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Growth and Yield of Strawberry (*Fragaria ananassa*) 'Sweet Charlie' Variety as Influenced by Gibberellic and Salicylic Acids

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Abstract. This study investigated the effects of Gibberellic acid (GA_3) and Salicylic acid (SA), applied individually and in combination, on the growth and yield performance of the strawberry variety 'Sweet Charlie.' A total of nine treatments were tested, including a control (water), two concentrations of GA_3 (75 and 100 ppm), two concentrations of SA (100 and 200 ppm), and their various combinations. The experiment was conducted from September 2024 to March 2025 at Sitio Little Baguio, Chua, Bagumbayan, Sultan Kudarat, using a Randomized Complete Block Design (RCBD) with a single-factor arrangement. Key growth parameters measured included plant height, number of branches and crowns, runner production, and morphological characteristics of runners. Yield-related variables such as number of flowers, days to flowering, fruit number per plant, fruit diameter, and fruit weight were also recorded. Data was analyzed using analysis of variance (ANOVA), and significant differences among treatments were determined through Tukey's Honestly Significant Difference (HSD) test. Results indicated that individual treatments of GA_3 (75 or 100 ppm) and the combination of 75ppm GA_3 with 200 ppm SA significantly enhanced vegetative growth, accelerated flowering, and improved fruit yield compared to the control and other treatments. Specifically, it increased plant height, number of runners, flower count, fruit number, fruit diameter, and total fruit weight per plant. Additionally, the days to flowering were shortened with 100 ppm SA application, and the period from flowering to fruit setting was optimized. The findings suggest that the synergistic application of GA_3 and SA at specific concentrations can effectively improve the growth and productivity of 'Sweet Charlie' strawberries, offering practical benefits for strawberry cultivation.

Keywords: *Fragaria ananassa*; Gibberellic; Salicylic acid; Strawberry growth and yield.

1.0 Introduction

Plants require essential elements such as light, water, oxygen, and minerals for growth and development. In addition, plant growth regulators (PGRs), which are organic compounds either naturally produced by plants or synthetically made, play a crucial role in regulating growth, morphogenesis, metabolism, and other biological processes by influencing enzyme activity within plant cells (Singh et al., 2022). When applied at appropriate doses and growth stages, PGRs can significantly enhance crop growth and yield, including strawberries (Katel et al., 2022). Strawberry (*Fragaria ananassa*), a hybrid of *Fragaria chiloensis* and *Fragaria virginiana* from the Rosaceae family, is a valuable soft fruit crop known for its nutritional and economic importance worldwide (Kumar et al., 2020). Previous studies have investigated the effects of exogenous plant growth regulators (PGRs), such as gibberellic acid (GA_3) and salicylic acid (SA), on strawberry growth. For instance, Thi et al. (2019) found that

GA_3 application accelerated vegetative growth but delayed flowering, while SA promoted inflorescence development. However, their study did not assess the impact on fruit yield.

This gap suggests that although SA may hasten flowering, the more vigorous growth induced by GA_3 could potentially increase flower number and fruit yield. Therefore, it is essential to investigate not only the individual effects of GA_3 and SA but also their combined influence on the vegetative growth and yield of the strawberry 'Sweet Charlie' variety. Considering these considerations, the present study aims to evaluate the effects of foliar applications of GA_3, SA, and their combinations on the growth and yield performance of the strawberry 'Sweet Charlie' variety under field conditions.

2.0 Methodology

2.1 Experimental Design and Treatments

This study employed a Randomized Complete Block Design (RCBD) with nine treatments, each replicated three times. Each treatment consisted of ten strawberry plants, which were evaluated for growth and yield parameters. The treatments included a control (water), two concentrations of gibberellic acid (GA_3: 75 and 100 ppm), two concentrations of Salicylic acid (SA: 100 and 200 ppm), and their various combinations. Foliar applications of GA_3 and SA were administered according to the treatment plan. Data on plant height, number of branches, runners, flowers, fruit number, fruit size, and weight were collected throughout the growing period. Statistical analysis was performed using analysis of variance (ANOVA), and differences between treatments were determined by Tukey's Honestly Significant Difference (HSD) test.

Strawberry Cultural Management Practices

Site preparation and planting. Strawberries were planted in well-drained soil at an elevation of 800 meters, with a pH range of 5.5 to 7.0, receiving 6–10 hours of direct sunlight daily. Land preparation involved clearing, weeding, and constructing raised beds to ensure proper drainage and root development. Organic and inorganic fertilizers, including muriate of potash, superphosphate, and decomposed chicken manure, were incorporated into the soil before transplanting.

Runner preparation and transplanting. Healthy strawberry runners with at least three root pegs and two trifoliate leaves were harvested, cleaned, and treated with fungicide before planting in trays containing a soil and vermicompost mix. Seedlings were misted regularly and kept under humidity domes to promote healthy growth and rooting. After developing 3–5 mature leaves and undergoing a 5-day hardening period, runners of uniform size were transplanted manually onto raised beds mulched with silver polyethylene and rice straw to conserve moisture and suppress weeds. Plants were spaced 25 cm apart using a quincunx pattern.

Irrigation and fertilization. Watering was applied daily for two weeks post-transplanting using overhead sprinklers to ensure proper moisture. Fertilizers were applied via side dressing: urea at 20 days after transplanting (DAT), followed by biweekly applications of a balanced 14-14-14 fertilizer, and muriate of potash at 60 DAT.

Weed, pest, and disease management. Weeds were controlled manually. Runners were removed twice weekly to promote fruit production. Leaf pruning was performed to enhance flowering by reducing shading. Insect pests such as beetles and aphids were managed using Lannate insecticide, while cutworms were controlled with Basudin granules.

Methods of Preparation of Plant Growth Regulator Stock Solution

Gibberellic acid (GA3). A 1 mg/ml stock solution of gibberellic acid (GA3) (1000 ppm) was prepared by weighing 100 mg of gibberellic acid (GA3) powder into a 100 ml volumetric flask. Add 3 to 5 mL of solvent (95% ethyl alcohol) to dissolve the powder. Once completely dissolved, bring to volume with distilled water. The solution was stirred while adding distilled water to keep the material in the solution. By diluting the stock solution, the 75 ppm and 100 ppm concentrations of gibberellic acid (GA3) were prepared.

Salicylic acid (SA). A stock solution of salicylic acid (SA) at 1 mg/mL (1000 ppm) was prepared by dissolving 100 mg of salicylic acid in 3 to 5 mL of 95% ethyl alcohol and then made up to 100 mL with distilled water in a volumetric flask. Salicylic acid (SA) was poorly soluble in water; thus, it became soluble in ethyl alcohol and purified water. The researchers prepared solutions of 100 ppm and 200 ppm salicylic acid (SA) concentrations from this stock by diluting the solution.

Stock solution dilution formula.

$$C_1V_1 = C_2V_2$$

where:

C1 = Concentration of the stock solution
V1 = Volume of the stock solution needed to make the new solution
C2 = Final concentration of the new solution
V2 = Final volume of the new solution

Preparation of 75 ppm and 100 ppm Gibberellic acid (GA3). To prepare 1 liter of 75 ppm gibberellic acid (GA3) from the 1000 ppm gibberellic acid (GA3) stock solution, 75 ml of the 1000 ppm gibberellic acid (GA3) stock solution was used and brought to volume (1 liter) using distilled water. To prepare 1 liter of 100 ppm gibberellic acid (GA3) from the 1000 ppm gibberellic acid (GA3) stock solution, 100 ml of the 1000 ppm gibberellic acid (GA3) stock solution was used and brought to volume (1 liter) using distilled water. Solutions of gibberellic acid (GA3) store poorly, so a fresh solution was prepared within two to three days of use.

Preparation of 100 ppm and 200 ppm Salicylic acid (SA). To prepare 1 liter of 100 ppm salicylic acid (SA) from the 1000 ppm salicylic acid (SA) stock solution, 100 ml of the 1000 ppm salicylic acid (SA) stock solution was used and brought to volume using distilled water. To prepare 1 liter of 200 ppm salicylic acid (SA) from the 1000 ppm salicylic acid (SA) stock solution, 200 ml of the 1000 ppm salicylic acid (SA) stock solution was used and brought to volume using distilled water.

