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EFFECT OF PLANT GROWTH REGULATORS ON GROWTH OF PETUNIA (*Petunia × Hybrida*) VAR. SURFINIA BURGUNDY

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ABSTRACT

Petunia × hybrida is an important annual ornamental crop valued for its attractive flowers, diverse colours and versatile use in landscape and container gardening. Regulation of vegetative growth and plant architecture is essential for producing compact, well-branched and aesthetically appealing petunia plants. Hence, the present investigation was carried out to evaluate the effect of different plant growth regulators on the growth and plant architecture of *Petunia × hybrida* var. Surfinia Burgundy during the rabi season of 2025–2026 at the Post Graduate Institute for Horticultural Sciences, Sri Konda Laxman Telangana Horticultural University, Mulugu, Siddipet, Telangana. The experiment was laid out in a Completely Randomized Design with nine treatments and three replications. The treatments included NAA, GA₃, CCC and paclobutrazol, applied individually and in combinations. Growth parameters viz., plant height, plant spread, number of branches, leaf area, stem girth, number of nodes, internodal length and chlorophyll content were recorded at 40, 60 and 80 days after transplanting. Significant differences were observed among the treatments for all the growth parameters. GA₃ at 250 ppm (T₂) recorded superior performance for most of the growth parameters, including plant height, plant spread, number of branches, leaf area, number of nodes, internodal length and chlorophyll content. The maximum stem girth was recorded with NAA 50 ppm + paclobutrazol 30 ppm (T₇). Overall, GA₃ at 250 ppm proved to be the most effective treatment for enhancing vegetative growth and plant architecture of Surfinia Burgundy under the experimental conditions.

Key words: *Petunia × hybrida*, Surfinia Burgundy, plant growth regulators, GA₃, NAA, vegetative growth, plant architecture.

Introduction

Petunia (Petunia × hybrida) is an important annual ornamental crop of the family Solanaceae, widely cultivated for its attractive flowers, diverse colours, vigorous growth and adaptability. It is extensively used in beds, borders, pots, window boxes and hanging baskets. Cultivar differences in plant height, spread, branching and architecture make the regulation of vegetative growth important for producing compact and well-balanced plants.

Plant growth regulators (PGRs) are widely used to manipulate plant growth and plant architecture by

influencing cell division, elongation and branching. Naphthalene acetic acid (NAA) promotes lateral shoot development and branching, while gibberellic acid (GA₃) stimulates cell elongation and increases plant height (Phinney, 1956; Sachs, 1965). In contrast, cycocel (CCC) and paclobutrazol inhibit gibberellin biosynthesis, thereby reducing stem elongation and producing shorter, compact plants (Latimer and Whipker, 2012).

The response to PGRs varies with the type and concentration of regulator, cultivar and stage of plant development. Therefore, the present study was

undertaken to evaluate the effect of different plant growth regulators on the vegetative growth and plant architecture of *Petunia × hybrida* var. Surfinia Burgundy, with particular emphasis on plant height, plant spread, branching, node production, internodal length, stem girth and leaf development.

Material and Methods

Experiment site and planting material

The investigation entitled “Effect of plant growth regulators on growth of petunia (*Petunia × hybrida*) Var. Surfinia Burgundy” was conducted during Rabi season 2025-2026 at the Post Graduate Institute for Horticultural Sciences, Sri Konda Laxman Telangana Horticultural University, Mulugu, Siddipet, Telangana. The experimental site located at 17°43' 02' N latitude and a longitude of 78°37' 34' E in central Telangana agroclimate zone.

Healthy, uniform, disease-free, one month old seedlings of petunia were procured from Sneha Nursery, Ibrahimpatnam, Hyderabad, Telangana. These seedlings are well established and free from pest and diseases.

The experiment design and treatments

The experiment was laid out in a Completely Randomized Design (CRD) with 9 treatments and three replications. Each treatment consists of five pots with two plants per pot. The treatments comprised NAA @50 ppm, GA₃ @ 250 ppm, CCC @ 300 ppm, Paclobutrazol @ 30 ppm, NAA @50 ppm + CCC @ 300 ppm, GA₃ @ 250 ppm + CCC @ 300 ppm, NAA @50 ppm + Paclobutrazol @ 30 ppm, GA₃ @ 250 ppm + Paclobutrazol @ 30 ppm, along with an untreated as control.

Potting media and transplanting

The potting mixture consists of red soil, cocopeat, Farmyard manure (FYM) in a 1:1:1 ratio. Seedlings have been carefully transplanted into 8 inches pots.

