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A review on effect of plant growth regulators on growth, flowering and quality attributes of pomegranate

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Abstract

Plant hormones are messenger molecules that are produced in very small amounts within the plant. The development of flowers, stalks, leaves, leaf shedding, and fruit ripening are all regulated by phytohormones. By influencing seed development, flowering period, flower sex, and leaf and fruit senescence, they mold the plant. Plants would essentially be a mass of undifferentiated cells without hormones, which are essential for plant growth. Gibberellins, cytokinins, auxins, ethylene, growth retardants, and growth inhibitors are examples of plant growth regulators. It's not uncommon for low-quality fruits to be produced. Thus, it would be beneficial to apply plant growth regulators topically to increase the quantity and quality of fruit harvests. For the majority of cultivated plants, and particularly for pomegranate plants, the application of growth regulators has emerged as a crucial part of agro technical processes. The influence of plant growth regulators on pomegranate output is the main topic of this review.

Keywords: Plant growth regulators, pomegranate, flowering, fruit quality, gibberellins

Introduction

One of the most well-known table fruits, pomegranates (*Punica granatum* L.) are grown mostly in tropical and sub-tropical conditions. The fruit of this commercially grown shrub is sweet and somewhat acidic, and is mostly eaten as a dessert. Pomegranates are grown for commercial purposes in Maharashtra, Karnataka, and Andhra Pradesh, India. The most significant cultivar in this region is "Bhagwa," which accounts for over 80% of the land planted to pomegranates in Maharashtra. Its cultivation has gained popularity in India's arid and semi-arid regions over the last two decades due to its sweet, acidic flavor, early bearing, and longer shelf life, as well as the fact that it is a lucrative crop. After ber, pomegranates take up the second-largest area among other arid fruits. Since ancient times, plant growth regulators have played a significant role in horticulture as a way to increase crop growth and development both quantitatively and qualitatively. The intricate and well-coordinated action of endogenous hormones greatly regulates plant growth and development as well as reactions to environmental stimuli. Pomegranates are said to be significantly impacted by plant growth regulators (Chaudhari and Desai, 1993) [6]. A variety of growth regulators used by plants, including auxins, gibberellins, and growth retardants, have been shown to affect the development, quality, blooming, fruit set, and fruit retention of a number of fruit crops at various concentrations (Bhujbal *et al.*, 2013) [3]. Therefore, the goal of the current study was to determine whether plant growth regulators were appropriate for pomegranate flowering and vegetative growth. However, naturally produced phytohormones, their chemical analogs, hormone releasing agents, agents that modify hormone sensitivity, and hormone synthesis inhibitors are all considered plant growth regulators (Hajam *et al.*, 2017) [10]. Additionally, organic compounds (apart from nutrients) that, in trace amounts, stimulate, hinder, or otherwise alter any physiological function in plants are known as plant growth regulators. The commercial application of plant growth regulators to control fruit development was studied by Lawes and Woolley (2001) [14]. Fruit trees are high-value products, and even minor adjustments to improve the quality of the final product, production efficiency, or aesthetic appeal can have a big impact on its worth.

As a result, the application of plant growth regulators has produced remarkable results in a number of fruit crops concerning growth, production, and quality. Since fruit trees are high-

value crops, even minor adjustments to production efficiency, product quality, or aesthetic appeal can have a big impact on product value.

Certain plant growth regulators' activities

Auxin

A synthetic auxin plant hormone called NAA is frequently used to propagate plants vegetative from stems and cuttings. The time of entrance and concentration have a significant impact on how NAA affects plant growth. It has been demonstrated that NAA significantly increases the production of cellulose fiber in plants. Spraying NAA in varying concentrations on various fruit crops is how most fruit plants manage fruit drop. Following flower fertilization, it is given.

2,4-D

The proper concentration of hormones that are produced internally can affect a bud's lifetime and modulate the mobilization of nutrients to the developing organs. Exogenous administration of 2,4-D or NAA has demonstrated the dependence of abscission on the endogenous concentration of auxins because the plant's ability to transport auxins appears to be unaffected by ethylene and lasts for a considerable amount of time.

