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Popular Article

Role of Bio-Regulators in Crop Production

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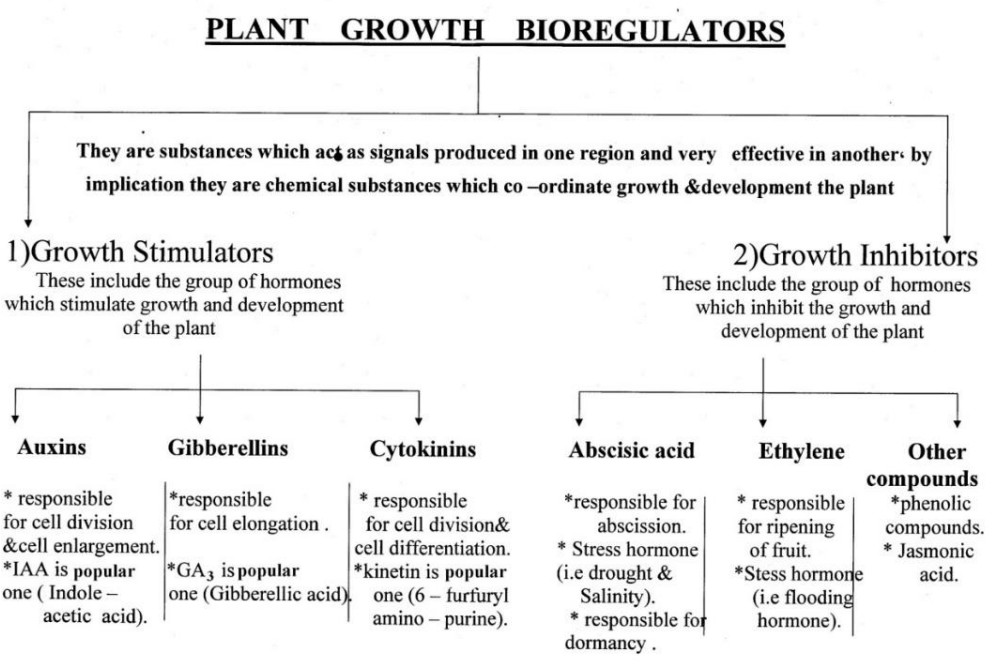
Introduction

The growth and development are governed by biotic and abiotic factors, Nature has given the mechanism to produce certain substances with adverse conditions and to produce end products which are called as bio-regulators. Plant growth regulators (PGRs) are organic compounds, other than nutrients, that modify plant physiological processes. Internal and external substance that regulate plant growth are bio-regulators or plant growth-regulating substances or hormones. It is an organic compound. It can be natural or



synthetic It control one or more specific physiological processes within a plant but the site of action and production are different. If the compound is produced within the plant, it is called as plant hormone. Both internal plant hormones and synthetic hormones are called plant growth bioregulators.

Common bioregulators

- Natural bio-regulator- Auxins, Gibberellins, Cytokinins, Ethylene, Abscisic acid
- Synthetic bio-regulator- IBA, 2,4-D,
  NAA, 2,4,5-T, Alar, Morphactin,
  Cycocel, Maleic hydrazide etc.

Auxin

- The word Auxin has been derived from a Greek word auxin "to grow/ increase."
- Frits Went (1926) determined auxin enhanced cell elongation.
- It was first isolated from human urine.
- These are generally produced by the apex of stem and root of the plants.
- This was the first group of plant hormones.
- Auxin increases the plasticity of plant cell walls and is involved in stem elongation.
- Discovered as substance associated with phototropic response.
- Auxin promotes activity of vascular cambium & vascular tissues.
- Play key role in fruit development

Functions of Auxins

- Promotes secondary growth of stem
- Promotes callus and root formation in cutting
- Restores apical dominance
- Increases fruit setting and size
- Delay leaf abscission
- Prevention of premature drop of fruits
- Develops parthenocarpic fruits
- Acts as herbicide at higher concentration
- Inhibition of prolonged dormancy
- Inhibiting aging processes in tissues.

1. **Apical dominance**

- Terminal buds prevent the development of lateral buds on plant stem.

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- Pinching of terminal bud stop flow of Auxin down the stem and allows side shoots to develop.

2. **Root initiation and development**

➢ Applied on cuttings to stimulate root growth and development

3. Phototropism

➢ Auxins are responsible for plants bending toward light.

➢ They move down towards shaded side of the stem and cause cells to elongate

4. **Parthenocarpy**

- Auxins induces parthenocarpy.

5. **Inhibition of abscission layer**

➢ Formation of an abscission layer at the base of petiole or pedicel results in shedding of leaves, flowers or fruits.

➢ Auxins inhibit abscission, as they prevent the formation of abscission layer.

6. Used as weedicide

➢ Many synthetic auxins are used as selective herbicides.

➢ 2,4-D is used to destroy broad leaved weeds.

➢ It does not affect mature monocotyledonous plants.

7**. Flowering**

- Foliar spray of NAA and 2,4- D induces flowering in many crop plants.

8. **Storage**

➢ NAA is used to prevent the sprouting of potato tubers.

➢ Hence, Increase the storage life of the potato.