2.2 Research Materials

The study utilized strawberry runners of the 'Sweet Charlie' variety as planting material. Key materials for propagation and cultivation included seedling trays, garden soil, vermicompost, polyethylene plastic mulch, and rice straw for mulching. Improvised humidity domes made from UV plastic were used to maintain moisture during runner rooting. The plant growth regulators applied were gibberellic acid (96% purity) and salicylic acid of premium quality. Distilled water and ethyl alcohol (95%) were used as solvents and disinfectants. Foliar applications were administered using an airless sprayer.

2.3 Data Gathering Procedure

The data gathered in this study was categorized into growth and yield parameters. Ten (10) data plants were used to collect the data from each treatment. Observations on growth and yield characters were recorded by using standard methods. Data collection for growth parameters such as plant height, number of branch crowns, number of runners, morphological descriptors of strawberry runners, number of days to flower, morphological descriptors of time of flowering, and number of flowers per plant started one week after the first application of the plant growth regulators (PGRs) at weekly interval. Data collection for yield parameters such as number of days from flowering to fruit setting, number of fruits per plant, fruit diameter, fruit weight per plant, morphological descriptors of fruit size, and total weight of fruits per plant started on the onset of flowering stage to fruiting stage with at least four data collection of harvesting strawberry fruits at weekly interval.

2.4 Ethical Considerations

As the subject of the study was strawberries, care was taken to ensure that all experimental procedures were conducted responsibly and sustainably, respecting environmental and agricultural ethics. The study avoided practices that could harm the plants or the surrounding ecosystem. The research was designed to uphold scientific integrity by ensuring that all methodologies were transparent, reproducible, and free from bias. Data collection and analysis were conducted rigorously, avoiding any form of research misconduct including fabrication, falsification, or plagiarism. Furthermore, the study complied with ethical standards for academic research, ensuring that all findings were reported honestly and accurately.

3.0 Results and Discussion

3.1 Plant Height

The summary table of plant height per weekly basis of the strawberry cv. Sweet Charlie, as influenced by gibberellic and salicylic acids, is presented in Table 1. Statistical analysis reveals no significant difference between treatment means for weeks 1 and 2. Treatment 2 had the tallest plant height, 8.73 cm, in week 1, and Treatment 1 had 10.93 cm in week 2, while Treatment 8 had the shortest plant height for weeks 1 and 2, with a mean of 7.67 cm and 8.73 cm. Statistical analysis also shows a highly significant difference among all treatment means from week 3 to week 8, where Treatment 2 had the tallest plant height of 13.93 cm, 15.73 cm, 18.70 cm, 20.43 cm, 21.23 cm, and 22.93 cm, respectively, but comparable to other treatments with common superscript. The shortest plant heights for week 3 to week 8 were observed in Treatment 4, with a mean of 9.53 cm, 10.23 cm, 11.17 cm, 12.00 cm, 13.00 cm, and 14.20 cm, respectively.

Table 1. *Summary Table of Plant Height (cm) per Weekly Basis of Strawberry cv. Sweet Charlie as Influenced by Gibberellic and Salicylic Acids*

Treatments	Mean Result Per Week							
	W1	**W2**	**W3**	**W4**	**W5**	**W6**	**W7**	**W8**
T0	8.70	9.73	10.70^{ab}	11.40^{bcd}	12.10^{bc}	13.03^{cd}	13.97^{bc}	15.07^{bc}
T1	8.47	10.93	13.43^{ab}	14.80^{abc}	17.63^{a}	18.83^{ab}	19.73^{abc}	21.33^{ab}
T2	8.73	10.17	13.93^{a}	15.73^{a}	18.70^{a}	20.43^{a}	21.23^{a}	22.93^{a}
T3	8.33	9.37	10.03^{ab}	10.93^{cd}	12.30^{bc}	13.20^{bcd}	14.43^{bc}	15.47^{bc}
T4	7.97	8.77	9.53^{b}	10.23^{d}	11.17^{c}	12.00^{d}	13.00^{c}	14.20^{c}
T5	8.57	9.60	12.77^{ab}	14.27^{abcd}	16.57^{ab}	18.33^{abc}	19.30^{abc}	21.37^{ab}
T6	8.40	9.73	13.40^{ab}	15.13^{ab}	17.53^{a}	18.87^{ab}	20.47^{ab}	22.53^{a}
T7	8.57	9.83	12.93^{ab}	15.07^{ab}	17.37^{a}	19.23^{a}	20.50^{ab}	22.60^{a}
T8	7.67	8.73	12.10^{ab}	14.67^{abc}	17.10^{ab}	18.73^{abc}	19.63^{abc}	21.77^{abc}
	ns	ns	**	**	**	**	**	**
cv	**9.78%**	**8.73%**	**11.51%**	**10.47%**	**11.11%**	**11.59%**	**12.86%**	**11.78%**

Means with common letters superscript are not significantly different.

The result implies that applying Treatment 2 with 100 ppm gibberellic Acid (GA_3) can significantly increase plant height. This finding aligns with the study of Uddin et al. (2012), which examined the effects of gibberellic Acid (GA_3) on strawberry growth and yield. Their research demonstrated that gibberellic Acid (GA_3) application significantly enhanced vegetative growth, with higher concentrations promoting shoot elongation and expansion of the vegetative branch apex. This effect is likely due to internode elongation during plant differentiation and development. Similarly, Keswani et al. (2022) confirmed that gibberellic Acid (GA_3) is a widely used plant growth regulator in agriculture, known for its positive impact on plant development. Their study highlighted that gibberellic Acid (GA_3) enhances germination, increases plant height, expands leaf area, promotes root elongation, and improves tuber formation. Furthermore, Kumra et al. (2018) reported that gibberellic Acid (GA_3) plays a crucial role in the growth and development of strawberries, stimulating plant height, runner formation, and flower production. Their findings also indicate that gibberellic Acid (GA_3) contributes to increased fruit set, yield, and fruit quality by promoting cell division and elongation. However, excessive application may lead to prioritizing vegetative growth over fruit production. These studies collectively support the present findings, reinforcing that the application of gibberellic Acid (GA_3) can significantly enhance plant height and overall growth when used at optimal concentrations.

3.2 Branch Crowns

The summary table of the number of branch crowns per week of the strawberry cv. Sweet Charlie, as influenced by gibberellic and salicylic acids, is presented in Table 2. Statistical analysis revealed no significant difference between all treatment means for weeks 1 and 2. For week 1, Treatment 2 and Treatment 0 got the most branch crowns, with the same mean of 2.00, and Treatment 5 got the least branch crowns, with a mean of 0.67. For week 2, Treatment 2 got the most branch crowns with a mean of 5.00, and Treatment 3 got the very least number of branch crowns with a mean of 1.33. Statistical analysis also reveals a significant difference among all treatment means from week 3 to week 8, where Treatment 2 had the most branch crowns, with means of 6.33, 8.67, 8.67, 11.00, 12.67, and 15.00, respectively. This result is comparable to all treatments with the same common superscript. For week 3, Treatment 3 and Treatment 5 had the lowest number of branch crowns, with the same mean of 2.33, and for week 4, Treatment 1 had the lowest number of branch crowns, with a mean of 2.67. From week 5 to week 8, Treatment 3 had the lowest number of branch crowns with a mean of 3.33, 4.33, 4.33, and 6.00, respectively.

