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Plant Growth Regulators in Vegetable Production

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Plant growth regulators play a crucial role as Indian agriculture becomes more mechanised and science expands the possibilities for using inputs to improve production and food safety. Plant growth regulators have an immediate impact on crop improvement programmes and take less time to apply, but their use must result in quantifiable benefits for the user, be specific in how they work, and be toxicologically safe. Vegetables include plant growth regulators that provide experts and researchers the knowledge they need to efficiently use these adaptable resources to increase vegetable output. The majority of physiological activities and development in plants are controlled by the activity and interaction of naturally occurring inhibitors and certain chemical substances called hormones in them.

Introduction

A group of compounds generated by plants known as plant growth regulators govern the growth and development of plants, even while photosynthesis provides the carbon and respiration provides the energy for plant growth (Pal, 2019). At extremely low quantities, these compounds have an effect on plant processes. They are frequently created in one place and then transferred to another, where they have an effect; however, they can also act on the same tissue. Other than minerals and vitamins, which can control plant development when used in modest quantities, plant growth regulators are organic chemicals. PGR are utilized in a variety of forms, including liquid, powder, and paste. The term "hormone" comes from the Greek root "hormao," which meant to excite. The first hormone found in plants was auxin, which was once thought to be the sole hormone that occurs naturally in plants (Bisht *et al.*, 2018).

Class of plant growth regulators

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

Plant growth regulators and their associated functions

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

Commercial Utility of PGRs in vegetable crops

Stimulation of fruit set : One of the biggest issues with solanum crops is poor fruit set. Applying 4-CPA, 2,4-D@2-5ppm, or PCPA 50-100ppm to tomatoes can improve fruit set and ripeness.

Inhibition of sprouting : MH at 2500 ppm application 15 days before to harvest suppresses onion growing in storage. The potato tuber's dormancy is broken by soaking it in thiourea at 1% concentration and IAA at 250–1000 ppm, which also prolongs hibernation.

Flowering : All potato types had flowers induced when GA at 50 mg/l was applied to young leaves of non-flowering cultivars at the time that floral buds were just beginning to develop. Okra blossoming was postponed by MH. According to reports, GA causes lettuce to blossom early.

Seed Germination : It has been suggested that pre-showing seed with growth regulators improves seed emergence. Seed germination is improved with okra IAA and NAA at 20 ppm. Higher germination of tomato plants with GA3 at 0.5 mg/l and 2,4-D at 0.5 mg/l has been documented. Muskmelon, squash melon, bottle gourd, and watermelon seeds benefited by soaking in ethephon at 480 mg/l for 24 hours when grown at low temperatures.

Seed Dormancy : Before the end of the rest period, potato tubers are unable to sprout; substances such as GA, ethylene chlorhydrin, and thiourea are said to disrupt the rest period. Include ethylene chlorhydrin vapour therapy (1 litre per 20 minutes), thiourea (1%) for 1 hour, and GA (1 mg/l) for 2 seconds for breaking dormancy in potatoes. Another vegetable where seed dormancy brought on by high temperatures has been found to be broken by GA treatment is lettuce.

Sex expression: Expression of sex It has been discovered that the use of growth regulators alters the sex expression in cucurbits, pepper, and okra. When sprayed on cucurbits between the second and fourth leaf stage, GA 3 (10–25 ppm),NAA (100 ppm) , and IAA (100 ppm) have been observed to enhance the amount of female flowers. In contrast, spraying cucurbits with GA 3 (1500–2000 ppm), silver thiosulphate (300–400 ppm), silver nitrate (300–400 ppm), and during the 2-4 leaf stage causes the formation of male flowers.

Parthenocarpy: Cucumbers and watermelons treated with auxin produced seedless fruits, tomatoes and brinjal treated with PCPA at 50-100 ppm caused parthenocarpy, and newly opened flower clusters treated with 2,4-D at 0.25% in lanolin paste have been found to induce parthenocarpy.

Gametocides: Plant growth regulators can be utilised to create F1 hybrid seeds since they have gametocidal effects that render male sterility. In order to induce male sterility in pepper, GA at 100 mg/l can be employed, as can MH at 100 to 500 mg/l in 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.

Hybrid seed production: In some squash varieties, ethephon has been employed to produce female lines. A successful F1 hybrid of butternut squash was created utilizing a female line that received 10 ethephon sprays each week. Gynoecious lines have also been maintained using plant growth regulators. Sprays containing GA3 have been developed to encourage staminate blooms in gynoecious cucumber lines. On gynoecious lines of cucumber, silver nitrate at a concentration of 500 mg/l has been shown to be just as effective as GA3 at inducing male flowers. However, it was shown that Silver thiosulphate foliar sprays at 400 mg/l worked best for inducing male flower on gynoecious lines in muskmelon.

Fruit ripening: According to reports, the ethylene-releasing chemical ethephon causes tomato and pepper fruit to mature. Application of ethephon at a concentration of 1000 mg/l at the turning stage of the earliest fruits caused early ripening, boosting fruit production by 30–35%. It has also been observed that a postharvest dip treatment with ethephon at 500–2000 mg/l causes mature green tomatoes to ripen.

Fruit Yield Enhancer: Tomato fruit output has been observed to increase after seed soaking in NOA at 25–50 mg/l, CIPA at 10–20 mg/l, GA at 5–20 mg/l, 2,4-D, 0.5 mg/l, or thiourea at 10–1 M. It has been shown that brinjal seedling roots soaked in NAA at 0.2 mg/l and ascorbic acid at 250 mg/l result in greater fruit output.

Conclusion

In several physiological processes connected to the growth and development of vegetables and other crops, plant growth compounds play a crucial role. It is evident that variations in endogenous hormone levels brought on by biotic and abiotic stress affect crop development, and any modification, including the exogenous administration of growth agents, would assist to increase yields or at the very least keep the crop alive. Hormones often migrate from their manufacturing site to their action site inside a plant. To govern the whole plant lifecycle, roots, growth, including germination, blooming, foliage, fruit ripening, and death, phytohormones are physiological intercellular messengers. Additionally, plants release hormones in reaction to environmental variables such nutrient availability, light, temperature, drought, and chemical or physical stress. As a result, hormone levels fluctuate during a plant's lifecycle and are influenced by the environment and season.

References

1. Pal, S. L. (2019). Role of plant growth regulators in floriculture: An overview. *Journal of Pharmacognosy and phytochemistry*, *8*(3), 789-796.
2. Bisht, T. S., Rawat, L., Chakraborty, B., & Yadav, V. (2018). A Recent Advances in Use of Plant Growth Regulators (PGRs) in Fruit Crops-A Review. *Int.J.Curr.Microbiol.App.Sci.,7*(5), 1307-1336