NEW ERA AGRICULTURE MAGAZINE

MECHANISM AND FUNCTIONS OF PLANT GROWTH HORMONES IN VEGETABLE PRODUCTION

Shailendra Kumar[1]*, Shubham Kumar[2], Vipin[3] and Nikhil Kumar Singh[4]

Introdution

The word plant hormones are also known as Phytohormones. These hormones helps to regulate growth of the plant and these hormones are small molecules that derived from different essential metabolic pathways. Thimann in 1948 was coined the term "Phytohormone" as organic substance that produces naturally in plants.

What are plant hormones?

Plant hormones are the organic substances which are produced naturally in the plants, controlling growth and other physiological functions at a site remote from its place of production and active in minute amounts. They are termed as phyto-hormones. These plant hormones control cellular processes in targeted cells. Plant hormones regulate the upward and downward growth of tissues, leaf formation, stem growth, fruit development and ripening, plant longevity and even plant death. Therefore, hormones are vital to plant growth and are also called as growth factors or growth hormones. These hormones usually move within plant from as it's of production to the site of action.

PGR$_S$?

Plant hormones may be defined as organic compounds other than nutrients, which in small amount promotes/inhibits or otherwise modify any physiological response in plants. Plant hormones are naturally produced within plants. Similar chemicals are also produced by fungi and bacteria which can affect plant growth. Alarge number of related chemical compounds are artificially synthesized to regulate the growth of different plants both under open field conditions and artificial or laboratory conditions. These man-made compounds are called Plant Growth Regulators or PGRs. The external application of these substances on plants can bring about modification by improved seed germination, rooting, better plant growth, better fruit set, increased rate of ripening and increased yield.

Classes of plant hormones:

In general, there are five main classes of plant hormones. Each class has stimulatory

Shailendra Kumar[1]*, Shubham Kumar[2], Vipin[3] and Nikhil Kumar Singh[4]
Ph.D. Research Scholar
Department of Horticulture, Post Graduate College of Agriculture,
[1]Dr. RPCAU, Pusa, Samastipur, Bihar-848125, India
[2]Anand Agricultural University, Anand, Gujrat-388110, India
[3]Punjab Agricultural University, Ludhiana, Punja-141004, India
[4]Banaras Hindu University, Varanasi, Uttar Pradesh-221005, India

as well as inhibitory action. These five major classes of plant hormones are:

1. Auxins
2. Gibberellins
3. Cytokinins
4. Absciscicacid
5. Ethylene

1. **Auxins:** Auxins promote the production of other hormones and in combination with cytokinins, control the growth of stems, roots, and fruits, and convert stems into flowers. They also promote lateraland adventitious root development and growth. e.g. Indol acetic acid (IAA), Indol butyric acid (IBAs), Napthalene acetic acid (NAA), 2,4-dichloro phenoxy acetic acid (2,4-D) etc.
2. **Gibberellins:** They are active in regulating dormancy, flowering, fruit setting and stimulating seed germination and extending growth of shoots after seed germination.They stimulate cell division or cell elongation or both especially in genetically dwarf species, beans, peas etc. Gibberellins also reverse the inhibition of shoot growth and dormancy induced by ABA e.g. Gibberellic acid (GA).
3. **Cytokinins:** They have similar effects as those of gibberlins in breaking the dormancy of a wide range of seeds and inincreased fruit set. They mainly stimulate cell division, and prevent chlorophyll degradation. They also help in delaying senescence or the aging of tissues. They are responsible form ediating auxin transport throughout the plant and affect internodal length and leaf growth. Cytokinins counter the apicald ominance induced by auxins. They in conjunction With ethylene promote abscission of leaves, flower parts, and fruits e.g. Kinetin, Zeatin.
4. **Ethylene:** It plays an important role in the ripening of fruits, inhibition of root growth, and abscission or the shedding of plant part sets. Ethylene is also known to play a role in seed and bud dormancy, induction of roots, flowering, and stem elongation. e.g. ethylene.
5. **Abscisic acid (also called ABA):** It is involved in the abscission of plant organs, retardation of vegetative buds, regulation of fruit ripening and generally in reduction of growth. It accumulates within seeds during fruit maturation and prevents seed germination within the fruit. In plants, ABA plays important role inclosing the stomata under water stress. e.g. Abscisic acid.