Table 2. *Summary Table of Number of Branch Crowns per Weekly Basis of Strawberry cv. Sweet Charlie as Influenced by Gibberellic and Salicylic Acids*

Treatments	Mean Result Per Week							
	W1	W2	W3	W4	W5	W6	W7	W8
T0	2.00	3.00	5.00^{ab}	5.67^{abc}	6.00$_{abcd}$	6.67^{bcd}	7.33^{cd}	8.33^{bc}
T1	1.00	1.67	2.67^{b}	2.67^{c}	3.67^{d}	5.00^{cd}	6.00^{d}	7.33^{bc}
T2	2.00	5.00	6.33^{a}	8.67^{a}	8.67^{a}	11.00^{a}	12.67^{a}	15.00^{a}
T3	1.33	1.33	2.33^{b}	3.33^{bc}	3.33^{d}	4.33^{d}	4.33^{d}	6.00^{c}
T4	1.33	2.00	3.33^{ab}	3.67^{bc}	4.33^{cd}	5.33^{cd}	6.00^{d}	7.00^{bc}
T5	0.67	1.67	2.33^{b}	4.67^{bc}	5.33^{cd}	6.00^{cd}	7.00^{cd}	8.00^{bc}
T6	1.33	1.67	2.67^{b}	4.33^{bc}	5.67^{bcd}	7.67^{bc}	9.67^{abc}	10.67^{abc}
T7	1.67	2.67	4.00^{ab}	5.33^{abc}	7.00^{abc}	7.67^{bc}	10.67^{ab}	12.33^{ab}
T8	1.00	3.00	5.33^{ab}	6.33^{ab}	8.33^{ab}	9.00^{ab}	9.33^{bc}	11.00^{abc}
	ns	ns	**	**	**	**	**	**
cv	29.69%	20.56%	22.87%	24.98%	17.04%	14.03%	13.24%	19.91%

Means with common letter superscript are not significantly different.

The results indicate that applying Treatment 2 with 100 ppm gibberellic Acid (GA_3) significantly increases the number of branch crowns. This finding aligns with previous studies demonstrating that gibberellic Acid (GA_3) is crucial in enhancing vegetative growth in strawberries, particularly in stimulating runner and crown development (Uddin et al., 2012). However, excessive concentrations of gibberellic Acid (GA_3) may lead to uncontrolled vegetative elongation, potentially delaying reproductive growth (Muhammad, 2021). Similarly, Sharma and Singh (2008) reported that foliar application of gibberellic Acid (GA_3) in 'Chandler' strawberries significantly improved growth and yield parameters, including crown height, crown spread, petiole length, leaf number, and leaf area. In addition to gibberellic acid (GA_3), salicylic acid (SA) has been recognized for its role in plant growth regulation and stress resistance. However, its direct impact on branch crown formation remains inconclusive (Metwally et al., 2013). The combined application of gibberellic acid (GA_3) and salicylic acid (SA) suggests a synergistic effect, where optimized concentrations contribute to enhanced crown formation and potential yield improvements. These findings underscore the importance of applying GA_3 correctly to promote vegetative growth while balancing its effects to optimize overall plant productivity.

3.3 Number of Runners

Table 3 presents a summary table of the number of runners per week of the Strawberry cv. Sweet Charlie, as influenced by gibberellic and salicylic acids. Statistical analysis reveals that there is no significant difference in Treatment means for week 1. Treatment 5 got the most runners, with a mean of 6.00, while Treatment 1 got the lowest number of runners, with a mean of 1.00. As shown, a significant difference exists among all treatment means for weeks 2, 3, and 4. For Week 2, Treatments 5 and 6 had the most runners, with a mean of 8.00. For weeks 3 and 4, Treatment 5 had the most runners, with a mean of 10.67 and 14.00, but it was comparable to the treatments with a common superscript. For weeks 5 to 8, Treatment 2 had the most runners, with a mean of 16.67, 21.00, 24.67, and 28.00, respectively, but it was comparable to treatments with common superscript.

On the other hand, Treatment 1 and Treatment 4 had the lowest number of runners, with the same mean of 2.00 for week 2 and Treatment 1 with a mean of 2.33 for week 3. From week 4 to week 7, Treatment 0 had the lowest number of runners, with a mean of 2.67, 2.33, 4.00, and 4.33, respectively. Treatment 4 also had the lowest number of runners, with a mean of 6.67 in week 8.

Table 3. *Summary Table of Number of Runners per Weekly Basis of Strawberry cv. Sweet Charlie as Influenced by Gibberellic and Salicylic Acids*

Treatments	Mean Result Per Week							
	W1	W2	W3	W4	W5	W6	W7	W8
T0	2.33	3.00^{ab}	4.00^{bcd}	2.67^{d}	2.33^{c}	4.00^{e}	4.33^{f}	7.67^{ef}
T1	1.00	2.00^{b}	2.33^{d}	3.33^{d}	4.00^{c}	5.33^{de}	7.33^{def}	9.00^{def}
T2	3.67	7.00^{ab}	8.00^{abc}	12.33^{ab}	16.67^{a}	21.00^{a}	24.67^{a}	28.00^{a}
T3	3.33	5.33^{ab}	7.00$_{abcd}$	9.00^{bc}	9.67^{b}	11.33^{cde}	12.33^{cde}	14.67^{cde}
T4	1.33	2.00^{b}	3.00^{cd}	3.67^{d}	4.67^{c}	5.00^{de}	6.00^{ef}	6.67^{f}
T5	6.00	8.00^{a}	10.67^{a}	14.00^{a}	14.67^{a}	17.00^{abc}	19.00^{abc}	24.67^{ab}
T6	4.00	8.00^{a}	9.00^{ab}	11.67^{ab}	14.67^{a}	19.00^{ab}	23.67^{ab}	26.33^{ab}
T7	2.33	4.00^{ab}	6.33$_{abcd}$	6.67^{cd}	8.33^{b}	10.00^{cde}	13.33^{cd}	15.33^{cd}
T8	1.33	3.33^{ab}	6.33$_{abcd}$	6.67^{cd}	8.33^{b}	11.67^{bcd}	17.33^{bc}	19.33^{bc}
	ns	**	**	**	**	**	**	**
cv	34.27%	29.51%	28.73%	21.59%	13.02%	22.40%	17.02%	15.51%

Means with common superscript letters are not significantly different.

This result indicates that the application of Treatment 2 with 100 ppm gibberellic acid (GA_3) significantly increases the number of runners. These findings are consistent with previous research on the effects of gibberellic acid (GA_3) and salicylic acid (SA) on strawberry growth. El-Naggar et al. (2020) reported that the gibberellic acid (GA_3) application enhances the development of strawberries' runners, crowns, and inflorescences. Additionally, SA has been shown to improve plant vigor, increase root length, and enhance overall plant metabolism, which may contribute to increased runner formation (Al-Kawari et al., 2021). Furthermore, Kumra et al. (2018) highlighted that gibberellic acid (GA_3) is crucial in promoting strawberries' plant height and runner formation. These findings reinforce the role of gibberellic acid (GA_3) in stimulating vegetative growth and suggest that its application, potentially combined with salicylic acid (SA), can optimize runner development and overall plant performance.

3.4 Morphological Descriptors of Number of Stolon or Runners

The influence of gibberellic and salicylic acids on the morphological descriptors of the number of stolons or runners of the strawberry cv. Sweet Charlie is presented in Table 4. Statistical analysis reveals no significant difference between all treatments and means tested. Treatment 5 had the most runners with a mean of 6.23, followed by Treatment 6 and Treatment 2 with the same mean of 5.92. Treatment 1, Treatment 8, Treatment 7, Treatment 3, and Treatment 4 had a mean of 5.17, 5.08, 5.00, 3.33, and 3.28, respectively. Treatment 0 had the lowest number of runners, with a mean of 2.92.

