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Growth Regulators Functions In Horticultural Crops

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ABSTRACT:- In plants, many behavioral patterns and functions are controlled by hormones. These are "chemical messengers" influencing many patterns of plant development. Plant hormones – a natural substance (produced by plant) that acts to control plant activities. They include growth promoting and growth retarding substances. Chemical messengers (Plant growth hormones) are produced in one part of a plant and then transported to other parts, where they initiate a response. They are stored in regions where stimulus are and then released for transport through either phloem or mesophyll when the appropriate stimulus occurs. According to Sinha (2004), Growth hormones differ from growth regulators. Plant growth regulators – include plant hormones (natural & synthetic), but also include non-nutrient chemicals not found naturally in plants that when applied to plants, influence their growth and development. Plant Growth Regulators (PGR) known as bio-stimulants or bio-inhibitors modifies physiological processes in plant. These organic compounds act inside plant cells to stimulate or inhibit specific enzyme or enzyme systems to regulate plant metabolism. These growth regulators are naturally produced in plants to control the growth and other physiological functions. They act even in very minute quantities.

Keywords:- Plant growth regulators, chemical messenger, bio stimulants

I. INTRODUCTION

The growth of plants is regulated by certain chemical substances in very small quantities. These substances are formed in one tissue or organ of the plant and are then transported to other sites where they produce specific effects on growth and development. They are referred to as plant hormones they include growth promoting and growth retarding substances (Wikipedia, 2010).

According to Sinha (2004), Growth hormones differ from growth regulators. The later includes natural as well as synthetic substances which have hormonal activity. But the former (growth hormones) include only natural substances produced within plants which have hormonal activity.Growth regulators are grouped into 2 main types - growth promoters have a positive effect on a process and thus promote it, whereas the growth inhibitors have a negative effect and cause inhibition.synthetic PGR are organic compounds and not soluble in Water effective at very low concentrations (less than 100 to 200 ppm; in some cases 0.05 ppm) pure PGR are highly costlythey are prepared in a suitable solvent which is nontoxic to plant tissueavailable at very low concentrations in the marketformulations have to further diluted for practical use.

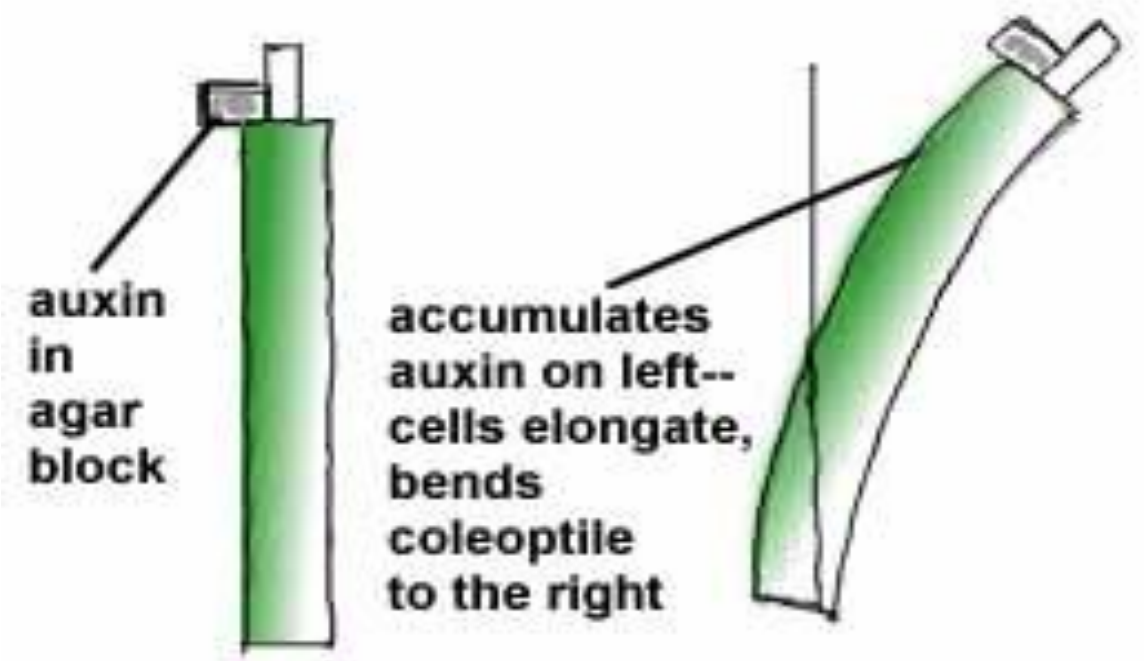
Growth Regulators

5 recognized groups of natural plant hormones and growth regulators.

