

Quadrant II

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Notes

Unit -8 Plant growth regulators

Introduction

Plant growth regulators are organic compounds other than nutrients which in small amounts promote, inhibit or otherwise modify any physiological process of plants. Many plant hormones or plant growth regulators have been detected in various plants and some of them have been crystallized in pure form. Some of the important naturally occurring plant hormones are Auxins, Gibberellins, Cytokinins, Abscisic acid and Ethylene.

Gibberellins are a large class of cyclic diterpenes that occur in all vascular plants as well as in many fungi. Gibberellins (GAs)

are naturally occurring tetracyclic diterpenoid carboxylic acids responsible for important process, that is, seed germination, shoot elongation, dormancy, flowering and fruit development, leaf and fruit senescence etc.

Discovery of Gibberellins

- Gibberellins are second growth hormones found in plants. It was first known by a Japanese farmer Konishi, (1898) but Kurosawa working in Famosa discovered GA 1926. It was first extracted from the ascomycetes fungus *Gibberella fujikuroi* (*Fusarium moniliformae*), the causal organism of “**foolish seedling of rice**” or **Bakane disease**. The infected plants were usually taller, seedless and pale in colour. These symptoms were produced due to a substance secreted by the fungus.
- In 1935, Yabuta and Hayashi first isolated the active principle toxin from the fungus which was called **Gibberellin** by them.
- Yabuta and Sumuki (1938) isolated gibberellin in crystalline form and identified Gibberellin A and Gibberellin B from their original preparation.
- These remarkable works of the Japanese remained unnoticed outside Japan for quite some time due to the Second World War.
- The importance of gibberellins on commercial basis was realized by western scientist Stodola, in 1955.
- In England, Brain.*et.al*, (1955) at the Imperial Chemical Laboratories independently obtained pure sample of a

single gibberellin which was named as **gibberellic acid**. Later on its structure was established by Cross et.al.

- West and Phinney, (1956) discovered GAs as natural products of higher plants.
- It was first isolated from immature seeds of *Phaseolus cocineus* by Mac Millan and Suter, (1958).
- There are more than 100 gibberellins reported from widely different organisms such as fungi and higher plants. They are denoted as GA₁, GA₂, GA₃, GA₄ and so on. However, gibberellic acid GA₃ is one of the first gibberellins to be discovered and intensively studied form.

Physiological Effects of Gibberellins

1. Elongation of intact stems:

Many plants respond to application of GA by a marked increase in stem length; the effect is primarily one of internode elongation.

2. Dwarf shoots:

Besides general increase in stem length, gibberellins specifically induce internodal growth in some genetically dwarf varieties of plants like Pea and Maize. It appears that dwarfness of such varieties is due to internal deficiency of gibberellins.

3. Bolting:

Gibberellins induce sub-apical meristem to develop faster. This causes elongation of reduced stem or bolting

in case of rosette plants (e.g., Henbane, Cabbage) and root crops (e.g., Radish).

4. Dormancy:

Gibberellins overcome the natural dormancy of buds, tubers, seeds etc., and allow them to grow.

5. Seed Germination:

During seed germination, especially of cereals, gibberellins stimulate the production of some messenger RNAs and then hydrolytic enzymes like amylases, lipases and proteases. The enzymes solubilize the reserve food of the seed. The same is transferred to embryo axis for its growth.

6. Fruit Development:

Along with auxin, gibberellins control fruit growth and development. They can induce parthenocarpy or development of seedless fruits from unfertilized pistils, especially in case of pomes (e.g., Apple, Pear).

7. Flowering:

They promote flowering in long day plants during noninductive periods.

8. Root Growth:

The initiation of roots is markedly inhibited by gibberellins in isolated cuttings.

9. Vernalization:

Vernalization or low temperature requirement of some plants can be replaced by gibberellins.

10. De novo Synthesis of the Enzyme- α -Amylase:

One of the important functions of gibberellins is to cause de novo (i.e., a new) synthesis of the enzyme α -amylase in the aleurone layer surrounding the endosperm of cereal grains during germination.

11. Parthenocarpy:

Gibberellins when artificially applied to immature flowers can induce parthenocarpic development of fruits. Seedless and fleshy tomatoes and large sized grapes are produced by gibberellin treatment.

12. Elongation of internodes:

Most pronounced effect of gibberellins on the plant growth is the elongation of the internodes, so in plants such as dwarf pea, dwarf maize etc., they overcome the **genetic dwarfism**.

Commercial or practical applications of gibberellins

Gibberellins are either purified or synthesized artificially. They are now used in agriculture and horticulture as follows

- To break dormancy and induce early germination.
- To overcome genetic dwarfism.
- To break dormancy of buds.

- To delay senescence.
- To promote malting in breweries for manufacture of beer.