Table 4. *Influence of Gibberellic and Salicylic Acids on the Morphological Descriptors of Number of Stolon or Runners of Strawberry cv. Sweet Charlie*

Treatments	Replication			Total	Mean
	I	II	III		
T0 - Control (water)	2.75	2.75	3.25	8.75	2.92
T1 - 75 ppm Gibberellic acid (GA_3)	5.25	5.00	5.25	15.50	5.17
T2 - 100 ppm Gibberellic acid (GA_3)	5.25	6.75	5.75	17.75	5.92
T3 - 100 ppm Salicylic acid (SA)	3.50	3.25	3.25	10.00	3.33
T4 - 200 ppm Salicylic acid (SA)	3.35	3.50	3.00	9.85	3.28
T5 - 75 ppm Gibberellic acid (GA_3) + 100 ppm Salicylic acid (SA)	6.00	6.50	6.50	19.00	6.23
T6 - 75 ppm Gibberellic acid (GA_3) + 200 ppm Salicylic acid (SA)	6.00	5.75	6.00	17.75	5.92
T7 - 100 ppm Gibberellic acid (GA_3) + 100 ppm Salicylic acid (SA)	4.50	5.25	5.25	15.00	5.00
T8 - 100 ppm Gibberellic acid (GA_3) + 200 ppm Salicylic acid (SA)	5.00	5.25	5.00	15.25	5.08
Grand Total & Mean	**41.60**	**44.00**	**43.25**	**128.85**	**4.77**

cv = 15.78%
ns = not Significant

3.5 Morphological Descriptors of Time of Appearance of First Stolon or Runners

The influence of gibberellic and salicylic acids on the morphological descriptors of the time of appearance of the first stolon or runners of the strawberry cv. Sweet Charlie is presented in Table 5. Statistical analysis reveals a significant difference between the treatment means. Treatment 8 had a very late appearance of the first stolon or runners, with a mean of 5.77. However, it is comparable to Treatment 6 with a mean of 5.40, followed by Treatment 7 with a mean of 4. 60, Treatment 5 and Treatment 0 with the same mean of 4.53, Treatment 1 with a mean of 4.40, Treatment 3 with a mean of 3.67, Treatment 4 with a mean of 3.47, and Treatment 2 got the earliest time of appearance of first stolon or runners with a mean of 3.40.

This result implies that the application of Treatment 2 with 100 ppm gibberellic acid (GA_3) significantly promotes early runner or stolon appearance, according to Kumra et al. (2018), who found that gibberellic acid (GA_3) plays a crucial role in promoting plant height and runner formation in strawberries. These findings reinforce the role of gibberellic acid (GA_3) in stimulating vegetative growth and suggest that its application, potentially combined with SA, can optimize runner development and overall plant performance.

Table 5. *Influence of Gibberellic and Salicylic Acids on the Morphological Descriptors of Time of Appearance of First Stolon or Runners of Strawberry cv. Sweet Charlie*

Treatments	Replication			Total	Mean
	I	II	III		
T0 - Control (water)	4.40	4.60	4.60	13.60	4.53[bc]
T1 - 75 ppm Gibberellic acid (GA_3)	4.80	4.20	4.20	13.20	4.40[cd]
T2 - 100 ppm Gibberellic acid (GA_3)	3.60	3.20	3.40	10.20	3.40[e]
T3 - 100 ppm Salicylic acid (SA)	3.80	3.60	3.60	11.00	3.67[cde]
T4 - 200 ppm Salicylic acid (SA)	3.60	3.60	3.20	10.40	3.47[de]
T5 - 75 ppm Gibberellic acid (GA_3) + 100 ppm Salicylic acid (SA)	4.60	4.60	4.40	13.60	4.53[bc]
T6 - 75 ppm Gibberellic acid (GA_3) + 200 ppm Salicylic acid (SA)	5.00	6.20	5.00	16.20	5.40[ab]
T7 - 100 ppm Gibberellic acid (GA_3) + 100 ppm Salicylic acid (SA)	4.40	5.00	4.40	13.80	4.60[bc]
T8 - 100 ppm Gibberellic acid (GA_3) + 200 ppm Salicylic acid (SA)	6.00	5.40	5.90	17.30	5.77[a]
Grand Total & Mean	**40.20**	**40.40**	**38.70**	**119.30**	**4.42**

cv = 7.42%
*** = Highly Significant*

3.6 Number of Days to Flower per Plant

The number of days to flower per plant of the strawberry cv. Sweet Charlie, as influenced by gibberellic and salicylic acids, is presented in Table 6. Statistical analysis revealed a significant difference among all treatments tested. Treatment 5 had the highest number of days to flower, with a mean of 40.10. It is comparable to Treatment 7 with a mean of 38.10, followed by Treatment 8, Treatment 4, Treatment 6, Treatment 3, Treatment 0, and Treatment 2 with a mean of 37.80, 35.80, 33.57, 33.37, 31.93, and 31.83, respectively, while Treatment 1 got the shortest number of days to flower with a mean of 29.77.

Table 6. *Influence of Gibberellic and Salicylic Acids on the Number of Days to Flower per Plant of Strawberry cv. Sweet Charlie*

Treatments	Replication			Total	Mean
	I	II	III		
T0 - Control (water)	31.80	32.60	31.40	95.80	31.93[de]
T1 - 75 ppm Gibberellic acid (GA_3)	28.90	30.70	29.70	89.30	29.77[e]
T2 - 100 ppm Gibberellic acid (GA_3)	30.90	31.80	32.80	95.50	31.83[de]
T3 - 100 ppm Salicylic acid (SA)	33.60	32.80	3.70	100.10	33.37[d]
T4 - 200 ppm Salicylic acid (SA)	34.40	35.50	37.50	107.40	35.80[c]
T5 - 75 ppm Gibberellic acid (GA_3) + 100 ppm Salicylic acid (SA)	39.20	40.00	41.10	120.30	40.10[a]
T6 - 75 ppm Gibberellic acid (GA_3) + 200 ppm Salicylic acid (SA)	33.90	32.60	34.20	100.70	33.57[d]
T7 - 100 ppm Gibberellic acid (GA_3) + 100 ppm Salicylic acid (SA)	38.10	37.40	38.80	114.30	38.10[ab]
T8 - 100 ppm Gibberellic acid (GA_3) + 200 ppm Salicylic acid (SA)	37.00	37.70	38.70	113.40	37.80[bc]
Grand Total & Mean	**307.80**	**311.10**	**317.90**	**936.80**	**34.70**

cv = 7.42%
*** = Highly Significant*

The result implies that the application of Treatment 1 with 75 ppm gibberellic acid (GA_3) can initiate early flower production, as supported by Kumra et al. (2018). They reported that gibberellic acid (GA_3) plays a crucial role in the growth and development of strawberries, stimulating plant height, runner formation, and flower production. These findings are consistent with previous research on the effects of gibberellic acid (GA_3) and Salicylic Acid (SA) on strawberry growth. El-Naggar et al. (2020) reported that gibberellic acid (GA_3) application enhances the development of runners, crowns, and inflorescences in strawberries. According to Rana et al. (2020), gibberellic acid (GA_3) contributes to increased fruit weight, plant height, early flowering, petiole length, fruit set, leaf area, and overall yield while improving fruit quality. Similarly, Sharma and Singh (2008) reported that gibberellic acid (GA_3) promotes flowering, fruit set, and size. Furthermore, Uddin et al. (2020) found that gibberellic acid (GA_3) treated strawberry plants exhibited greater vegetative growth, with increased plant height, leaf development, larger leaf areas, and a higher number of flower buds and flowers. Kumar et al. (2020) also confirmed that gibberellic acid (GA_3) accelerates flowering and bud formation, leading to increased flowers and a higher fruit yield per plant and per hectare.

3.7 Morphological Descriptors of Time of Flowering (50% of plants at first flower)

The influence of gibberellic and salicylic acids on the morphological descriptors of time of flowering (50% of plants at first flower) of the strawberry cv. Sweet Charlie is presented in Table 7. Statistical analysis revealed no significant difference between all treatments and means tested. Treatment 4 had the longest time of flowering, with a mean of 5.20, followed by Treatment 7, with a mean of 4.87, Treatment 6 and Treatment 0, with the same mean of 4.20, Treatment 8 and Treatment 3, with the same mean of 4.20, Treatment 5, with a mean of 3.93, and Treatment 2, with a mean of 3.80, while Treatment 1 had the shortest time of flowering, with a mean of 3.67.

