THE SCIENCE WORLD
A Monthly e Magazine
ISSN:2583-2212

Popular Article

July, 2023; 3(07), 1586-1589

Effect of Plant Growth Regulators in solanaceae family

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https://doi.org/10.5281/zenodo.8186973

Introduction

Other than minerals and vitamins, plant growth regulators are organic chemicals which can control plant development when used in modest quantities. PGRs are utilized in a variety of forms, including liquid, powder, and paste. The word "hormone" comes from the Greek root "hormao," which meant to excite. They are referred to as phytohormones to set them apart from animal hormones. An organic substance known as a growth regulator, which can be either natural or synthetic, alters or regulates one or more particular physiological processes in a plant, though the synthesis and action sites are located at distinct locations. A substance is referred to as a plant hormone if it is secreted by the plant itself. Plant growth regulators refer to both naturally occurring plant hormones and hormones produced in laboratories. In comparison to the amount of minerals and vitamins that plants need, the hormone concentration needed to trigger a response in plants is extremely low (10-6 to 10-5M). Plant hormones are molecules, not nutrients, that in small doses encourage and have an influence on the division, growth, and differentiation of cells and tissues. Auxin was the first hormone to be discovered in plant and at one time considered to be only naturally occuring plant growth hormone. Three types of plant hormones, auxins, gibberellins and cytokinins were discovered in the early decades of the twentieth century, in 1930's and1960's respectively.

Utility in vegetable crops

a) **Stimulation of fruit set:** Poor fruit set is a significant issue for solanum crops. Applying 4-CPA, 2,4-D @2-5ppm, or PCPA 50-100 ppm to tomatoes can improve fruit set and ripeness.

b) **Inhibition of sprouting:** Maleic Hydrazide (MH) @ 2500 ppm application 15 days before harvesting suppresses onion growing in storage. The potato tuber dormancy is broken by soaking it in thiourea at 1% concentration and IAA at 250–1000 ppm, which also prolongs hibernation.

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*Published:*25.07.2023

c) **Flowering:** GA @ 50 mg/l caused bloom induction in all varieties of immature potato leaves of non-flowering kinds. Okra blossoming was postponed by MH. According to reports, GA causes lettuce to blossom early.

d) **Seed germination:** It has been suggested that pre-sowing seed with growth regulators improves seed emergence. Okra IAA and NAA @ 20 ppm improve seed germination. Higher germination of tomato plants with GA_3 at 0.5 mg/l and 2,4-D at 0.5 mg/l has been documented. Muskmelon, bottle gourd, squash melon, and watermelon seeds benefited by soaking in ethephon at 480 mg/l for 24 hours when grown at low temperatures.

e) **Seed dormancy:** Before the end of the resting period, potato tubers are unable to sprout; substances such as GA, ethylene chlorhydrin, and thiourea are said to disrupt the resting period. Include the 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.

f) **Sex expression:** It has been discovered that the use of growth regulators alters the sex expression in cucurbits, okra, and pepper. When sprayed on cucurbits between the second and fourth leaf stage, GA_3 (10–25 ppm), IAA (100 ppm), and NAA (100 ppm) have been observed to increase the amount of female flowers. In contrast, spraying cucurbits with GA_3 (1500–2000 ppm), silver nitrate (300–400 ppm), and silver thiosulphate (300–400 ppm) at the 2-4 leaf stage causes the formation of male flowers.

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

h) **Gametocides:** Plant growth regulators can be utilized to produce F_1 hybrid seeds since they have gametocidal effects that render male sterility. MH at 100 to 500 mg/l in okra, muskmelon, onion, root crops, spinach, and tomato; GA_3 in onion; and TIBA in cucumber, okra, onion, and tomato. GA can also be used to induce male sterility in peppers at a dose of 100 mg/l.

i) **Hybrid seed production**: In some squash varieties, ethephon has been employed to produce female lines. A successful F_1 hybrid of butternut squash was created utilizing a female line that received 10 ethephon sprays per week. Gynoecious lines have also been maintained using plant growth regulators. Sprays containing GA_3 have been developed to encourage staminate flowers 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 GA_3 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.

j) **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 during the turning stage of the earliest fruits caused early ripening, boosting fruit production by 30–35%. Additionally, it

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has been observed that a postharvest dip treatment with ethephon at 500–2000 mg/l causes mature green tomatoes to ripen.

k) **Fruit yield enhancer:** Tomato fruit output has been observed to increase after seed soaking in NOA at 25–50 mg/l, GA at 5–20 mg/l, CIPA at 10–20 mg/l, 2,4-D, 0.5 mg/l, or thiourea at 10–1 M. In brinjal, it has been found that soaking seedling roots in NAA at 0.2 mg/l and ascorbic acid at 250 mg/l increases fruit output.

