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EFFECT OF PLANT GROWTH REGULATOR ON GROWTH PARAMETERS AND LEAF YIELD OF CORIANDER (*CORIANDRUM SATIVUM* L.)

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ABSTRACT

An experiment was conducted at a College Orchard, SRM College of Agricultural Sciences, Chengalpattu district, Tamil Nadu to study the "Effect of Plant growth regulator on growth parameters, leaf yield of Coriander (*Coriandrum sativum* L.)". The experiment was laid out in Randomized Block Design (RBD) with three replications. There were seven treatments, *viz.*, GA_3 30ppm, GA_3 40 ppm and NAA 30 ppm, NAA 40 ppm, CCC 250 ppm, CCC 500 ppm and control. The results indicate that GA_3, especially at concentrations of 40 ppm, consistently outperforms other treatments, significantly enhancing plant height (51.43), number of branches (7.14 cm), number of nodes per plant (8.14), the weight of leaves per plant (17.40), number of leaves per plant (38.28), plant spread (44.39cm) and yield per plot (2.42 kg). From the present study, it is recommended that spraying of GA_3 40 ppm improved growth and yield parameters in coriander. These findings offer practical insights for coriander cultivation, highlighting GA_3 as a key regulator for optimizing growth and productivity.

Key words : Coriander, Gibberellic acid, Growth, PGR, Yield.

Introduction

Coriander (*Coriandrum sativum* L.) is a multipurpose herb that is highly esteemed for its potential health advantages as well as its culinary importance. Coriander, also referred to as chinese parsley or cilantro, belongs to the Apiaceae family (Laribi *et al.,* 2015). Originating from areas encompassing southern Europe, Northern Africa and Western Asia, coriander has achieved worldwide recognition and popularity as an aromatic component in a variety of cuisines. India is responsible for approximately 80% of the global production of coriander (Nadeem *et al*., 2013). Production of coriander was documented at 4.62 lakh tonnes on an area of 5.53 lakh hectares in 2014-2015. As per the findings of the United States Department of Agriculture (USDA), coriander is estimated to have the following nutritional composition: 3.7 grammes of carbohydrates, 2.1 grammes of protein and 0.5 grammes of fat. Significantly, coriander offers 2.8 grammes of dietary fibre per 100 grammes, which is an excellent amount. Coriander, which is high in vitamins, provides substantial quantities of folate (62 g), vitamin A (6748 IU), vitamin C (27 mg) and vitamin K (310 mg). In addition, potassium (521 mg), calcium (67 mg), iron (1.8 mg) and magnesium (26 mg) are among the minerals present. In addition to its culinary uses, coriander has been incorporated into traditional medicine due to its possible antimicrobial, anti-inflammatory and antioxidant properties (Bhat *et al*., 2014; Prachayasittikul *et al*., 2018).

In light of the increasing requirements of an expanding human population, agriculture is consistently progressing, and the utilisation of plant growth regulators (PGRs) presents itself as a potentially effective approach to enhance both the quantity and quality of crops (Rademacher, 2015). Plant growth substances are of critical importance in numerous physiological processes that regulate the development and growth of crops. The influence of endogenous hormone fluctuations, which can be induced by biotic and abiotic stresses, on crop growth is clearly discernible. It is expected that the implementation of any type of manipulation, such as the exogenous administration of growth substances, will result in an increase in yield or, minimum, ensure the continued existence of the crop (Bhatla and Lal, 2023). Plant growth hormones, which are organic substances that occur naturally in higher plants, regulate growth and various physiological processes at a location far from their point of production (Sharma *et al*., 2024). Furthermore, even in trace quantities, these hormones maintain their activity. It is essential to apply plant growth regulators at specific intervals, such as 25 and 50 days after sowing, in the context of coriander cultivation. Additionally, the growth, development, and biosynthesis of secondary metabolites in medicinal and aromatic plants, such as coriander are impacted by both intrinsic and extrinsic factors. It has been determined that photosynthesis and plant growth regulators (PGRs) are significant determinants of primary and secondary metabolite pools and plant growth. Commercialization of PGRs in agriculture has occurred and these substances have been lauded as agents of transformation with the potential to substantially increase agricultural output. Fundamentally, plant growth regulators have become indispensable instruments with the ability to surmount obstacles posed by environmental and genetic factors; thus, they have significantly contributed to increased agricultural output (Prajapati *et al*., 2015).

The objective of this research is to examine the complex relationship between coriander and plant growth regulators in order to determine how these regulators influence the leaf yield and growth parameters of this vital herb. The ultimate goal of this research is to contribute to the field of modern agriculture by shedding light on sustainable and optimised cultivation methods, while also advancing our knowledge of the physiology of coriander.

