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Plant Growth Regulators (Plant Hormone) in Vegetables: Their Functions and Commercial Application

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INTRODUCTION

Although photosynthesis supplies the carbon and respiration supplies the energy for plant growth, a group of chemicals produced by plants known as plant growth regulators control the growth and development of trees. These chemicals act on plant processes at very low concentrations. Often they are produced at one location and transported to another where they exert their influence; however, they may also act on the same tissue in which they are produced. Plant growth regulators are organic chemical substance, other than nutrients and vitamins which regulate the growth of plant when applied in small quantities. PGR are used in different forms like liquid, powder, paste etc. "Hormone" is Greek word derived from *"hormao"* which means to stimulate. *Thimone (*1948) suggested the use of term phytohormones as the organic substance which are produced naturally in plants, synthesized in one part and usually translocated to other part where in every small quantity affect the growth and other physiological function of the plants. To distinguish them from the animal hormones they are termed as phytohormones. Auxin was the first hormone to be discovered in plants and at one time considered to be only naturally occurring plant growth hormone.

Definitions

Plant hormone: "Plant hormone is an organic compound synthesised in one part of the plant and translocated to another part, where in very low concentrations it causes a Indian agriculture becomes more mechanized and science increases the possibilities for using inputs to enhance production and food safety, the role of plant growth regulators becomes more vital. Plant growth regulators in vegetables provides professionals and researchers with the information needed to effectively tap these versatile resources to enhance vegetables production.

Most of the physiological activates and growth in plants are regulated by action and interaction of some chemical substance in them is called hormones and by some naturally occurring inhibitors. In general plants are known to produced five classes of hormone namely auxins, aibberellin, cytokinin, abscissic acid and ethylene, both auxin and gibberellins cause stem elongation by different mechanism while abscissic acid and ethylene inhibits stem growth. Thus, two or more growth regulator similar in their action. physiological response. The plant hormones are identified as promoters (auxins, gibberellins and cytokinin), inhibitors (abscissic acid and ethylene) and other hypothetical growth substance (florigen, flowering hormone, *etc*.)"

Plant Growth Regulators: "An organic substance other than nutrients,which in small amount promotes/inhibit or otherwise modify any physiological response in plants."

Classification of plant growth regulators and retardants

- ✓ **Auxins:** (IAA, NAA, IBA, 2-4D, 4-CPA)
- ✓ **Gibberellins:** (GA3)
- ✓ **Cytokinins:** (Kinetin, Zeatin)
- ✓ **Ethylene:** (Ethereal)
- ✓ **Abscissic acid:** (Dormins, Phaseic Acid)
- ✓ **Phenolic substances:** (Coumarin)
- ✓ **Flowering hormones:** (Florigin, Anthesin, Vernalin)
- ✓ **Natural substances:** (Vitamins, Phytochrome Tranmatic)
- ✓ **Synthetic substances:** (Synthetic Auxins, Synthetic Cytokinins)
- ✓ **Growth inhibitors:** (AMO-1618, Phosphon-D, Cycosel, B-999, Morphacting)

Table 1: Different Plant growth regulators and their associated functions

PGR Associated functions

PGR	Associated functions
Auxins	Apical dominance, root induction ,control fruits drops, regulation of flowering, parthenocarpy, phototropism, geotropism, herbicides, inhibit abscission, sex determination, xylem differentiation, nucleic acid activity.
Gibberellin	Stimulate cell division and elongation, stimulate germination of seeds. Stimulates bolting/flowering in response to long days, prevention of genetic dwarfism, increase flower and fruit size, dormancy, induces maleness in dioecious flowers, extending self life.
Cytokinin	Promotes cell division, cell enlargement and cell differentiation, stimulate bud initiation and root growth, translocation of nutrients, prolong storage life of flowers and vegetables, prevent chlorophyll degradation, morphogenesis, lateral bud development, delay of senescence.
Ethylene	Induce uniform ripening in vegetables, promotes abscission, senescence of leaf.
Abscisic acid	Act as plant stress hormone, dormancy induction of buds and seeds, induces seeds to synthesize storage proteins, dormancy, seed development and germination, stomata closing.

Commercial Utility of Plant Growth Regulator in Vegetable Crops

Stimulation of fruit Set: Poor fruit set is a major problem in solanum crops. In tomato apply 4-CPA, or 2,4-D@2-5ppm or PCPA 50-100ppm enhance the fruit set, and earliness.

Inhibition of sprouting: Application of MH@ 2500 ppm 15 days before harvesting prevents sprouting of onion in storage. Soaking potato tuber in IAA @250 to 1000 ppm solution or prolongs dormancy and thiourea@1% breaking the tuber dormancy.

Flowering: Application of GA at 50 mg/l to young leaves of non- flowering varieties of potato, when floral buds had just formed, resulted in flower induction in all varieties. MH delayed flowering in okra. GA has been reported to induce early flowering in lettuce.

Seed Germination: Pre-showing treatment of seed with growth regulators has been reported to enhance seed emergence. Okra IAA, NAA @ 20ppm enhances seed germination, In tomato, higher germination with GA3 at 0.5 mg/l, and 2,4-D at 0.5 mg/l is reported. Soaking of seeds in ethephon at 480 mg/l for

24 h improved germination in muskmelon, bottle gourd, squash melon and watermelon at low temperature.

