbrelline 3-Cytokinins**

**B/Inhibit hormones:**

**1-Ethylen 2-Abscisic acid**

**\*\*\*Note:** that hormones are a specific chemicals which produced in specific organism in small quantities and travel to other areas (the target area), at the target area they regulate physiological responses (like: growth, movement, reproduction).

**\*\*\*There are some definitions in plant hormones:**

**1-plant regulators:** are organic compounds other than nutrients that in small amounts promote, inhibit or modify a physiological process in plants.

**2-plant hormones or phytohormones:** are regulators produced by plants which in low concentration regulate plant physiological processes. Hormones usually move within the plant from site of production to a site of action.

**3-growth regulators or growth substances:** are regulators that affect growth.

**4-growth hormones:** are hormones that regulate growth.

**5-flowring regulators:** are regulators that affect flowering.

**6-flowering hormones:** are hormones that initiate the formation of floral primordial or promote their development.

**\*\*\*\*Auxins(Indol acetic acid – IAA)\*\*\*\***

**1-**Firist plant hormones to be discovered.

**2-**very simple chemical structure, dramatic influences on growth.

**3-**early on it was believed to be the master (plant hormone)

**4-**growth promoting hormone.

**5-**Auxin found in embryo of seed, young leaves, meristem of apical buds.

**\*\*there are some physiological effects influenced by Auxins:**

**1-**cell enlargement of stems, leaves and roots.

**2-**cell and organ differentiation.

**3-**flower initiation and development, fruit set, fruit growth, and embryo growth.

**4-**abscission of leaves, flowers and fruits.

**5-**direction of growth (tropism of stems or roots).

**6-**apical dominance.

**7-**parthenocarpy in some plants.

**8-**enlargment and cell division of callus tissue culture.

**\*\*Tropism:** it is defined as the movement of plant organ towards the environmental stimulus such as light, gravity, water and chemical stimulus. There are several types of tropism:

**1-photo tropism:** it is bending of plant towards the light source due to translocation of auxin to the shaded side. The increased concentration in the shaded side causes increase in cell enlargment and growth of the cell in this region and cause bending.

**2-Eotropism:** movement of roots towards the earth center due to earth gravity. This happens due to accumulation of auxin in the lower region. Roots are different from stems in their response to auxin. High concentration of auxin in roots causes inhibition instead of stimulation. Root is positive geotropism while stem is negative geotropism.

**3-Apical dominance:** it is phenomenon in which apical bud dominate over the lateral bud and doesn’t allow it to grow. This happens when the auxin in the apical bud translocated to lateral buds and increases their auxin concentration. The high concentration of auxin inhibited growth of lateral buds.

Scientists found the presence of several compound of indol in nature which have similar function of IAA such as Indole pyruvic acid, Indol acetonitrl and Indol acetaldehyde.

These compounds may be metabolized and change to IAA in plants.

There are two kinds of auxin in plants:

1. Free auxin, which can be isolated by diffusion.
2. Bound auxin, which cannot be isolated by diffusion.

There are some compound similar to auxin and these compounds have the ability to bind with auxin and inactivated it, these are called **antiauxins**.

**\*\*Artificial auxins:** are synthetic chemical compounds acts as plant hormones and are divided into two groups:

**1-**compound containing indol derivative such as indol butyric acid and indol propionic acid.

**2-**compound don’t contain indol derivative such as α and β naphthalene acetic acid, 2,4 dichloro phenoxy acetic acid and 2,4,5 trichloro phenoxy acetic acid.

The low concentration of these compounds acts as auxin.

**\*\*Biosynthesis of Indol acetic acid (IAA):**

The amino acid tryptophan is considered a primary precursor of IAA of plants. The production of auxin is an enzymatic process.

IAA could be formed from tryptophan via two different pathways:

1. By the deamination of tryptophan to form indol pyruvic acid, followed by decarboxylation to form indol acetaldehyde.
2. By the carboxylation of tryptophan to form tryptamine followed by deamination to form indol acetaldehyde.

By either pathway indol acetaldehyde is formed thus must be considered the immediate precursor of IAA in plants.

**\*\*\*Destruction of Auxin:**

Two means of destruction of IAA in plants appear to dominate :

1. Enzymatic oxidation.
2. 2- Photo oxidation.

The enzymatic system is called IAA oxidase, the IAA oxidase content of the various plant parts. The enzyme increases in activity from tip to down. IAA oxidase activity seams to be low in regions of high auxin content (high growth) and high in regions with low IAA content (low growth).

**\*\*\*photooxidation:** it has long been known that IAA can be inactivated by ionizing radiation x and gamma radiation. Ultra violet light also in activate IAA, and visible light between 300-700 millemicron.

**\*\*\*Gibberellins (GA)\*\*\*\***

Gibberellins are belonged to terpenoids group which synthesized from isoprene units. GA consist of 4 isoprene units and differ among each other in the position and number of methyl, carboxyl and hydroxyl groups and in the number of saturated in the first ring.

**\*\*\*positions of GA synthesis in the plants:**

1. Juvenile leaves. **2**-roots. **3-**buds. **4-**embryo and fruits.

GA are broken down slowly in plant. Also it can be transformed into inactive form by conjugation with sugar or protein molecules.

**\*\*\*GA movement in plants:**

GA moved through phloem and xylem.

**\*\*GA present in plant in two forms:**

1. Free GA which are the active form.
2. Bound GA in this case, GA bound to sugar by glycoside linkage or proteins. It was believed that the bound form is sort of storage process used by plant.

**\*\*Anti Gibberellins:**

It is also called growth retardant compounds:

1. cycocel. 2-phosphon. 3-cultar.

All these compounds caused dwarf of the plants and increased plant tillering.

**\*\*\*Mechanisms of action of GA:**

 1-Activation of cell division in shoot apex.

2-stimulate cell elongation.

3-increase the plasticity of cell wall and thus enlarge the cells of stem.

4-activation of genes responsible for the synthesis of hydrolytic enzyme in the endosperm during seed germination.

**\*\*physiological effect of GA:**

1. Control genetic dwarfism: genetic dwarfism is caused by gene mutation in some crop cultivars such as corn, peas.
2. Stimulation of flowering and growth of flower branches:

A/ in some plants growth of leaves become very dense and the branch of flower are stunted (rosette). This happens in long day plants which doesn’t receive enough light.

B/ in other plants the flowering branch is elongated abnormally because the plant doesn’t received enough cold temperature.

1. Inhibition of root formation in cutting and callus:

GA stimulates translocation of nutrients from the region of roots formation in the cutting and callus to other parts causing inhibition.

1. Stimulate germination of seed which required dark conditions:

Some seeds require dark conditions to germinate. Treatment of seeds with GA causes germination in light condition.

1. GA stimulates male flower in some plants such as cucumber. Other GA stimulate female flower.
2. Stimulate the synthesis of enzymes in endosperm of germinated seeds such as α- amylase, β-amylase, proteases, ribonucleases.
3. Breaking the dormancy of seeds and buds:

Dormancy means inability of seeds to germinate and buds to grow in presence of favorable environment (moisture, temperature and light). When the seeds or buds treated with cold temperature (4ᵒC) for a definite period, both of them germinate. It was found that GA can substitute cold temperature and caused germination of seeds and growth of buds.