Crop management

Fertilizers are sprayed at 15 days interval at 500 ml of 19:19:19 nutrient solution per pot at a concentration of 3 g L⁻¹. Thirty days old seedlings were transplanted and Irrigation was provided at weekly intervals, regular hand weeding was undertaken to keep the pots free from weeds. Pinching was done at 15 DAT.

The respective plant growth regulators were applied as foliar sprays at 40, 60 and 80 DAT.

Observation recorded

Vegetative observations were recorded at 40, 60 and 80 days after transplanting (DAT). The parameters recorded were:

- **Plant height (cm):** Measured from the ground

level to the terminal growing point using a measuring scale.

- **Plant spread (cm):** Measured in North-South and East-West directions and the mean was recorded.
- **Number of branches per plant:** Total branches arising from the main stem were counted.
- **Leaf area (cm²):** Five fully expanded leaves were selected randomly from each plant and measured using a portable leaf area meter.
- **Stem girth (mm):** Measured at a uniform height above the soil surface using a vernier calliper.
- **Number of nodes:** Total number of nodes per plant was counted.
- **Internodal length (cm):** Measured as the distance between two consecutive nodes on the main stem.
- **Chlorophyll content (SPAD units):** Measured on five fully expanded leaves per plant using a SPAD chlorophyll meter and the mean value was recorded.

Statistical analysis

The data were analysed statistically using Completely Randomized Design. Treatment differences were tested using the “F” value at 5% level of probability and wherever the F value was found significant critical difference (CD) at 5 per cent significance level were calculated for significant treatment effects following Panse and Sukhatme (1985).

Results and Discussion

Plant height (cm)

There were significant differences among the treatments at 40, 60 and 80 DAT (Table 1). The maximum plant height was consistently recorded in T₂ (GA₃ 250 ppm), with 18.3, 32.6 and 51.0 cm at 40, 60 and 80 DAT, respectively. At 40 DAT, T₆ (GA₃ 250 ppm + CCC 300 ppm) recorded 14.3 cm, while at 60 DAT, T₈ (GA₃ 250 ppm + Paclobutrazol 30 ppm) recorded 31.7 cm and was on par with T₂. At 80 DAT, T₈ (43.4 cm) was followed by T₆ (42.1 cm), while the minimum height at 40 and 60 DAT was recorded in T₉ (9.7 cm) and T₄ (12.8 cm), respectively.

The increased plant height under GA₃ may be attributed to its stimulation of cell division and cell elongation, particularly through enhanced internodal elongation. GA₃ also promotes the mobilization of assimilates towards actively growing tissues, resulting in enhanced vegetative growth. In contrast, paclobutrazol inhibits gibberellin biosynthesis, thereby reducing internodal elongation and producing compact plants. Similar findings were reported by Shanan *et al.*, (2014) in celosia,

Table 1: Effect of plant growth regulators on growth of *Petunia* (*Petunia × hybrida*) var. Surfinia Burgundy.