Seed Dormancy: potato tubers fail to sprout before the termination of rest period; chemicals reported to break the rest period are GA, ethylene chlorhydrin and thiourea. For breaking of dormancy in potato comprise the vapour treatment with ethylene chlorhydrin (1 liter per 20 q) followed by dipping in thiourea (1%) for 1hr. finally in GA (1 mg/l) for 2 seconds. Lettuce is another vegetable in which treatment with GA has been reported to break seed dormancy induced by high temperatures.

Sex expression: Sex expression the treatment with growth regulators has been found to change sex expression in cucurbits, okra and pepper. GA 3 (10-25 ppm), IAA (100 ppm) and NAA (100 ppm) when sprayed at 2-4 leaf stage in cucurbits, then they have been found to increase the number of female flowers. Whereas, GA 3 (1500-2000 ppm), silver nitrate (300-400 ppm) and Silver thiosulphate (300-400 ppm) sprayed at 2-4 leaf stage induces male flower production in cucurbits.

Parthenocarpy: Auxin produced seedless fruits in cucumbers and watermelon, PCPA 50-100 ppm induced parthenocarpy in tomato and brinjal, application of 2,4-D at 0.25% in lanolin paste to cut end of styles or foliar sprays to freshly opened flower cluster has been reported to induced parthenocarpy.

Gametocides: Plants growth regulators possess gametocidal actions to produce male sterility this can be used for F1 hybrid seed production. MH at 100 to 500 mg/l in okra, okra, peppers and tomato, GA3 in onion, 2,3-dichloro-isobutyrate (0.2 to 0.8%) in okra, muskmelon, okra, onion, root crops, spinach and tomato and TIBA in cucumber, okras, onion, and tomato. GA at 100 mg/l can also be used for inducing male sterility in pepper.

Hybrid seed production: Ethephon has been used for producing female lines in some cucurbits. Successful F1hybrid in butter-nut squash has been made by using female line produced with ten weekly sprays of ethephon. Plant growth regulators have also been used for maintenance of gynoecious lines. In cucumber, GA3 sprays have been made to induce staminate flowers in gynoecious lines. Silver nitrate at 500 mg/l has been reported to be as effective as GA3 in inducing male flowers on gynoecious lines of cucumber. However, in muskmelon foliar sprays of Silver thiosulphate at 400 mg/l was found best for induction of male flower on gynoecious lines.

Fruit ripening: Ethephon, an ethylene releasing compound, has been reported to induce ripening in tomato and pepper. Application of ethephon at 1000 mg/l at turning stage of earliest fruits induced early ripening of fruits thus increasing the early fruit yield by 30-35%. Post-harvest dip treatment with ethephon at 500-2000 mg/l has also been reported to induce ripening in mature green tomatoes.

Fruit yield enhancer: Soaking of seed in NOA at 25-50 mg/l, GA at 5-20 mg/l and CIPA at 10-20 mg/l, 2,4-D, 0.5 mg/l or thiourea at 10-1 M have been reported to improve fruit yield in tomato. In brinjal soaking of seedlings roots in NAA at 0.2 mg/l and ascorbic acid at 250 mg/l has been reported to produce higher fruit yield.

PGR application methods

1. **Application in Powder form:** PGR powders dissolved in organic solvent mixed with moistened charcoal powder, soybean flour or wheat flour and prepare a uniform paste. The paste is allowed to stand until the solvent evaporates.
2. **Application in Lanoline paste:** Most of the roots promoting PGR are readily soluble in lanoline; a lanoline paste which promotes advantageous roots in plant is made by mixing PGR in lanoline and allowing it to cool.
3. **Soaking Method:** Measured quantity of PGR is dissolved in alcohol then dilute with distilled water to make required quantity and concentration of solution (20-2000 ppm), Cuttings are soaked in solution for 24 hours before planting.
4. **Aerosol Method:** This method is popular in green houses, where the PGR solution is released through a small aerosol bottle / cylinder. Liquid gases soon evaporate leaving the PGR chemical in the air.
5. Spraying method.
6. Root feeding method.

7. Injection of solution into internal tissues.

Precaution in Application of Plant Growth Regulator

· Use growth substances at an appropriate stage of plant growth.

· Growth substances should be sprayed preferably in the afternoon.

· Spray should be uniform and wet both the surface of leaves.

· Add surfactant or adhesive material like Teepol, Tween-20.

· Solution should always be prepared in distilled water only.

· Fine spray can be ensured by hand automizer.

· Use always fresh solution of chemicals.

· Avoid spraying in windy hours.

Constraints in the Use of Growth Regulators

- Sensitivity of each plant species or cultivars to a given chemical treatment prevents easy predication of the biological effects.
- Screening for PGR activities entails high costs and much difficult. Some synthetic plant growth regulators causes human health hazards.
- The cost of developing new PGR is very high due to which they are very much costly.
- It's difficult in identification of proper stage of crop at which the growth regulators should be applied.
- Lack of support from agricultural researchers in public and private sectors.
- Lack of basic knowledge of toxicity and mechanism of action.

CONCLUSION

Plant growth regulators are a group of chemicals for controlling and enhancing the natural plant growth processes to better meet the requirements of food supply in general. The use of Plant Growth Regulators may be beneficial for short imperatives. Plant growth regulators provide an immediate impact on crop improvement programmes and are less time consuming. Applications of Plant growth regulators must lead to quantifiable advantages for the user plant growth regulators must be specific in their action and toxicologically and environmentally safe. Industries involved in development of Plant growth regulators should be well informed about the latest scientific development in production of Plant growth regulators. They are not only interesting but profitable to use to grower, distributor and manufacture. There is need for some plant growth regulators which can inhibit photorespiration in plants. More research is needed to develop simple, economical and technical viable production systems of Plant growth regulators.

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