Gibberellins

Gibberellins have a variety of effects on fruit growth at different phases. Fruit development is a complicated process that is strictly controlled. Fruit growth has a high metabolic activity and is a powerful nutrient sink, with hormones potentially influencing the process (Brenner and Cheikh, 1995) [5]. Pre-pollination, pollination, fertilization and fruit set, post-fruit set, ripening, and senescence are the segments that make up a fruit's lifetime. Cell division and expansion follow the ovule's successful fertilization, which causes the fruit to grow. It is known that gibberellins affect cell expansion as well as cell division (Adams *et al.*, 1975) [1].

Cytokinin

The term "cytokinin" refers to a class of naturally occurring chemicals that are known to stimulate cell division. Letham came up with the word cytokinin in 1963. It is also known to postpone aging. The first naturally occurring cytokinin, known as zeatin, was discovered in corn. Synthetic benzyladenine and kinetin are the most prevalent cytokinins. The organic cytokinin present in developing fruits, inflorescences, and the apical root meristem. Cytokinin plays a function in cell division, lateral bud growth, postponing senescence, and organogenesis or shoot creation, parthenocarp fruit generation, and other processes in plants. Shoot bud development may be aided by low auxin and high cytokinin levels.

Ethylene

A chemical that occurs naturally in plants, ethylene has a variety of effects on the growth, development, and shelf life of various fruit crops. Ethylene can be obtained from both endogenous and external sources, and harvested fruits may be exposed to physiologically active quantities of ethylene either purposefully or accidentally. In addition to several biotic and abiotic stressors, ethylene production and sensitivity are increased during specific phases of plant development.

Use of plant growth regulators in pomegranate crops

The effects of hormone synthesis inhibiting substances, hormone

releasing agents, naturally generated phytohormones, and agents that change hormone sensitivity on pomegranate production are discussed in this paper.

Rahemi *et al.* (2004) [18], "Shisheh Cup" pomegranate plants were treated with plant growth regulators in 1999 and 2000 to determine the effects of the compounds 2,4-dichlorophenoxyacetic acid (2,4-D), the naphthalene acetic acid (NAA), and naphthalene acetamide (NAD) on the yield and quality of pomegranate fruits. 2,4-D (15, 30, 45 mg/L), NAA (25, 50, 100 mg/L), and NAD (50, 100, 200 mg/L) were administered to uniform branch units of pomegranate plants at full flowering, 45 days after full blossoming, and 90 days after full bloom in the first experiment. The uniform branch units of the pomegranate plant were treated with 2,4-D (15, 30, 45 mg/L) at full bloom, 30, 60, and 90 days after peak flowering in the second investigation. In both trials, three trees and four uniform branch units per tree received treatments that were administered with a hand sprayer till the drip point. At the maturity stage, fruit samples from treated branches were collected, and the fruits' qualitative and quantitative characteristics were assessed. Fruit L/D ratio, fruit weight, fruit volume, (naturally) rind weight, aril weight, and leaf area index were all markedly elevated in both experiments by plant growth regulators. Using 2,4-D (30 mg/L), NAA (50 mg/L), and NAD (100 mg/L) is advised for the optimum effects of plant growth regulators on the qualitative and quantitative characteristics of pomegranate fruits.

Ghosh *et al.* (2009) [8], pomegranate cv. Ruby yield and fruit quality were affected by plant growth regulators. Seven treatments were sprayed three times, beginning at 50% blooming stage and then at 21-day intervals. The treatments included three growth regulators: NAA @ 25, 50 ppm; GA₃ @ 10, 20 ppm; 2,4-D @ 5, 10 ppm; and control (water spray). The application of NAA at 25 ppm produced considerably higher fruit setting (44.3%) and fruit retention (44.1%), according to the results. At 7 years of age, the highest fruit production was 7.8 kg/plant, compared to 1.7 kg in the control. Sprays containing growth regulators greatly increased the weight and quality of the fruit.