1. Auxins
2. Gibberellins
3. Cytokines
4. Ethylene
5. Abscisic acid

AUXIN

Influence plant growth – found in leaves and stems – growth regulators and hormones. Cell enlargement or elongation – located in meristems and shoot tips (terminal & lateral buds). Auxins move mainly from apex (top) down.Lengthening of the internodes and influence the developing embryos in the seed.Precursor-Tryptophan



What happens when auxin is added to a stem. The stem will bend away from the auxin. It elongates faster on the extra auxin side.

Cell Enlargement: It stimulates cell enlargement and stem growth.

Cell Division: It stimulates cell division in cambium. Used in tissue culture plant production in combination with Cytokinin.

Vascular Tissue Differentiation: It stimulates differentiation of phloem and xylem.

Root Initiation: It stimulates root initiation on stem cuttings. Used in plant propagation by tissue culture for development of roots.

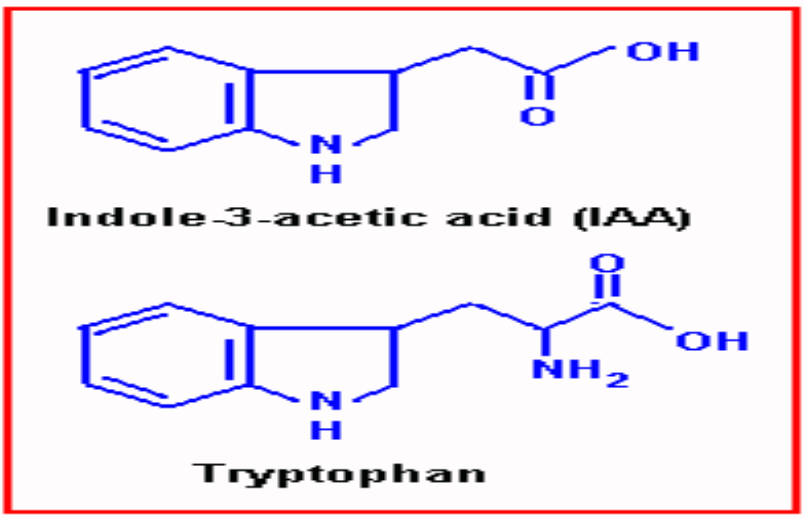
Apical Dominance: It suppresses the apical shoot growth and promotes the growth of lateral buds.

Types of auxins

Natural auxins: These are naturally occurring in plants.The best known and universally present natural auxin is Indole - 3 - acetic acid. Other natural auxins are Indole - 3 - pyuruvic acid, Indole - 3 - ethanol, Indole - 3 - acetaldehyde.

Synthetic auxins: These are the chemicals synthesized by chemists that cause various physiological actions similar to IAA.Some of the synthetic auxins are Indole - 3 - butyric acid (IBA), b - napthalene acetic acid (NAA) and 2,4 - dichlorophenoxy acetic acid (2,4 - D).

Auxin molecules



Cytokinins

Promotes cell division. Found in all tissues with considerable cell division.Ex: embryos (seeds) and germinating seeds, young developing fruits. Roots supply cytokinins upward to the shoots.Interact with auxins to influence differentiation of tissues (may be used to stimulate bud formation).As roots begin to grow actively in the spring, they produce large amounts of cytokinins that are transported to the shoot, where they cause the dormant buds to become active and expand.Tissue cultures use cytokinins to induce shoot development.Cytokinins may slow or prevent leaf senescence (leaf ageing or leaf fall).

Functionsof Cytokinins

Cell division: cytokinins stimulate cell division in plants. Secondary growth occurs due to cell division in cambium cells.

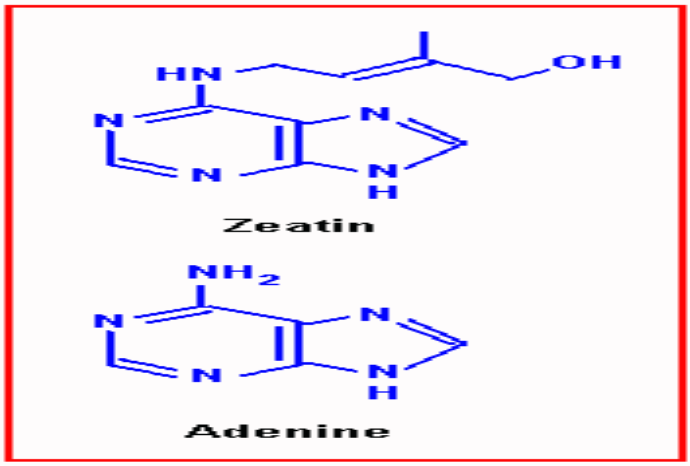
Cell elongation: Cytokinins appears to promote overall enlargement of cells and not simply elongation.