Materials and Methods

An investigation was undertaken to assess the impact of various plant growth regulators on the growth and yield of coriander at the college orchard of SRM College of Agricultural Sciences, Orathy, Achurapakam (Tamil Nadu), throughout the summer months of April and May 2022. Geographically located at 79° 73′ E longitude and 12° 38′ N latitude, it stands at an elevation of 6.7 m above mean sea level. The experimental field soil had the following characteristics: a light black loamy texture, a pH of 6.8, an EC of 1.076 dSm^{-1} low nitrogen content of 124.18 kg/ha, a low phosphorus content of 8.63 kg/ha and a high potassium content of 492.50 kg/ha. Control, two concentrations of Gibberellic acid (30 and 40 ppm), two concentrations of Naphthalene Acetic acid (30 and 40 ppm) and two concentrations of Chlormequat Chloride (250 and 500 ppm) were among the seven treatments that were evaluated. Three replications of a randomised block design were utilised to evaluate these treatments. Seeds of coriander (Acr-1) were planted with 30 cm spacing between rows. The crop was aerated with NPK at a basal dose of 60:40:30kg ha^{-1}. At 30 DAS, growth regulators were sprayed onto the foliage in accordance with the treatments. The plant parameters comprised of leaf yield per plot, plant height, number of nodes per plant, leaf weight per plant, plant spread and leaf number of branches per plant was measured.

Results and Discussion

The examination of coriander plant height in response to various treatments involving a number of plant growth regulators showed distinctive results (Fig. 1A). The height of the plants in the control group (T_1) was 11.21 cm. However, treatments involving gibberellic acid (GA_3) at concentrations of 30 ppm (T_2) and 40 ppm (T_3) resulted in a significant increase in plant height to 16.30 cm and 19.53 cm, respectively. Conversely, treatments with 30 ppm (T_4) and 40 ppm (T_5) naphthalene acetic acid (NAA) led to reduced plant heights of 10.69 cm and 10.51 cm, respectively. Treatments with chlormequat chloride (CCC) at concentrations of 250 ppm (T_6) and 500 ppm (T_7) resulted in concentration-dependent increases in height of 12.10 cm and 13.01 cm, respectively. The results indicate that GA_3 has a beneficial impact on the growth of coriander, whereas the effects of NAA and CCC are inconsistent. GA_3, a regulator of plant growth, facilitates stem elongation, cell division and cell elongation in general, thereby contributing to the augmentation of plant stature. The study observed that compounds containing GA_3, specifically at a concentration of 40 ppm had a beneficial effect on the height of the coriander plants (19.53 cm). This finding indicates that GA_3 is an effective enhancer of vertical growth. Potentially, this will result in enhanced plant architecture and increased leaf yield (Tiwari *et al*., 2011). Furthermore, GA_3 has been identified as a critical factor in facilitating seed germination, overcoming the detrimental impacts of stressful environments and reversing dormancy. As a result of its numerous beneficial impacts on plant development, GA_3 treatment is an advantageous alternative for maximising yield and optimising coriander cultivation (Akter *et al*., 2007).

Different responses were observed when the number of nodes per coriander plant was assessed in response to various treatments involving various plant growth regulators (Fig. 1B). The average number of nodes in the control group (T_1) was 4.10, whereas treatments involving GA_3 at concentrations of 30 ppm (T_2) and 40 ppm (T_3) substantially increased the node count to 6.64 and 8.14, respectively. In contrast, the application of NAA at concentrations of 30 ppm (T_4) and 40 ppm (T_5) resulted in moderate growth to nodes 6.50 and 7.40, respectively. At concentrations of 250 ppm (T_6) and 500 ppm (T_7), CCC produced 6.50 and 6.34 nodes, respectively. The significant increase in node count observed in coriander plants treated with GA_3 demonstrates the efficacy of this substance in promoting branching and node development (Ram *et al*., 2024). This may result in an expansion of leaf-bearing locations, which may have an impact on the overall productivity of the plant. The results underscore the efficacy of GA_3 as an enhanced regulator of plant growth, which can be utilised to optimise the cultivation methods of coriander (Zhou *et al*., 2024).