Reddy *et al.* (2011) [16] investigated how ethylene-inhibiting compounds affected pomegranate output and quality. The best way to lower the amount of ethylene in pomegranate leaves was to apply different ethylene-inhibiting compounds. When 2.5 ppm of cobalt chloride was sprayed on pomegranate leaves, the amount of ethylene was dramatically reduced. Pomegranate plants treated with 2.5 ppm cobalt chloride had the maximum numbers of fruits per tree, yield per tree, and average fruit weight. As an inhibitor, KNO₃ produced outcomes that were moderate. Pomegranate with cobalt chloride 2.5 ppm and KNO₃ 500 ppm had the highest total soluble solids. In pomegranates, the highest percentage of titratable acidity was seen when KNO₃ was applied as a foliar spray. For every character, foliar treatment of ethylene inhibitors proved to be more effective than soil application.

Supe and Marbhal (2008) [20] found that BA application encourages maximal fruit drop on pomegranate var. mirdula, Sharma and Belsare (2011) [19] found that foliar spraying CPPU 5ppm in April increased the size and juice content of the pomegranate.

Reddy and Prasad (2012) [17] found that in pomegranate cv. Ganesh, applying 2,4-D at 20, 30, and 40 ppm three times, beginning at full bloom and then at 45 and 90 days after fruit set, resulted in significantly larger fruit in terms of length, width, and volume. The fruit also weighed more (262.23g), had a higher aril percentage, and had the greatest number of fruits

(64.00), the highest fruit yield being 16.78 kg/plant.

Goswami *et al.*, (2013) ^[9] investigated how plant growth agents affected pomegranate qualitative characteristics. Only the 200 ppm ethrel treatment was shown to be effective on all five quality attributes out of the 15 treatments that were used. The TSS (17.18%), reducing sugar (10.83%), non-reducing sugar (1.68%), total sugar (12.50%), and the vitamin C content (14.85%) were all enhanced once ethrel 200 ppm was applied.

Anawal *et al.* (2016) ^[2] investigate how the pomegranate cv. Bhagwa fruit setting and yield are affected by a number of plant growth regulators at varying doses, specifically NAA (40, 50, 60 ppm) and GA3 (40, 50, 60 ppm). The findings showed that, in comparison to the control, NAA 40 ppm was effective in enhancing the average number of fruits per plant (62.44), length of fruit (8.66 cm), width of the fruit (8.71 cm), fruit mass (262.23 g), fruit volume (255.44 ml), total sugars (15.58%), reducing sugars (13.83%), and non-reducing sugars (1.75%).

Digrase *et al.* (2016) ^[7], GA3 75 ppm application resulted in the largest mean fruit volume (308.00 ml), greatest height (170.75 cm), spread of the plant (152.50 cm), greatest fruit length (8.67 cm), and largest fruit diameter (9.20 cm). The compounds did not significantly alter fruit width, plant spread, or height. Greatest fruit diameter (8.57 cm), largest mean fruit volume (291.00 ml), the greatest number of fruits per plant (99.9), average fruit weight (161.56 g), and fruit production per ha (16.25 Mt/ha) were all considerably higher with the pre-harvest boron 0.3% spray. Higher pomegranate fruit growth and yield were achieved using an interactive treatment combination of GA3 75 ppm + boron 0.3%.

Phawa *et al.* (2017) ^[15] The "Influence of Plant Growth Regulators on Pomegranate (*Punica granatum* L.) cv. Kandhari Growth and Blooming" Using GA₃ at 75 parts per million resulted in the greatest height of the plant (194.90 cm), spread of plant (194.20 cm), crown volume (3.81 m³), length of the internode (8.07 cm), shoot length (15.57 cm), plant girth (3.24 cm), leaf surface (7.37 cm²), and number of flowers per plant (29.01), according to the data. The shortest days to blossoming (23.67) were measured under 40 ppm NAA.

Kishor *et al.* (2017) ^[17] investigated how several chemicals and plant hormones affected the physico-chemical characteristics of immature pomegranates (cv. Bhagwa) that were two years old. According to the observation, fruit mass (101.67 g), fruit length (6.00 cm), fruit volume (92.00), specific gravity (1.10), number of arils/fruit (363.33), number of segments/fruit (5.00), acidity (0.45%), antioxidant vitamin C (10.20 mg/100g), total sugar (6%) and non-reducing sugar (1.93%) improved more when treatment T8 (2,4-D @ 15 ppm) was applied. whereas treatment T1 (NAA @ 50 ppm) produced the highest T.S.S.: Acid ratio and decreasing sugar. The application of NAA at 75 ppm under treatment T2 increased the largest fruit (4.73 cm in width). Treatments T4 (GA₃ @ 75 ppm) and T6 (Borax @ 50 ppm) produced the highest pericarp thickness (4.73 mm) and total soluble solids (12.57 O_{Brix}).