❖ **Gibberellins**

- Second most important growth hormone.
  - In 1930, Kurosawa and colleagues were studying plants suffering from "foolish seedling" disease in rice.
  - Disease caused by fungus called, *Gibberella fujikuroi*, which was stimulating cell elongation and division, causing rice plants to grow abnormally tall.
  - Compound secreted by fungus could cause bakanae disease in uninfected plants.
  - It Synthesized in apical portions of stems and roots
- More than 60 types of gibberellins are known today.

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- **Functions of Gibberellins**

1. Stem elongation

- Gibberellins cause internodes to stretch in relation to light intensity.
- Less is the light intensity More will be internode length.
- Stimulate stem growth through cell elongation and cell division.

2. Seed germination and seedling growth

- Used commercially in stimulating seed germination and seedling growth.

3. Seed dormancy

- GA_3 is used to break the seed dormancy of freshly harvested seeds in many vegetable crops such as potato and lettuce.

❖ **Cytokinins**

- It is first isolated from coconut milk.
- Miller, Skoog and their co-workers isolated the growth factor responsible for cellular division from a DNA preparation calling it as cytokinins (1950).
- They are synthesized root apex, endosperm of seed, young fruit, where cell division takes place continuously.

◆ All cytokinins (artificial or natural) are chemically similar to adenine.

◆ Cytokinins move nonpolar in xylem and phloem tissues.

◆ In plants cytokinins are produced in the roots, seeds, fruits and young leaves.

Function of cytokinins

- Promotes cell division, cell enlargement and cell differentiation (used in tissue culture).
- They prevent aging of plants.
- They inhibit apical dominance and help in growth of lateral buds therefore, it is also known as anti-Auxins
- Lateral bud development.
- Delay of senescence.
- Most cytokinin produced in root apical meristems and transported throughout plant.

❖ **<u>Ethylene</u>**

✹ In the 1800s, it was recognized that street lights burned gas, could cause neighboring plants to develop short, thick stems and cause the leaves to fall off.

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- In 1901, Neljubow identified that a byproduct of gas burning was ethylene gas and this gas could affect plant growth.
- It is showed that this same gas was naturally produced by plants and that it caused faster ripening of many fruits.
- Synthesis of ethylene is inhibited by carbon dioxide.
- Found in ripening fruits, flowers, leaves and nodes of stem.

◆ **Functions of Ethylene**

- Gaseous in form and rapidly diffusing.
- Gas produced by one plant will affect nearby plants.
- Fruit ripening.
- Epinasty – downward curving of leaves.
- Encourages senescence and abscission.
- Flowering - Ethylene inhibits flowering in most plant species.
- Sex expression - Cucumber buds treated with ethylene become carpellate (female) flowers, whereas those treated with gibberellins become staminate (male) flowers.

❖ **Abscisic Acid**

It is also known as dormins, which acts as anti- gibberellins.

It is synthesized in leaves of wide variety of plants.

Responsible for closing stomata during drought condition, hence acts as plant stress hormone.

Functions of Abscisic Acid

- ✓ Causes stomatal closure.
- ✓ Produced in response to stress.
- ✓ General growth inhibitor.
- ✓ It inhibits seed germination and development.
- ✓ Abscisic acid is produced chiefly in mature green leaves & in fruits.
- ✓ Suppresses bud growth and promotes leaf senescence

Precaution of bio regulators application

- Growth substances should be sprayed in the afternoon.
- Avoid to spray in windy hours.
- Spray should be uniform and wet both the surface of leaves.
- Add surfactant or adhesive material like Teepol, Tween-20 is gum with growth substances @ 0.5-1.0 ml/l solution.

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- Use growth substance at an appropriate stage of plant growth.
- Bioregulators should be completely dissolved before use over plant.
- Spray should be as fine as possible.
- Wash the machine/pump after each spraying.
- Repeat the spray within eight hours if chemical is wash out due to rain

Constraints in the use of bioregulators

- The cost of developing new plants bioregulators is very high due to which they are very much costly.
- Some synthetic bioregulators cause human health hazards e.g. dominozide
- Poor knowledge of toxicity and mechanism of action.
- Inadequate market potential.
- Inadequate support from agricultural researchers in public and private sectors.
- Difficulty in identification of proper stage of crop at which the growth bioregulators should be applied.

Conclusion

- Use of SA (100 ppm) in sesame and SA (100 ppm) / brassinosteroid (0.40 ppm) / NAA (50 ppm) in mustard improve plant growth and recorded higher seed yield.
- Spraying of brassinosteroid (0.25) ppm / cycocel (1000 ppm) to wheat and GA3 (20 ppm) at pre-flowering stage in rice gave maximum grain yield.
- Foliar application of cycocel (100 ppm) / Tracontanol (1 ml/lit) / NAA (20 ppm) / GA3 (75 ppm) in coriander and NAA (100 ppm) in black cumin significantly improved growth and quality parameters as well as seed yield.
- Foliar application of cycocel (200 ppm) in clusterbean, thiourea (100 ppm), GA3 (150 ppm) in cowpea, IAA (50 ppm) in greengram and cycocel (500 ppm) in chick pea gave maximum seed yield.
- Use of GA (50 ppm) in cabbage, GA3 (40 or 75 ppm) in tomato and GA3 (90 ppm) in brinjal registered significantly higher fruit yield.
- Application of NAA (10 ppm) / Chlormequat chloride (0.2 ml/lit) improve quality of fiber and seed yield of cotton.

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