The analysis of the leaf weight of coriander plants subjected to different treatments involving different plant growth regulators reveals substantial differences (Fig. 1C). The control group (T_1) demonstrated a leaf weight of 7.10 g. In contrast, treatments containing GA_3 at concentrations of 30 ppm (T_2) and 40 ppm (T_3) resulted in significant weight gains of 16.00 g and 17.40 g, respectively. In contrast, NAA treatments at concentrations of 30 ppm (T_4) and 40 ppm (T_5) led to leaf weights of 12.40 g and 12.80 g, respectively, which were considered moderate. The application of CCC at concentrations of 250 ppm (T_6) and 500 ppm (T_7) resulted in reduced leaf weights of 11.86 g and 10.19 g, respectively. Treatments with GA_3 resulted in a significant increase in leaf weight, demonstrating its effectiveness in facilitating healthy leaf growth and biomass accumulation. The augmented leaf mass signifies enhanced photosynthetic capability and nutrient absorption, implying that the application of GA_3 is especially advantageous for optimising the yield of coriander leaves. The results of this study underscore the potential of GA_3 to function as an enhanced plant growth regulator, thereby increasing the yield of coriander farming (Ei *et al*., 2024).

By comparing the number of branches per coriander plant in response to various treatments involving distinct plant growth regulators, branching patterns are determined to be significantly altered (Fig. 1D). The mean number of branches observed in the control group (T_1) was 5.00. In contrast, treatments involving GA_3 at concentrations of 30 ppm (T_2) and 40 ppm (T_3) resulted in substantial growth increases, attaining 6.14 and 7.14 branches, respectively. In contrast, treatments with NAA at concentrations of 30 ppm (T_4) and 40 ppm (T_5) resulted in slight expansions to branches measuring 5.45 and 5.80, respectively. 5.14 and 5.12 branches, respectively were produced by CCC treatments at 250 ppm (T_6) and 500 ppm (T_7). The efficacy of GA_3 in eliciting lateral growth and branching architecture in coriander plants is underscored by the significant promotion of branching observed with its treatments. The potential outcome of this increased branching is a denser canopy and a higher overall yield. The results indicate that the utilisation of GA_3 has a significant positive impact on the optimisation of coriander cultivation methods through its influence on branching patterns and by extension, plant architecture (Ram *et al*., 2024).

The examination of the number of leaves per coriander plant under various treatments with different plant growth regulators highlights substantial variations in foliar development (Fig. 1E). The control group (T_1) displayed an average of 23.46 leaves, while treatments with GA_3 at 30 ppm (T_2) and 40 ppm (T_3) demonstrated remarkable increases, reaching 35.30 and 38.28 leaves, respectively. NAA treatments at 30 ppm (T_4) and 40 ppm (T_5) resulted in moderate increases, yielding 29.72 and 34.54 leaves, respectively. CCC treatments at 250 ppm (T_6) and 500 ppm (T_7) showed leaf counts of 27.24 and 24.91, respectively. The robust enhancement in the number of leaves with GA_3 treatments emphasizes its efficacy in promoting foliar development in coriander plants. GA_3's ability to stimulate both vertical and lateral growth contributes to a denser canopy, maximizing overall leaf count. This increased foliar density, especially at 40 ppm, may be attributed to the balanced promotion of lateral branches and vertical growth, making GA_3 application the most effective in optimizing coriander leaf production (Chhiroliya *et al*., 2023).

The analysis of coriander plant spread in response to different treatments involving various plant growth regulators reveals substantial variations in horizontal growth (Fig. 1F). The control group (T_1) demonstrated a spread of 29.40 cm, whereas the treatments involvingGA_3 at concentrations of 30 ppm (T_2) and 40 ppm (T_3) exhibited significant expansions, with respective spreads of 44.39 cm and 42.40 cm. On the other hand, treatments with NAA at concentrations of 30 ppm (T_4) and 40 ppm (T_5) led to moderate increases in spread values of 34.60 cm and 37.50 cm, respectively. Spreads of 30.10 cm and 33.16 cm were produced, respectively, by CCC treatments at 250 ppm (T_6) and 500 ppm (T_7). The significant increase in plant spread observed alongside GA_3 treatments underscores the effectiveness of this substance in facilitating lateral growth and broadening the overall plant canopy in coriander. The augmented dissemination could potentially result in a broader canopy, thereby augmenting the absorption of light and potentially impacting