Table 7. *Influence of Gibberellic and Salicylic Acids on Number of Days to Flower per Plant of Strawberry cv. Sweet Charlie*

Treatments	Replication			Total	Mean
	I	II	III		
T0 - Control (water)	4.00	3.60	4.40	12.60	4.20
T1 - 75 ppm Gibberellic acid (GA_3)	2.80	3.80	4.40	11.00	3.67
T2 - 100 ppm Gibberellic acid (GA_3)	4.60	3.80	3.00	11.40	3.80
T3 - 100 ppm Salicylic acid (SA)	2.80	4.60	4.60	12.00	4.00
T4 - 200 ppm Salicylic acid (SA)	5.00	5.80	4.80	15.60	5.20
T5 - 75 ppm Gibberellic acid (GA_3) + 100 ppm Salicylic acid (SA)	3.40	4.40	4.00	11.80	3.93
T6 - 75 ppm Gibberellic acid (GA_3) + 200 ppm Salicylic acid (SA)	4.40	4.60	3.60	12.60	4.20
T7 - 100 ppm Gibberellic acid (GA_3) + 100 ppm Salicylic acid (SA)	5.20	5.20	4.20	14.60	4.87
T8 - 100 ppm Gibberellic acid (GA_3) + 200 ppm Salicylic acid (SA)	4.20	4.00	3.80	12.00	4.00
Grand Total & Mean	**37.00**	**39.80**	**36.80**	**113.60**	**4.21**

cv = 7.42%
*** = Highly Significant*

3.8 Number of Flowers per Plant

The summary table shows the number of flowers per plant every week for the strawberry cv. Sweet Charlie, as influenced by gibberellic and salicylic acids, is presented in Table 8. Statistical analysis showed highly significant differences in flower count among all treatment means from week 3 to week 6, as indicated by different superscript letters. Treatment 2 consistently produced the highest number of flowers during these weeks, with means of 14.67, 17.67, 20.00, and 22.33, respectively.

Table 8. *Summary Table of Number of Flowers per Plant per Weekly Basis of Strawberry cv. Sweet Charlie as Influenced by Gibberellic and Salicylic Acids*

Treatments	Mean Results Per Week					
	W3	W4	W5	W6	W7	W8
T0	9.67^{cd}	11.00^{d}	12.33^{de}	14.00^{de}	16.67^{c}	18.00^{c}
T1	14.00^{ab}	17.00^{a}	19.67^{ab}	22.33^{a}	24.67^{a}	26.00^{a}
T2	14.67^{a}	17.67^{a}	20.00^{a}	22.33^{a}	23.67^{a}	25.67^{a}
T3	12.33^{abc}	14.00^{bc}	16.33^{bc}	19.33^{abc}	21.67^{ab}	23.33^{ab}
T4	11.00^{abc}	12.00^{cd}	14.33^{cd}	16.00^{bcd}	16.33^{c}	18.67^{c}
T5	10.33^{bcd}	12.67^{bcd}	14.00^{cd}	15.33^{cde}	18.67^{bc}	20.00^{bc}
T6	13.00^{abc}	15.00^{ab}	17.00^{abc}	20.00^{ab}	23.33^{a}	27.33^{a}
T7	6.67^{d}	7.67^{e}	9.33^{e}	11.33^{e}	12.33^{d}	13.67^{d}
T8	11.33^{abc}	13.00^{bcd}	14.67^{cd}	16.33^{bcd}	19.33^{bc}	24.00^{ab}
	**	**	**	**	**	**
cv	**12.31%**	**7.34%**	**7.54%**	**8.65%**	**6.36%**	**6.53%**

Means with common superscript letters are not significantly different.

In week 7, Treatment 1 recorded the highest number of flowers per plant, averaging 24.67, while Treatment 6 had the highest number of flowers per plant, with a mean of 27.33 in week 8. However, treatments with common superscripts from week 7 to week 8 showed comparable results, indicating no significant difference. Conversely, Treatment 7 consistently had the lowest number of flowers per plant throughout the study, with 6.67, 7.67, 9.33, 11.33, 12.33, and 13.67 from week 3 to week 8. This suggests that Treatment 7 with 100 ppm gibberellic acid (GA_3) and 100 ppm Salicylic Acid (SA) application was the least effective in enhancing flower production per plant.

The result implies that the application of Treatment 6, which combines 75 ppm gibberellic acid (GA_3) with 200 ppm salicylic acid (SA), significantly increases the number of flowers per plant. This finding is supported by previous studies highlighting the role of gibberellic acid (GA_3) in enhancing strawberry growth and reproductive development. According to Sharma and Godara (2020) gibberellic acid (GA_3) promotes flowering, fruit set, and size. Also, the influence of gibberellic acid (GA_3) on the growth of fruit and flowers and the lengthening or shortening of roots (Kosakivska, 2021).

Furthermore, Ali et al. (2023) found that gibberellic acid (GA_3) treated strawberry plants exhibited greater vegetative growth, with increased plant height, leaf development, larger leaf areas, and a higher number of flower buds and flowers. Kumar et al. (2020) also confirmed that gibberellic acid (GA_3) accelerates flowering and bud formation, leading to increased flowers and a higher fruit yield per plant and per hectare. In addition to gibberellic acid (GA_3), the application of Salicylic acid (SA) has also been shown to enhance plant growth and reproductive performance. Jamali et al. (2013) demonstrated that foliar spraying of Salicylic acid (SA) improved strawberry growth, flowering, and fruit production while advancing plant development and reducing gray mold incidence. Their study highlighted that the 'Festival' cultivar responded particularly well to Salicylic acid (SA) treatment, resulting in the highest yield and longest production season. These findings confirm that the combined application of gibberellic acid (GA_3) and Salicylic acid (SA) optimizes plant growth and flower production, ultimately improving overall yield and fruit quality.

3.9 Number of Days from Flowering to Fruit Setting

The number of days from flowering to fruit setting of the strawberry cv. Sweet Charlie, as influenced by gibberellic and salicylic acids, is presented in Table 9. Statistical analysis revealed a significant difference among all treatment means tested. Treatment 7 had the highest number of days from flowering to fruit setting, with a mean of 13.10, but was comparable to Treatments 6, 0, 5, and 4, with means of 11.57, 11.43, 11.40, and 11.33, respectively. Treatment 3, Treatment 8, and Treatment 1 got a mean of 11.00, 10.97, and 10.37, respectively, and Treatment 2 got the earliest number of days from flowering to fruit set with a mean of 10.13.

Table 9. *Summary Table of Number of Flowers per Plant per Weekly Basis of Strawberry cv. Sweet Charlie as Influenced by Gibberellic and Salicylic Acids*

Treatments	Replication			Total	Mean
	I	II	III		
T0 - Control (water)	12.70	11.10	10.50	34.30	11.43[ab]
T1 - 75 ppm Gibberellic acid (GA_3)	10.90	10.40	9.80	31.10	10.37[b]
T2 - 100 ppm Gibberellic acid (GA_3)	9.60	10.60	10.20	30.40	10.13[b]
T3 - 100 ppm Salicylic acid (SA)	11.10	11.50	10.40	33.00	11.00[b]
T4 - 200 ppm Salicylic acid (SA)	11.70	11.00	11.30	34.00	11.33[ab]
T5 - 75 ppm Gibberellic acid (GA_3) + 100 ppm Salicylic acid (SA)	11.60	10.80	11.80	34.20	11.40[ab]
T6 - 75 ppm Gibberellic acid (GA_3) + 200 ppm Salicylic acid (SA)	12.60	10.90	11.20	34.70	11.57[ab]
T7 - 100 ppm Gibberellic acid (GA_3) + 100 ppm Salicylic acid (SA)	13.20	13.20	12.90	39.30	13.10[a]
T8 - 100 ppm Gibberellic acid (GA_3) + 200 ppm Salicylic acid (SA)	10.00	11.70	11.20	32.90	10.97[b]
Grand Total & Mean	**103.40**	**101.20**	**99.30**	**303.90**	**11.26**

cv = 7.42%
*** = Highly Significant*

This result implies that the application of Treatment 2 with 100 ppm gibberellic acid (GA_3) significantly reduces the number of days from flowering to fruit setting. These findings are supported by previous research on the effects of gibberellic acid (GA_3) and Salicylic Acid (SA) on strawberry growth. El-Naggar et al. (2020) reported that the gibberellic acid (GA_3) application enhances the development of runners, crowns, and inflorescences in strawberries. Additionally, salicylic acid (SA) has been shown to improve plant vigor, increase root length, and enhance overall plant metabolism, which may contribute to increased runner formation (Youssef et al., 2017). Furthermore, Sharma and Godara (2020) highlighted that gibberellic acid (GA_3) is crucial in promoting strawberries' plant height and runner formation. These findings reinforce the role of gibberellic acid (GA_3) in stimulating vegetative growth and suggest that its application, potentially combined with salicylic acid (SA), can optimize runner development and overall plant performance.