Commercial application of PGRs in vegetable crops

Tomato

In order to increase tomato productivity, quality, early fruit set, cold and high temperature tolerance, and TLCV resistance, plant growth regulators have been demonstrated to be advantageous. The germination of seeds is improved by soaking them in GA_3 (0.5 ppm) or 2,4-D (0.5 ppm) prior to planting. Beta-napthoxy-acetic acid (BNOA) at 25–50 ppm is used to treat seeds. To boost tomato growth and yield, gibberellic acid (GA_3) at 5–20 ppm and chlorophenoxy acetic acid at 10–20 ppm were reported to be effective. The early and total yield increases, in seedlings that were treated with NAA at 0.1 ppm for 24 hours. Fruit yield was observed to increase with foliar applications of GA_3 at 10 ppm, NAA at 1000 ppm, PCPA at 50 ppm, 2,4-D at 0.5 ppm, or cytozyme at 1.25%. Spraying PCPA at 50 ppm, IAA at 50 ppm, or borax at 1% improved summer fruit set. When plants are in the flowering stage, PCPA (50–100ppm) applied topically promotes both low- and high-temperature fruit set. It has been discovered that Cycocel (500 ppm) and GA_3 (25 ppm) are useful for repairing damage brought on by frost. The cold resistance of tomato plants that have been treated with CCC at 0.4-0.5% is noticeably increased. Fruit yield was observed to increase with foliar sprays of CCC (200ppm), ethephon (250ppm), paclobutrazol (40-150ppm), and mixtallol (2.0ppm). Early fruit set results from 2,4-D seed treatment at 2–5 ppm, which also causes parthenocarpy. The incidence of leaf curl disease is decreased and the early and total yield are increased by applying CCC (500 ppm) to the plants in the nursery 3–4 days prior to transplanting and again 25–30 days later. In determinate types with a high degree of flowering synchronization, spraying is efficient. Spraying at a flower cluster is more beneficial because it has no negative effects on the plant's growth. Male sterility can be induced quite well with MH at 100-500 ppm. Harvested fruit that has been treated with ethrel ripens more quickly. Ethrel 1000 ppm can be sprayed on the plants at the start of fruit ripening to accelerate fruit ripening. Early spraying could harm the leaves and shrink the size of the fruits. The storage life of tomato fruit is increased by dipping it in a solution of GA_3 (100–500 ppm) to delay ripening. Application of GA_3 during flowering lengthens the flower stigmatic position and prevents selfing. These lines can be utilized as female lines in programmes to produce hybrid seeds. Although there was no reduction in salt intake, Cycocel administration at 5-12 mg a.i./plant as a soil application or as a foliar spray at 0.1-0.3% enhances salinity tolerance significantly.

Brinjal (Eggplant)

Numerous researchers have noted that growth agents have a positive impact on the brinjal fruiting

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cycle. When used at flowering, 2,4-D @2.0 ppm causes parthenocarpy, boosts fruit set, speeds up fruit ripening, and dramatically boosts overall output. Seed germination is improved by soaking them in GA_3 for 24 hours at 10-40 ppm. By spraying 2,4-D at 2ppm on the entire plant at intervals of one week beginning 60-70 days after the start of flowering, a considerable increase in yield (50%) was achieved. Spraying brinjal plants with n-metatolylphthalamic acid (0.5%), 2,4-D (2.5ppm), and 4 CPA (20ppm) encourages fruit set. Spraying n-metatolylphthalamic acid at 250-500ppm significantly boosts the early production and improved fruit set and development when NAA 60ppm alone or in conjunction with BA 30ppm was applied to open flowers. When one-month-old seedlings are dipped in ascorbic acid, GA_3, IAA, and thiourea at the roots, the flowering time is shortened by 4-5 days. Plants whose roots were immersed in GA_3 and ascorbic acid, each at 250ppm solution, produced a higher yield. Male sterility can be induced quite well with MH at 100-500 ppm.

Chilli and Capsicum

The application of several growth regulators is known to enhance the growth of chilli plants. Application of CCC or cycocel is one of the many growth regulators on the market. The most advantageous time for NAA (planofix) to be applied to plants was at blooming, 10 days following transplant. In chilli cultivars, 10 ppm of Planofix during blooming and three weeks later increased the number of branches. Ethrel (300-500ppm) and CCC (500-2000ppm) treatment reduced the height of the chilli plant while increasing branching. Application of growth regulators such GA_3 (10-100ppm), NAA (20-200ppm), and CCC (1000ppm) can enhance fruit set in chilli. Male sterility can be induced quite well with MH at 100-500 ppm. Foliar spray of Triacontanol (1-2 ppm) improve the fruit set and reduces the flower and fruit drop at high temperature condition.

Potato

Increased tuber yield was achieved by soaking potato seed tubers in CCC at 500 mg/L, sodium ascorbate at 100 mg/L, cytozyme at 5%, or ethephon at 400 mg/L, CCC at 25 mg/L, or gallic acid at 10-100 mg/L. It has been observed that ethylene chlorohydrin applied as a vapour to potato tubers at a rate of 50 ml/q, followed by dips in thiourea (1%) and GA_3 (1 ppm), breaks dormancy. When potato haulms are sprayed with 0.74 kg/ha of CCC, the growth is temporarily slowed, the root system is stimulated, and the plant's resilience to frost is increased.

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