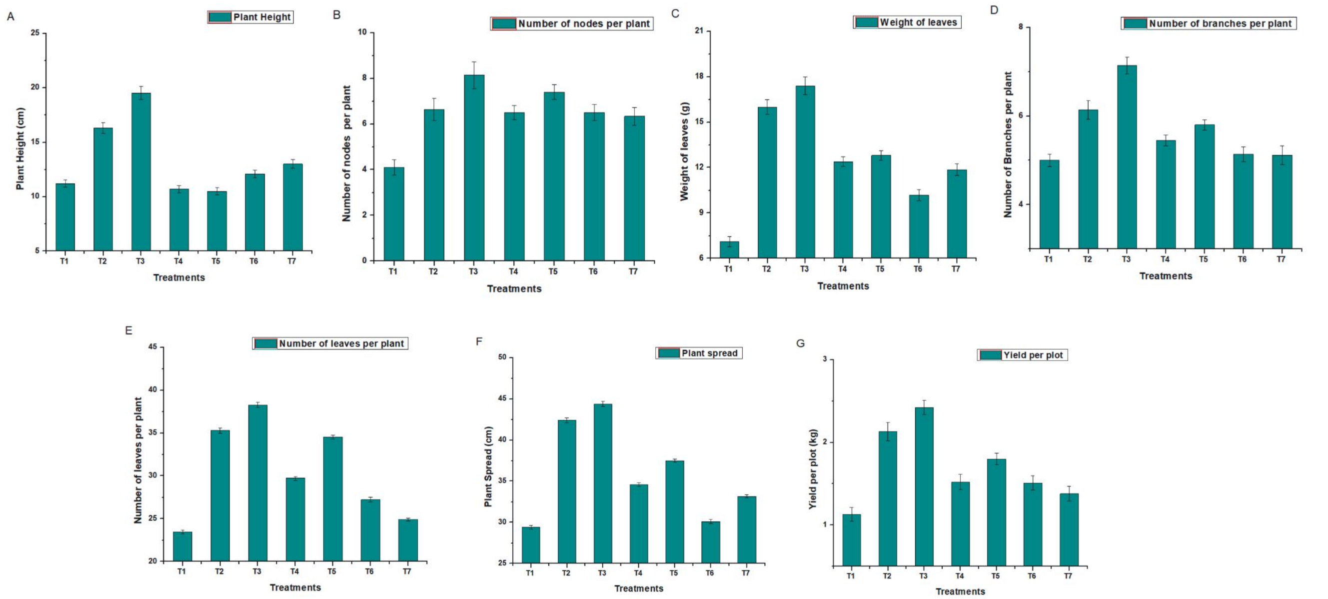

Fig. 1 : Effect of plant growth regulators on the a) plant height (cm); b) number of nodes per plant; c) weight of leaves (g); d) number of branches per plant; e) number of leaves per plant; f) plant spread (cm) and g) leaf yield per plot (kg) in Coriander (Acr-1) (T_1 - Control; T_2 – GA3 30 ppm; T_3 - GA3 40 ppm; T_4 - NAA 30 ppm; T_5 - NAA 40 ppm; T_6 - CCC 250 ppm and T_7 - CCC 500 ppm).

the overall crop production. The results indicate that the application of GA_3 has a significant positive impact on optimising coriander cultivation methods through its ability to regulate plant dispersal and encourage the development of a dense canopy (Sahu *et al.*, 2023).

The assessment of coriander leaf yield per plot in response to diverse treatments involving various plant growth regulators indicates a distinct impact on overall productivity (Fig. 1G). The results obtained from the control group (T_1) were 1.13 kg, whereas treatments containing GA_3 at concentrations of 30 ppm (T_2) and 40 ppm (T_3) significantly increased the yield to 2.13 kg and 2.42 kg, respectively. In contrast, treatments with 30 ppm (T_4) and 40 ppm (T_5) NAA led to reduced yields of 1.52 kg and 1.80 kg, respectively. The yields of CCC treatments at concentrations of 250 ppm (T_6) and 500 ppm (T_7) were 1,51 kg and 1.38 kg, respectively. The notable increase in leaf yield observed in response to GA_3 treatments provides strong evidence of its effectiveness in substantially boosting coriander productivity. The positive effects of GA_3 on various growth parameters, such as increased plant height, the number of branches, and the number of leaves, as seen in the study, are responsible for its superior performance (Chhiroliya *et al.*, 2023). The capacity of GA_3 to stimulate lateral and vertical expansion, in addition to increasing the number of leaves, contributes to the formation of a dense canopy that optimises light absorption and ultimately results in an exceptional leaf yield. The results of this study underscore the critical significance of utilising GA_3 to optimise the cultivation methods of coriander in order to increase overall productivity (Reddy *et al.*, 2023).