3.10 Number of Fruits per Plant

Table 10 presents a summary table of the number of fruits per plant per week of the strawberry cv. Gibberellic and salicylic acids influence Sweet Charlie. Statistical analysis reveals a highly significant difference among all treatment means from week 4 to week 8. Treatment 3 produced the highest number of fruits per plant, with means of 31.67, 36.00, 37.33, 40.67, and 42.33, respectively.

Table 10. *Summary Table of Number of Fruits per Plant per Weekly Basis of Strawberry cv. Sweet Charlie as Influenced by Gibberellic and Salicylic Acids*

Treatments	Mean Results Per Week				
	W4	W5	W6	W7	W8
T0	18.00^{c}	19.67^{c}	21.67^{b}	25.00^{b}	28.00^{cd}
T1	26.33^{b}	27.67^{b}	34.00^{a}	36.33^{a}	40.33^{a}
T2	26.00^{b}	33.67^{a}	36.33^{a}	37.67^{a}	41.33^{a}
T3	31.67^{a}	36.00^{a}	37.33^{a}	40.67^{a}	42.33^{a}
T4	20.00^{c}	21.00^{c}	22.33^{b}	24.00^{b}	25.33^{cd}
T5	31.33^{a}	34.00^{a}	35.67^{a}	38.33^{a}	38.67^{ab}
T6	17.33^{c}	19.67^{c}	20.67^{b}	22.33^{b}	23.67^{d}
T7	17.33^{c}	21.67^{c}	22.67^{b}	27.33^{b}	31.67^{bc}
T8	16.33^{c}	18.67^{c}	20.67^{b}	22.67^{b}	23.33^{d}
	**	**	**	**	**
cv	**6.94%**	**6.38%**	**5.02%**	**9.11%**	**7.44%**

Means with common superscript letters are not significantly different.

Meanwhile, Treatment 8 had the lowest fruit count per plant in weeks 4 and 5, with means of 16.33 and 18.67, respectively. In week 6, Treatment 6 and Treatment 8 recorded the lowest fruit count per plant, with the same mean of 20.67. In week 7, Treatment 6 had the lowest number of fruits per plant, with a mean of 22.33, while Treatment 8 again had the lowest fruit count per plant, with a mean of 23.33 in week 8. Overall, the results suggest that different levels of gibberellic and salicylic acids significantly influenced fruit production per plant, with specific treatments enhancing fruit yield more effectively than others.

The result implies that the Treatment 3 application of 100 ppm Salicylic Acid (SA) significantly increases the number of fruits per plant. This finding is supported by Kumar and Bisarya (2023), who reported that foliar application of Salicylic Acid (SA) enhances plant tolerance and improves key growth characteristics, including leaf area, as well as the fresh and dry weight of shoots and roots, ultimately leading to a higher yield. Similarly, El-kenawy (2017) found that spraying with Salicylic Acid (SA) had a positive and significant impact on vegetative growth, increasing the number of fruits per plant, promoting early and total yields, and enhancing the fruit's soluble solids content. Additionally, these effects are comparable to those of gibberellic acid (GA_3), which is also known to improve fruit production. Silva et al. (2018) demonstrated that gibberellic acid (GA_3) application in strawberries enhanced plant growth by increasing plant height, the number of leaves and crowns, and extending the harvesting period. Moreover, gibberellic acid (GA_3) improved fruit size, weight, and yield. Similarly, Prakash et al. (2022) confirmed that the application of gibberellic acid (GA_3) positively influences fruit weight, size, and yield in strawberries. These findings highlight the effectiveness of both salicylic acid (SA) and gibberellic acid (GA_3) in enhancing fruit production. While Salicylic Acid (SA) improves plant tolerance and fruit quality, gibberellic acid (GA_3) is crucial in promoting vegetative growth and increasing fruit yield, making both plant growth regulators valuable for optimizing strawberry production.

3.11 Fruit Diameter (mm)

The summary table of fruit diameter per weekly basis of the strawberry cv. Sweet Charlie, as influenced by gibberellic and salicylic acids, is presented in Table 11. Statistical analysis showed highly significant differences among treatment means in weeks 5 and 6. Treatment 6 produced the largest fruit diameter, with means of 21.38 mm and 21.40 mm, respectively. In contrast, Treatment 0 of week 5 and week 6 had the smallest fruit diameter, with a mean of 19.10 mm and 19.87 mm, respectively.

Table 11. *Summary Table of Fruit Diameter (mm) per Weekly Basis of Strawberry cv. Sweet Charlie as Influenced by Gibberellic and Salicylic Acids*

Treatments	Mean Result Per Week			
	W5	W6	W7	W8
T0	19.10^{d}	19.87^{d}	19.79^{b}	20.75^{a}
T1	20.06^{bcd}	20.76^{abc}	21.35^{a}	22.01^{a}
T2	19.63^{cd}	20.51^{bcd}	21.20^{a}	22.04^{a}
T3	19.59^{cd}	20.11^{cd}	20.41^{ab}	20.94^{a}
T4	20.07^{bcd}	20.31^{bcd}	20.79^{ab}	21.16^{a}
T5	20.38^{abc}	20.96^{ab}	21.02^{ab}	21.66^{a}
T6	21.38^{a}	21.40^{a}	21.33^{a}	21.74^{a}
T7	21.00^{ab}	20.99^{ab}	21.18^{a}	21.37^{a}
T8	20.67^{ab}	20.66^{abcd}	20.83^{ab}	21.08^{a}
	**	**	**	**
cv	**1.72%**	**1.38%**	**2.03%**	**2.08%**

Means with common superscript letters are not significantly different.

In week 7, Treatment 1 produced the largest fruit diameter with a mean of 21.35 mm, while Treatment 0 recorded the smallest fruit diameter with a mean of 19.79 mm. In week 8, Treatment 2 produced the largest fruit diameter with a mean of 22.04 mm, while Treatment 0 had the smallest fruit diameter with a mean of 20.75 mm. However, treatments with common superscripts from weeks 5 to 8 had comparable results, indicating no significant difference. Overall, the results suggest that applying gibberellic and salicylic acids had a positive influence on fruit diameter, with certain treatments producing significantly larger fruit diameters than Treatment 0 (control).

The result implies that the Treatment 2 application of 100 ppm gibberellic acid (GA_3) significantly increases fruit diameter per plant. This finding is supported by Verma et al. (2022) in their study, Fruit Characters and Yield of Strawberry (*Fragaria ananassa*) as Influenced by Different Concentrations of Gibberellic Acid, which reported that gibberellic acid (GA_3) enhances fruit diameter, length, and weight, ultimately leading to higher yields. Gibberellic acid (GA_3) has consistently improved strawberry fruit diameter and yield across multiple studies. Foliar application of gibberellic acid (GA_3) increased fruit diameter, with 'Winter Dawn' measuring 3.38 cm and 'Sweet Charlie' reaching 3.28 cm. Additionally, gibberellic acid (GA_3) significantly impacted fruit weight and size, promoting the development of larger and heavier fruits (Gundogdu et al., 2021).

3.12 Average Fruit Weight (Grams) per Plant

The summary table of the average fruit weight (grams) per plant every week of the strawberry cv. Sweet Charlie, as influenced by gibberellic and salicylic acids, is presented in Table 12. Statistical analysis showed highly significant differences among treatment means in weeks 5 and 6. Treatment 6 had the highest average fruit weight (grams) per plant, with means of 7.26 and 7.33, respectively. In contrast, Treatment 0 had the lowest average fruit weight (grams) per plant, with means of 5.07 and 5.67, respectively.