Kuldip *et al.* (2017) ^[13] examined how two growth regulators (2,4-D & NAA at 10, 20, 40 ppm) and irrigation were used at 15 and 30 days after fruit set, as well as the impact of micronutrients and plant growth regulators on fruit output and fruit cracking in pomegranate cv. Jodhpur Red. During all application stages, there was a higher incidence of premature fruit cracking than with mature fruits. Cracking that was longitudinally (radial) was more common than cracking that was diagonal (transverse). The incidence of cracking was substantially lower with 2,4-D and NAA at 10 ppm than with all other treatments. NAA at 20 ppm produced the highest fruit

production per acre (50.8 q) when sprayed 15 days after fruit set, whereas 2,4-D at 10 ppm produced the greatest number of fruits when applied 30 days after the development of fruit.

Thakur *et al.* (2018) conducted research to ascertain how plant growth regulators affect the physico-chemical characteristics of fruits. The findings of this study indicate that NAA 30 ppm (May and June) is the most effective application of fertilizers and plant growth regulator for enhancing pomegranate quality.

Borana *et al.* (2018) ^[4] found that nine different concentrations of plant growth promoters (GA3 and NAA at 0, 25, and 50 ppm and MH at 0, 100, and 200 ppm concentrations), and 27 treatment combinations were replicated three times using a factorial randomized block design to examine the impact of plant growth promoters on yield as well as quality of pomegranate (*Punica granatum* L.) cv. Bhagwa. Applying GA3 at 25 ppm resulted in considerably higher optimum fruits per plant (27.00), fruit diameter (6.72 cm), average fruit weight (207.15 g), yield per plant (5.89 kg), number of arils per fruit (370.31), and non-reducing sugar (1.58%), according to the results. The greatest reducing sugar (9.29%), total sugar (10.69%), number of arils / fruit (357.29), the average fruit mass (201.26 g), and average volume (219.67 cc) of fruit were all significantly increased by applying NAA at a concentration of 25 ppm. MH 200 ppm spraying resulted in the greatest TSS (13.340brix), non-reducing sugar (1.39%), the greatest number of fruits / plant (29.04), fruit diameter (6.79 cm), average fruit weight (194.89 g), yield per plant (6.06 kg), average fruit volume (218.48 cc), and number of arils per fruit (350.67). Pomegranate fruits of the highest quality and largest production were obtained by spraying GA3 at 25 ppm and MH at 200 ppm.

Jhade *et al.* (2020), ^[11] three applications of NAA (10, 15 ppm), GA3 (10, 15 ppm), 2,4-D (10, 15 ppm), and control were made beginning at 50% during the flowering stage and then every 20 days after that. The administration of plant growth regulators at different intervals had a substantial impact on measures such as average fruit weight, number of fruits/tree, yield per plant, and yield MT/ha. According to the results, applying 15 ppm of NAA produced a noticeably higher fruit set, resulting in the greatest fruit output of 10.5 kg/plant at 6 years of age, compared to 5.21 kg in the control. Growth regulator sprays resulted in a considerable improvement in fruit weight and quality.

References

1. Adams PA, Montague MJ, Tepfer M, Rayle DL, Ikuma H, Kaufman PB. Effect of gibberellic acid on the plasticity and elasticity of *Avena* stem segments. *Plant Physiology*. 1975;56:757-760.
2. Anawal VV, Narayanaswamy P, Ekabote SD. Effects of plant growth regulators on fruit set and yield of pomegranate cv. Bhagwa. *International Journal of Scientific Research*. 2016;4(9):1-4.
3. Bhujbal DS, Naik DM, Kale SA. Studies on effect of growth regulators on flowering, fruiting and quality of sapota. *International Journal of Agricultural Sciences*. 2013;9(1):289-292.
4. Borana PD, Joshi PC, Verma P, Nandre BM, Bhaduria HS, Joshi ND. Effect of plant growth regulators on yield and quality of pomegranate (*Punica granatum* L.) cv. Bhagwa. *Green Farming*. 2018;9(1):165-168.
5. Brenner ML, Cheikh N. The role of hormones in photosynthate partitioning and seed filling. In: Davies PJ, editor. *Plant Hormones: Physiology, Biochemistry and Molecular Biology*. Dordrecht: Kluwer Academic Publishers; 1995. p. 649-670.