Conclusion

In summary, the thorough examination of the impacts of different plant growth regulators on the growth parameters of coriander (*Coriandrum sativum*) has yielded significant knowledge regarding the optimisation of farming techniques to increase production. From the treatments that have been examined, gibberellic acid (GA_3) has consistently demonstrated superior performance in various aspects, making it the most effective regulator of plant growth. Significant enhancements in plant growth were observed with the application of GA_3, specifically at concentrations of 40 ppm. These improvements included an increase in leaf yield per plot, number of nodes, number of branches, leaf count, and plant spread. The strong reaction to GA_3 indicates that it plays a crucial role in facilitating lateral and vertical expansion, thereby enhancing the development of the canopy and optimising the overall capacity for photosynthesis. The results of this study highlight the potential of GA_3 as a crucial instrument for coriander cultivators to enhance crop management approaches and attain increased yields. Nevertheless, it is critical to acknowledge that the concentration-dependent reactions witnessed with alternative growth regulators, including chlormequat chloride (CCC) and naphthalene acetic acid (NAA), underscore the significance of accurate application in order to prevent inadvertent consequences. Additional research delving into the physiological and biochemical mechanisms that underlie the observed responses will enhance our comprehension of the subject matter and furnish more precise suggestions for the cultivation of coriander.

References

Akter, A., Ali E., Islam M.M.Z., Karim R. and Razzaque A.H.M. (2007). Effect of GA_3 on growth and yield of mustard. *Int. J. Sust. Crop Prod.*, **2(2)**, 16-20.

Bhat, S., Kaushal P., Kaur M. and Sharma H.K. (2014). Coriander (*Coriandrum sativum* L.): Processing, nutritional and functional aspects. *Afr. J. Plant Sci.*, **8(1)**, 25-33.

Bhatla, S.C. and Lal M.A. (2023). Plant growth regulators: an overview. *Plant physiology, development and metabolism*, 391-398.

Chhiroliya, J.K., Morya R., Bhargava A. and Gupta P.K. (2023). Effect of Plant Growth Regulators and Bio-fertilizer on Growth and Quality of Fenugreek (*Trigonella foenum-graecum* L.). *Int. J. Plant Soil Sci.*, **35(21)**, 912-920.

Laribi, B., Kouki K., M' Hamdi M. and Bettaieb T. (2015). Coriander (*Coriandrum sativum* L.) and its bioactive constituents. *Fitoterapia*, **103**, 9-26.

Nadeem, M., Muhammad Anjum F., Issa Khan M., Tehseen S., El Ghorab A. and Iqbal Sultan J. (2013). Nutritional and medicinal aspects of coriander (*Coriandrum sativum* L.) : A review. *British Food J.*, **115(5)**, 743-755.

Prachayasittikul, V., Prachayasittikul S., Ruchirawat S. and Prachayasittikul V. (2018). Coriander (*Coriandrum sativum*): A promising functional food toward the well-being. *Food Res. Int.*, **105**, 305-323.

Prajapati, S., Jamkar T., Singh O.P., Raypuriya N., Mandloi R. and Jain P.K. (2015). Plant growth regulators in vegetable production: An overview. *Plant Archives*, **15(2)**, 619-626.

Rademacher, W. (2015). Plant growth regulators: backgrounds and uses in plant production. *J. Plant Growth Regulation*, **34**, 845-872.

Ram, G., Chopra S., Bhushan A., Samnotra R.K., Ola A.L. and Kantwa R.C. (2024). Effect of GA_3 and Potassium on Growth and Yield in Red Radish (*Raphanus sativus* L.) under Subtropical Conditions of Jammu. *Int. J. Environ. Clim. Change*, **14(1)**, 186-193.

Reddy, L.Y., Cheena J., Nirmala A., Mamatha A. and Kumar S.P. (2023). Effect of plant growth regulators on growth, yield and quality parameters in tomato (*Solanum lycopersicum* L.) hybrids under Southern Telangana zone.

Sahu, M.K., Sharma G.L., Singh P., Kumar H., Panigrahi T.C. and Saxena R.R. (2023). Effect of plant growth regulators on growth, yield and quality characters of papaya under net house: A review.

Sharma, P., Thakur N., Mann N.A. and Umar A. (2024). Melatonin as plant growth regulator in sustainable agriculture. *Scientia Horticulturae*, **323**, 112421.

Tiwari, D.K., Pandey P., Giri S.P. and Dwivedi J.L. (2011). Effect of GA_3 and other plant growth regulators on hybrid rice seed production. *Asian J. Plant Sci.*, **10(2)**, 133-139.

Zhou, Z., Li Z., Fan F., Qin H. and Ding G. (2024). Effects of exogenous GA_3 on stem secondary growth of *Pinus massoniana* seedlings. *Plant Physiol. Biochem.*, **206**, 108254.