Table 12. *Summary Table of the Average Fruit Weight (g) per Plant per Weekly Basis of Strawberry cv. Sweet Charlie as Influenced by Gibberellic and Salicylic Acids*

Treatments	Mean Res ult Per Week			
	W5	W6	W7	W8
T0	5.07^{e}	5.67^{e}	6.13^{e}	7.12^{bc}
T1	6.17^{cd}	6.79^{bcd}	7.40^{ab}	7.95^{a}
T2	6.62^{bcd}	7.21^{ab}	7.56^{a}	7.96^{a}
T3	6.07^{d}	6.38^{d}	6.69^{d}	7.04^{bc}
T4	6.63^{bcd}	6.70^{cd}	7.08^{bcd}	7.14^{bc}
T5	6.85^{ab}	6.97^{abc}	7.01^{bcd}	6.93^{bc}
T6	7.26^{a}	7.33^{a}	7.22^{abc}	7.35^{b}
T7	6.88^{ab}	6.85_{abcd}	6.94^{cd}	6.99^{bc}
T8	6.66^{bc}	6.64^{cd}	6.71^{d}	6.82^{c}
	**	**	**	**
cv	**3.00%**	**2.54%**	**2.23%**	**2.46%**

Means with common letter superscript are not significantly difference.

In weeks 7 and 8, Treatment 2 produced the highest average fruit weight (grams) per plant, with means of 7.56 and 7.96, respectively. Meanwhile, Treatment 0 recorded the lowest average fruit weight (grams) per plant in week 7, with a mean of 6.13, while Treatment 8 had the lowest average fruit weight (grams) per plant, with a mean of 6.82 in week 8. However, treatments with common superscripts from weeks 5 to 8 had comparable results, indicating no significant difference. Overall, the results suggest that applying gibberellic and salicylic acids positively influenced the average fruit weight (grams) per plant, with specific treatments producing significantly.

The result implies that the application of Treatment 2 with 100 ppm gibberellic Acid (GA_3) significantly increases the average fruit weight (grams) per plant. Gibberellic Acid (GA_3) plays a crucial role in enhancing fruit weight, plant height, early flowering, petiole length, fruit set, leaf area, and overall yield while also improving fruit quality. Additionally, it promotes stem elongation and stimulates cell division, contributing to better vegetative and reproductive growth (Li et al., 2019). Gibberellic acid (GA_3) significantly impacts the growth and development of strawberries. It enhances plant height, runner formation, and flower production, leading to a higher fruit set percentage, increased fruit count, and greater overall yield. Moreover, Sharman and Godara (2020) reported that the application of gibberellic acid (GA_3) in strawberries effectively enhances fruit weight, size, and yield.

3.13 Morphological Descriptors of Fruit Size (weight in grams)

The influence of gibberellic and salicylic acids on the morphological descriptors of fruit size (weight in grams) of the strawberry cv. Sweet Charlie is presented in Table 13. Statistical analysis revealed no significant difference among the means of all treatments tested. Treatment 2, Treatment 6, and Treatment 8 got the same mean of 5.00 for the highest fruit size (weight in grams), followed by Treatment 7, Treatment 5, Treatment 4, Treatment 1, and Treatment 3 with a mean of 4.98, 4.95, 4.90, 4.77, and 4.60, respectively. Treatment 0 got the lowest fruit size (weight in grams) with a mean of 4.57.

Table 13. *Influence of Gibberellic and Salicylic Acids on Morphological Descriptors of Fruit Size (weight in g) of Strawberry cv. Sweet Charlie*

Treatments	Replication			Total	Mean
	I	II	III		
T0 - Control (water)	5.70	3.90	4.10	13.70	4.57
T1 - 75 ppm Gibberellic acid (GA_3)	4.60	4.90	4.80	14.30	4.77
T2 - 100 ppm Gibberellic acid (GA_3)	5.00	5.00	5.00	15.00	5.00
T3 - 100 ppm Salicylic acid (SA)	4.60	4.50	4.70	13.80	4.60
T4 - 200 ppm Salicylic acid (SA)	4.80	5.00	4.90	14.70	4.90
T5 - 75 ppm Gibberellic acid (GA_3) + 100 ppm Salicylic acid (SA)	4.90	4.95	5.00	14.85	4.95
T6 - 75 ppm Gibberellic acid (GA_3) + 200 ppm Salicylic acid (SA)	5.00	5.00	5.00	15.00	5.00
T7 - 100 ppm Gibberellic acid (GA_3) + 100 ppm Salicylic acid (SA)	5.00	4.95	5.00	14.95	4.98
T8 - 100 ppm Gibberellic acid (GA_3) + 200 ppm Salicylic acid (SA)	5.00	5.00	5.00	15.00	5.00
Grand Total & Mean	**37.20**	**37.10**	**38.40**	**112.70**	**4.77**

cv = 7.12%
ns = not Significant

3.14 Total Weight of Fruits (grams) per Plant

The summary table of the total weight of fruits (grams) per plant every week of the strawberry cv. Sweet Charlie, as influenced by gibberellic and salicylic acids, is presented in Table 14. Statistical analysis showed highly significant differences among treatment means in weeks 5 and 6. Treatment 6 had the highest total weight of fruit (grams) per plant, with means of 72.66 and 73.31, respectively. In contrast, Treatment 0 had the lowest total weight of fruit (grams) per plant, with means of 50.33 and 56.31, respectively. In weeks 7 and 8, Treatment 2 produced the highest total weight of fruit (grams) per plant with means of 75.56 and 79.59, respectively. Meanwhile, Treatment 0 recorded the lowest total weight of fruit (grams) per plant in week 7, with a mean of 61.30, while Treatment 8 had the lowest total weight of fruit (grams) per plant, with a mean of 68.20 in week 8. However, treatments with common superscripts from week 5 to week 8 had comparable results, indicating no significant difference.

The result implies that the application of Treatment 2 with 100 ppm gibberellic Acid (GA_3) significantly increases the total weight of fruit (grams) per strawberry plant. El-Naggar et al. (2020) support this finding, reporting that gibberellic Acid (GA_3) application enhances strawberry growth, flowering, fruiting, yield, and overall fruit quality. It has been shown to improve fruit size, weight, and sweetness, making it an effective regulator for plant growth and fruit production.

Table 14. *Summary Table of Total Weight of Fruit (g) per Plant per Weekly Basis of Strawberry cv. Sweet Charlie as Influenced by Gibberellic and Salicylic Acids*

Treatments		Mean Result Per Week		
	W5	**W6**	**W7**	**W8**
T0	50.33^{d}	56.31^{e}	61.30^{e}	71.18^{c}
T1	61.64^{c}	67.83^{bcd}	73.99^{ab}	78.55^{ab}
T2	66.22^{bc}	72.14^{ab}	75.56^{a}	79.59^{a}
T3	60.68^{c}	63.75^{d}	66.85^{d}	70.35^{c}
T4	66.24^{bc}	66.95^{cd}	70.82^{bcd}	71.40^{c}
T5	68.50^{ab}	69.74^{abc}	70.06^{bcd}	69.27^{c}
T6	72.66^{a}	73.31^{a}	72.17^{abc}	73.51^{bc}
T7	68.78^{ab}	68.46^{abcd}	69.37^{cd}	69.91^{c}
T8	66.29^{bc}	66.45^{cd}	67.13^{d}	68.20^{c}
	**	**	**	**
cv	**2.99%**	**2.61%**	**2.22%**	**2.67%**

Means with common superscript letters are not significantly different.

Gundogdu et al. (2021) also found that gibberellic Acid (GA_3) significantly impacts fruit weight and size, leading to the development of larger and heavier fruits. Similarly, Sharma and Godara (2020) demonstrated that gibberellic Acid (GA_3) treated strawberry plants produced more fruits with greater weight, contributing to an increased overall harvest. Additionally, gibberellic Acid (GA_3) was observed to enhance the sweetness of strawberries, further reinforcing its role in improving both growth and fruit quality. Beyond yield improvements, gibberellic Acid (GA_3) application has been linked to increased fruit weight, plant height, early flowering, petiole length, fruit set, and leaf area, all of which contribute to better overall productivity (Prem, 2020).