Expansion of cotyledons and leaves: Cytokinins induce expansion of excised cotyledons in several dicots (eg. Mustard, radish, etc). They cause cotyledon expansion by increasing cell size rather than cell division).

Promotion of chloroplast development: Exogenous application of cytokinins promotes chloroplast developments in callus tissue of excised cotyledons. It is essential for the transformation of etioplasts to chloroplasts.

Morphogenesis: Cytokinins have a significant role in morphogenesis. Relative concentration of auxins and cytokinins and cytokinins determine the particular organ formation.

Cytokinins molecule structure



Gibberellins

Different forms of gibberellins are found in a plant but only one form predominates. This hormone is widely distributed in natures.They are reported from algae. Mosses, ferns, gymnosperms and angiosperms. They are also reported from some species of bacteria and fungi. In higher plants, they are mainly distributed in meristematic regions like stem apex, root apex, young expanding organs, buds, embryos and seeds.Gibberellins are found in plants in free form and conjugate form. Conjugate forms are inactive while free forms are active.

Functions ofGibberellins

Germination: Increases length of hypocotil and cotyledenary leaf area. Overnight soaking of peas' seeds in GA 3 (10 ppm) improves germination.

Leaf Expansion: Leaves become broader and enlarged (Cabbage, Sweet corn).

Hyponasty of leaves: GA treated leaves of plants holds their leaves more erect.

Flowering: Induces flowering in long day plants and in plants requiring cold induction. Also promotes formation of male flowers.

Root Growth: Inhibits root growth

Parthenocorpy: Brinjal, Guava (Allahabad round).

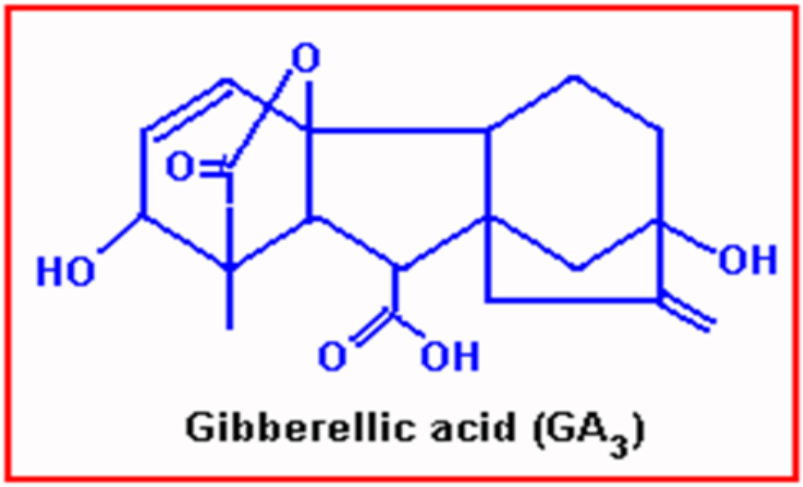
Pollen Germination: Sugar cane 15 out of 34 germinated against normal conditions.

Breaking Dormancy: Enhanced cell elongation. Potato tubers can be made to sprout in winter by GA (Sihna, 2004 and Gopalakrishnan, 2007).

Anti-gibberellins

- AMO – 1618
- CCC - Chloro choline chloride
- Phosphon – D
- Paclobutrazol

GA Molecule Structure



Abscisic Acid

Stomata Closure: Water shortage brings about increase in ABA level, leading to stomata closure as a response to water stress.

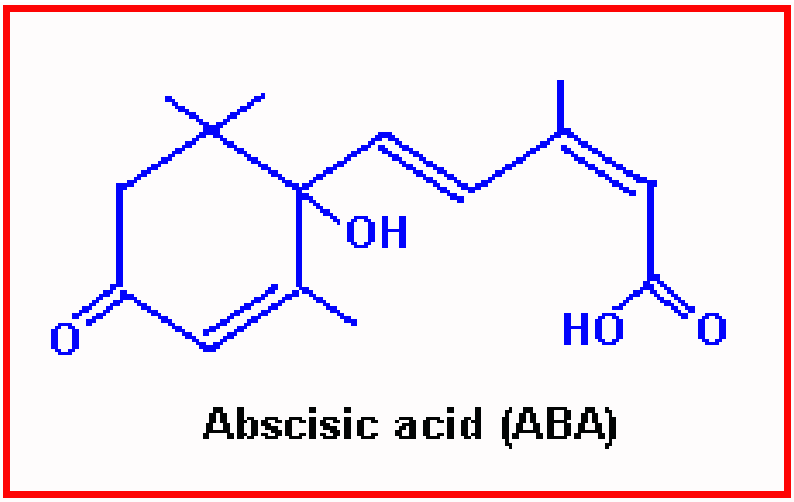
Growth Inhibiters: ABA inhibits shoot growth but has less effect on root growth.