6. Chaudhari SM, Desai UT. Effect of plant growth regulators on flower sex in pomegranate. Indian Journal of Agricultural Sciences. 1993;63:34-35.
7. Digraze SS, Tambe TB, Kadam AS, Kalalbandi BM. Effect of different plant growth regulators and chemicals on growth and yield of pomegranate (*Punica granatum* L.) cv. Bhagwa. Advance Research Journal of Crop Improvement. 2016;7(1):96-99.
8. Ghosh SN, Bera B, Roy S, Kundu A. Effect of plant growth regulators on yield and fruit quality in pomegranate cv. Ruby. Journal of Horticultural Science. 2009;4(2):158-160.
9. Goswami JD, Patel NM, Bhadauria HS, Wankhade VR. Effect of plant growth regulators on quality traits of pomegranate cv. Sinduri. The Asian Journal of Horticulture. 2013;8(1):361-363.
10. Hajam MA, Hassan GI, Bhat TA, Bhat IA, Rather AM, Parray EA, Wani MA, Khan IF. Understanding plant growth regulators and their interplay for nursery establishment in fruits. International Journal of Chemical Studies. 2017;5(5):905-910.
11. Jhade RK, Deshmukh G, Ambulkar PL, Alawa SL. Impact of plant growth regulators on yield and yield attributing characters in pomegranate (*Punica granatum* L.) cv. Bhagwa in Satpura plateau region of Madhya Pradesh. International Journal of Chemical Studies. 2020;8(1):2579-2582.
12. Kishor S, Maji S, Meena ML, Deepa H, Kishor SD, Kumar S. Effect of plant bio-regulators and chemicals on fruit physico-chemical traits of pomegranate (*Punica granatum* L.) cv. Bhagwa. Journal of Pharmacognosy and Phytochemistry. 2017;6(4):1573-1575.
13. Kuldip K, Joon MS, Yadav R, Daulta BS. Effect of growth regulators and micronutrients on fruit cracking and fruit yield in pomegranate. Indian Journal of Agricultural Research. 2017;51(3):326-331.
14. Lawes GS, Woolley DJ. The commercial use of plant growth regulators to regulate fruit development. Acta Horticulturae. 2001;553:149-150.
15. Phawa T, Prasad VM, Rajwade VB. Effect of plant growth regulators on growth and flowering of pomegranate (*Punica granatum* L.) cv. Kandhari in Allahabad agro-climatic conditions. International Journal of Current Microbiology and Applied Sciences. 2017;6(8):116-121.
16. Reddy ChP, Reddy YN, Narayanareddy P, Chandrashekhar R. Effect of ethylene inhibiting chemicals on yield and quality of pomegranate. Acta Horticulturae. 2011;890:353-358.
17. Reddy PA, Prasad DM. Effect of plant growth regulators on fruit characters and yield of pomegranate (*Punica granatum* L.) cv. Ganesh. International Journal of Plant, Animal and Environmental Sciences. 2012;2(2):2331-4490.
18. Rahemi M, Atahosseini A. Effect of plant growth regulators on fruit characteristics and leaf area of pomegranate cv. Shisheh. Acta Horticulturae. 2004;662:313-317.
19. Sharma N, Belsare C. Effect of plant bio-regulators and nutrients on fruit cracking and quality in pomegranate (*Punica granatum* L.) 'G-137' in Himachal Pradesh. Acta Horticulturae. 2011;890:347-352.
20. Supe VS, Marbhal SK. Effect of plant growth substances on fruit size of pomegranate (*Punica granatum* L.) cv. Mridula. The Asian Journal of Horticulture. 2008;3:18-20.
21. Thakur C, Sharma CL. Effect of plant growth regulators on physicochemical parameters of pomegranate (*Punica granatum* L.) cv. Kandhari. International Journal of Chemical Studies. 2018;6(4):1849-1855.