4.0 Conclusion

This study demonstrated that the application of different levels and combinations of gibberellic acid (GA_3) and salicylic acid (SA) significantly influenced the growth and yield of the strawberry 'Sweet Charlie' variety, particularly from the third week after treatment onward. Specifically, Treatment 2 (100 ppm GA_3) significantly enhanced plant height, number of branch crowns, and runner production from week 3 to week 8 ($p < 0.05$). It also accelerated the appearance of stolons and increased the number of flowers between weeks 3 and 6. Treatment 1 (75 ppm GA_3) consistently increased the number of days to flowering and flower count at later stages, while Treatments 5 (75 ppm GA_3 + 100 ppm SA) and 6 (75 ppm GA_3 + 200 ppm SA) significantly boosted runner numbers during weeks 2 to 4. Regarding fruit yield, Treatment 2 (100 ppm GA_3) shortened the days from flowering to fruit setting and improved fruit diameter and weight from week 7 onwards. Treatment 3 (100 ppm SA) increased the number of fruits per plant between weeks 4 and 8. Treatment 6 (75 ppm GA_3 + 200 ppm SA) notably enhanced fruit diameter, fruit weight, and total fruit yield during weeks 5 to 6, with effects sustained through weeks 7 and 8 under Treatment 2. The combined application of GA_3 and SA, particularly at 75 ppm GA_3 with 200 ppm SA, and the sole application of 100 ppm GA_3, significantly improved both vegetative growth and fruit yield parameters of the 'Sweet Charlie' strawberry. These findings suggest that strategic use of these plant growth regulators can effectively enhance strawberry production.

5.0 Contributions of Authors

The principal author contributes to the study's writing and implementation. The co-author edits and supervises the data.

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7.0 Conflict of Interests

The authors assert no conflicts of interest regarding the publication of this paper.

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9.0 References

Ali, S., Islam, N., & Choudhury, S. (2023). Influence of gibberellic acid and mulch materials on yield and biochemical attributes of strawberry (*Fragaria ananassa*) CV. Festival. AgroEnvironmental Sustainability, 1(2), 162-171. https://doi.org/10.59983/s2023010209

Al-Karawi, H. N., Salman, F. A., & Al-Deheimawi, A. J. (2021). The effect of foliar application of organic matter and salicylic acid on the growth and yield in strawberry (*Fragaria Ananassa*). IOP Conference Series: Earth and Environmental Science, 910(1), 012081. https://doi.org/10.1088/1755-1315/910/1/012081

El-kenawy, M. (2017). Effect of chitosan, salicylic acid and fulvic acid on vegetative growth, yield and fruit quality of Thompson seedless grapevines. Egyptian Journal of Horticulture, 44(1), 45-59. https://doi.org/10.21608/ejoh.2017.1104.1007

El-Naggar, A., Hassan, M., Abdelgawad, M., & Abd El-Salam, A. E. (2020). Effect of saline irrigation water, gibberellic Acid (GA3) and biofertilizers on growth, flowers yield and oil production of Matricaria chamomilla, L.plants. Journal of the Advances in Agricultural Researches, 25(3), 286-313. https://doi.org/10.21608/jalexu.2020.161624

Gundogdu, M., Berk, S., Yıldız, K., Kaki, B., Tuna, S., Canan, I., Okatan, V., & Ercisli, S. (2021). Influence of foliar application with gibberellic acid on phenolic and bioactive compounds of strawberry fruits. Erwerbs-Obstbau, 63(1), 15-23. https://doi.org/10.1007/s10341-021-00543-z

Jamali, B., Eshghi, S., & Taffazoli, E. (2013). Vegetative growth, yield, fruit quality and fruit and leaf composition of strawberry CV. 'Pajaro' as influenced by salicylic acid and nickel sprays. Journal of Plant Nutrition, 36(7), 1043-1055. https://doi.org/10.1080/01904167.2013.766803

Katel, S., Mandal, H. R., Kattel, S., Yadav, S. P. S., & Sharma, B. (2022). Impacts of plant growth regulators in strawberry plant: A review. Heliyon, 8(12), e11959. https://doi.org/10.1016/j.heliyon.2022.e11959

Kosakivska, I. (2021). Gibberellins in regulation of plant growth and development under abiotic stresses. Biotechnologia Acta, 14(2), 5–18. https://doi.org/10.15407/biotech14.02.005

Kumar, S., Prakash, S., Singh, M. K., Kumar, V., & Kumar, A. (2020). Growth and floral behavior of strawberry (*Fragaria* X *ananassa* Duch.) varieties under western Uttar Pradesh condition. International Journal of Current Microbiology and Applied Sciences, 9(9), 2064-2068. https://doi.org/10.20546/ijcmas.2020.909.257

Kumar, V., & Bisarya, D. (2023). Foliar application of silicon and salicylic acid improves growth, leaf pigments and yield of maize (Zea mays L.) under nutrient deficient sandy soil. https://doi.org/10.21203/rs.3.rs-3144795/v1

Li, M., Cheng, S., Wang, Y., & Dong, Y. (2019). Improving fruit coloration, quality attributes, and phenolics content in 'Rainier' and 'Bing' cherries by gibberellic acid combined with Homobrassinolide. Journal of Plant Growth Regulation, 39(3), 1130-1139. https://doi.org/10.1007/s00344-019-10049-4

Prakash, R., Jokhan, A. D., & Singh, R. (2022). Effects of foliar application of gibberellic acid, boric acid and sucrose on noni (M. citrifolia L.) fruit growth and quality. Scientia Horticulturae, 301, 111098. https://doi.org/10.1016/j.scienta.2022.111098

Prem, K. (2020). Effect of foliar application of plant growth regulators on flowering, growth, fruit set, fruit drop, yield, quality of Kinnow Mandarin (*Citrus reticulata*). International Journal of Current Microbiology and Applied Sciences, 9(10), 2948-2951. https://doi.org/10.20546/ijcmas.2020.910.355

Sharma, A., & Godara, A. (2020). Effect of gibberellic acid application on the growth, vigour, flowering, fruiting and quality of strawberry: A review. International Journal of Current Microbiology and Applied Sciences, 9(10), 3426–3431. https://doi.org/10.20546/ijcmas.2020.910.395

Silva, P. S., Barreto, C. F., Kirinus, M. B., Schiavon, A. V., Malgarim, M. B., & Mello-Farias, P. (2018). Effects of gibberellic acid (GA3) on reduction of rot disease and physico-chemical quality of 'Pinot noir' grape. Australian Journal of Crop Science, 12(08), 1363-1369. https://doi.org/10.21475/ajcs.18.12.08.pne1282

Singh, S., Mishra, D., Singh, A. K., Singh, A. K., Verma, S., & Mishra, P. (2022). Plant growth regulators in Aonla. Plant Growth Regulators in Tropical and Sub-tropical Fruit Crops, 52-63. https://doi.org/10.1201/9781003300342-4

Thi, L., Nguyen, Q. H., Park, Y. G., & Jeong, B. R. (2019). Growth and flower bud induction in strawberry 'Sulhyang' runner plant as affected by exogenous application of benzyladenine, gibberellic acid, and salicylic acid. Protected Horticulture and Plant Factory, 28(2), 178–184. https://doi.org/10.12791/ksbec.2019.28.2.178

Verma, S., Dwivedi, A. K., & Tripathi, D. V. (2022). Effect of gibberellic acid and boron on growth, yield and yield attributory traits in strawberry (*Fragaria* X *ananassa* Duch.) under north Gangetic plains. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.4189998

Youssef, S., Abu El-Azm, N., & Abd Elhady, S. (2017). Frequent foliar sprayings of salicylic acid with elevated concentrations enhance growth, yield and fruit quality of strawberry (*Fragaria* X *ananassa* Duch. CV. Festival) plants. Egyptian Journal of Horticulture, 44(1), 61-74. https://doi.org/10.21608/ejoh.2017.1100.1008