Inhibitors: These are the diverse group of plant growth substances that inhibitors retard the physiological processes in plants. ABA is the most common naturally occurring

inhibitor. It has been reported to act as antiauxin, antigibberlin or anticytokinin.

Paclobutrazol, uniconazol, triapentanol etc.

Practical utility of plant growth hormones:

Classes	Practical utility
Auxins	Promote lateral and adventitious root growth; stimulate stem elongation, flower formation and fruit development.
Gibberellins	Increase seed germination, shoot length, flowering, fruit setting and fruit size
Cytokinins	Delay aging of tissues i.e. prolonged storage life of vegetables, stimulate bud initiation and root growth
Ethylene	Induce uniform ripening in fruit and vegetables
Abscisic acid (ABA)	Promote flower production by shortening internodes and regulate fruit ripening

Non-traditional plant hormones: These are present in some plant species, not universally available in all plant species. These are

1. **Aromatic compounds:** They include phenols and benzoic acid to the polymeric tannins, the cinnamic, the commarins and the flavanoids. They affect flowering and such other physiological characteristics. The commarins are strong inhibitors of seed germination.
2. **Nitrogen containing compounds:** *E.g.*colchicines
3. **Terpenoid compounds:** *E.g.* monoterpene essential oil (growth inhibitor), α-methylene lactones (both growth inhibitor and root stimulator)
4. **Aliphaticalcohols:** *E.g.*Tricontanol
5. **Triazoles:** It is a new type of plant growth retardant and has a great broad spectrum retarding ability e.g.
6. **Polyamines:** They are essential for cell division, normal morphology and hence plant development.

Mechanism of hormone action: The responses to plant hormones have bearing on the mechanism of hormone action-

1. Increased plasticity of the shoot and elasticity of the root wall
2. Increased permeability to water
3. Enhanced capacity to retain water
4. Decrease in protoplastic viscosity.
5. An accelerated rate of respiration and cyclosis.
6. More rapid synthesis of protein, with lowered levels of free amino acid.
7. Increase in monosaccharides at the expense of reserve polysaccharides.

Growth retardants: They are new type of organic chemicals which in general check the rate of growth without any adverse effect. They may retard cell division and cell

elongation, and thus plant height is affected without causing mal formation of leaves and stems e.g. CCC (Chloro choline chloride). The main advantages of growth retardants are

1. Control of lodging
2. Reduction in vegetative growth
3. Increase in chlorophyll biosynthesis and photosynthesis
4. Delay in leaf senescence
5. Improving the quality of seedlings used for transplanting
6. Resistance against low temperature stress
7. Resistance against fungal infection. *e.g. Fusarium* wilt in watermelon

Functions of Plant Growth Hormones in Vegetable Production:

The chief purpose of using plant growth regulators is to optimize plant production by modifying growth, development, stress behavior, and yield of vegetable crops. The synthetic plant growth regulators cause their effects through changing the endogenous level of naturally occurring hormones and hence modifying growth and development of plants in the intended direction and to a desired extent. The role in hardening of seedlings raised through biotechnology before transferring to the open field conditions deserves special mention. The plant regulators carry following benefits:

Benefits of Using PGRs

- ❖ Better seed germination
- ❖ Improved plant establishment
- ❖ Increased root development
- ❖ Efficient nutrient uptake
- ❖ Healthy and vigorous crop and Better fruit set
- ❖ Increased retention of flowers and fruits
- ❖ Bigger and shining produce
- ❖ Breaking seed dormancy
- ❖ Helps in modifying sex expression
- ❖ Induction of dormancy (CIPC treatment in Potato)
- ❖ Enhanced keeping quality
- ❖ Enhanced tolerance to stress conditions
- ❖ Significant increase in yield

Conclusion:

To enhance productivity and food safety Indian Agriculture become more mechanized and science based by using inputs and the plant growth regulators are among of them; plant growth regulators has quicker impact on vegetative as well as yield of the crops. As it have various advantages like less time consuming to treat the plant and environment friendly. Vegetables crops are rich sources of vitamins and minerals. Use of growth regulators in vegetable production must be specific their action and toxicologically and environmentally safe. The physiological activities of vegetable crops regulate and after the application of growth regulator finally enhance the vegetable production.