GA Counteracts: ABA counteracts the effect of gibberellins on a-amylase synthesis in germinating cereal grains.

Induced Dormancy: ABA affects induction or maintenance of dormancy in seeds.

- Precursor - Mevalonic acid
- ABA exists in all parts of the plant and its concentration within any tissue seems to mediate its effects and function as a hormone; its catabolism within the plant affects metabolic reactions and cellular growth and production of other hormones (Sihna, 2004).

Molecular structure of ABA



ETHYLENE

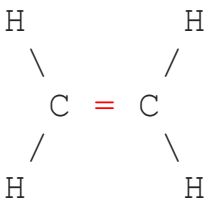
Fruit Ripening: Ethylene in the form of gas helps ripens fruits under natural conditions.

Induction of Femaleness: Promotes production of female flowers in cucurbits (cucumber, squash, and melon) to increase the yield.

Flower Opening: Promotes flower initiation and controlled ripening in pineapples.

Leaf and Fruit Abscission: Accelerates fruit abscission for mechanical harvesting in fruit crops such as grapes, cherries, and citrus.
Precursor: Methionine

Ethylene molecular structure



Ethylene inhibitors

- AVG (aminoethoxyvinylglycine)
- AOA (aminooxy-acetic acid) are inhibitors of ethylene biosynthesis
- KMnO4 (Ethylene absorber) binds ethylene which are released by the fruits

OTHER IDENTIFIED PLANT GROWTH REGULATORS

❖ **Brassinosteroids**

Brassinosteroids, are a class of polyhydroxysteroids, a group of plant growth regulators are have been recognized as a **sixth class of plant hormones** which stimulate cell elongation and division, gravitropism, resistance to stress and xylem differentiation.They inhibit root growth and leaf abscission. Brassinosteroids were the first identified and was isolated from organic extracts of rapeseed (Brassica napus) pollen in 1970 (Vidya et al., 2006).

❖ **Morph actins**

They are synthetic growth regulators, acts in variety of ways on the natural regulation of mechanisms of plants.

The important are:

Phenoxyalkancarboxylic acid (synthetic auxin)
Substituted benzoic acid.
Maleic acid hydrazide
Flurene - carboxylic acid and their derevatives
Chlorflurenol
Chlorfluron
Flurenol
Methylebenzilate
Dichlorflurenol
The action of these substances is systemic and after their uptake they are transported and distributed not polarly, but basipetally and acropetally.

The role of Morph actins in growth and development of plants

Seed Germination: inhibition
Growth of seedlings: inhibits growth of both root and shoot this property is similar to cytokinin.
Stem elongation: dwarfing effect.
Prolonged bud dormancy: Bud dormamcy of potato tubers can be prolonged by application of morphactin.
Root growth and root branching: Lateral roots are inhibited and primary roots are promoted.
Flowering: Prevents flowering in short day plants, sequence of flowering, position and number of flowers and parthenocarpy**.**

❖ **Salicylic acid**

It activates genes in some plants that produce chemicals that aid in the defense against pathogenic invaders.

❖ **Jasmonates**

These are produced from fatty acids and seem to promote the production of defense proteins that are used to fend off invading organisms. They are believed to also have a role in seed germination, and affect the storage of protein in seeds, and seem to affect root growth.

❖ **Plant peptide hormones**

They encompass all small secreted peptides that are involved in cell-to-cell signaling. These small peptide hormones play crucial roles in plant growth and development, including defense mechanisms, the control of cell division and expansion, and pollen self-incompatibility.

❖ **Polyamines**

These are strongly basic molecules with low molecular weight that have been found in all organisms studied thus far. They are essential for plant growth and development and affect the process of mitosis and meiosis.

❖ **Nitric oxide (NO):** serves as signal in hormonal and defense responses,

❖ **Strigolactones:** are implicated in the inhibition of shoot branching,

❖ **Karrikins:** are a group of plant growth regulators found in the smoke of burning plant material that have the ability to stimulate the germination of seeds.

❖ **Florigen:**is responsible for flower initiation in plants - synthesised in older leaves and then transferred to growing region, where it innitiates floral bud,

❖ **Xanthoxin:** is a potent growth inhibitor which can be converted metabolically to ABA. Finally, Batasins are solated from yam plants -cause dormancy in bulbs.

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