OB	PH			PSE			PSN			NBP			LA			SG			NN			IL			CC		
	40	60	80	40	60	80	40	60	80	40	60	80	40	60	80	40	60	80	40	60	80	40	60	80	40	60	80
DAT																											
T ₁	13.5	21.2	27.1	15.4	17.6	18	17.4	14.4	20.7	8.2	14.6	16.2	416.9	524.6	152.1	4.9	6.5	8.5	10.0	14.9	17.7	3.5	4.8	5.7	10.2	11.3	11.7
T ₂	18.3	32.6	51.0	16.2	19.8	21.2	17.1	20.4	22.7	8.8	16.4	18.4	709.1	753.2	378.4	4.4	5.9	10.2	8.4	12.9	15.7	4.8	6.5	7.7	18.2	24.3	20.5
T ₃	12.4	19.9	25.4	11.2	17.8	19.4	15.3	16.0	19.1	7.0	12.2	12.2	317.0	569.6	296.0	5.4	7.3	9.4	12.1	18.3	21.4	2	3.7	4.3	8.6	12.1	15.6
T ₄	11.4	12.8	11.2	7.8	13	16.2	8.8	11.2	16.5	5.0	8.2	10.0	384.6	378.4	258.6	5.8	8.2	7.7	13.2	19.2	22.7	2.3	3.2	3.7	8.4	9.4	5.7
T ₅	12.0	21.8	28.8	15.8	17.8	18.8	15.2	14.6	20.8	7.4	15.4	17.4	551.6	716	298.0	5.6	7.5	9.6	12.5	18.3	22.0	2.9	4.0	4.6	9.6	13.7	10.2
T ₆	14.3	24.5	42.1	11.8	15	14.6	14.3	13.1	15.2	7.6	12.8	13.6	328.6	660.8	369.8	5.2	7.0	9.0	10.9	16.3	18.6	4.2	5.6	6.5	7.2	14.4	9.8
T ₇	10.1	15.2	29.2	11	12.4	17.4	10.8	14.1	17.1	7.4	11.2	12.4	463.2	540.8	221.4	6.0	8.4	10.5	13.8	20.1	23.7	2.6	3.6	4.1	6.7	21.3	15.8
T ₈	12.6	31.7	43.4	12.6	17	17.2	15.4	15.9	15.4	8.2	15.4	15.8	338.8	295.4	156.6	5.7	7.8	9.9	11.5	17.4	20.6	3.9	5.0	5.9	11.2	16.1	12.7
T ₉	9.7	16.3	18.9	11.2	14	14.4	12.5	16.2	14.6	7.2	10.4	12.2	242.8	239	84.8	4.2	5.6	7.3	9.3	14.3	18.3	3.1	4.4	5.1	9.0	10	10.3
SEm ±	0.17	0.28	0.28	0.22	0.26	0.27	0.24	0.50	0.41	0.03	0.02	0.03	0.31	0.13	0.10	0.04	0.05	0.09	0.14	0.43	0.02	0.03	0.06	0.20	0.31	0.21	
CD/LSD 5%	0.52	0.86	0.86	0.65	0.77	0.80	0.72	1.48	0.23	0.08	0.05	0.07	0.92	0.38	0.30	0.13	0.14	0.27	0.27	0.42	1.29	0.06	0.08	0.18	0.59	0.93	0.62
CV %	2.36	2.29	1.62	3.02	2.76	2.65	2.96	5.68	1.41	0.37	0.24	0.03	0.13	0.04	0.07	1.39	1.15	1.70	1.40	1.44	3.71	1.03	1.07	1.95	3.45	3.64	2.88
OB: Observations; DAT: Days after Transplanting; T ₁ : NAA500 ppm; T ₂ : GA ₃ 250 ppm; T ₃ : CCC 300 ppm; T ₄ : Paclobutrazol 30 ppm; T ₅ : NAA500 ppm + CCC 300 ppm; T ₆ : GA ₃ 250 ppm + CCC 300 ppm; T ₇ : NAA500 ppm + Paclobutrazol 30 ppm; T ₈ : GA ₃ 250 ppm + Paclobutrazol 30 ppm; T ₉ : Control;																											
PH: Plant height; PSE: Plant spread E-W; PSN: Plant spread N-S; NBP: Number of branches per plant; LA: Leaf area (cm ²); SG: Stem girth (mm); NN: No of nodes; IL: Internodal length; CC: Chlorophyll content (SPAD)																											

Maitra and Roychowdhury (2015) in carnation, Sethy *et al.*, (2016) in ornamental sunflower, Bordoloi and Talukdar (2019) in anthurium and Sekhar (2020) in jasmine.

Plant spread (East-West)

Significant differences were observed among the treatments for plant spread (E-W) at 40, 60 and 80 DAT (Table 1). At 40 DAT, the maximum plant spread (16.2 cm) was recorded in T₂ (GA₃ 250 ppm), which was on par with T₅ (15.8 cm) and T₁ (15.4 cm), while the minimum (7.8 cm) was recorded in T₄ (Paclobutrazol 30 ppm). At 60 DAT, T₂ recorded the highest plant spread (19.8 cm), significantly superior to all other treatments, followed by T₃ (17.8 cm), which was on par with T₅ (17.8 cm), T₁ (17.6 cm) and T₈ (17.0 cm). The minimum spread (12.4 cm) was observed in T₄. At 80 DAT, T₂ again recorded the maximum spread (21.2 cm), followed by T₃ (19.4 cm), while T₅ (18.8 cm) was on par with T₁ (18.0 cm). The minimum was recorded in T₉ (14.4 cm), which was on par with T₄ (14.2 cm).

The maximum plant spread (E- W) with GA₃ at 250 ppm may be attributed to enhanced cell division and elongation, which promoted vigorous lateral growth and expansion of the plant canopy. GA₃ also improved overall vegetative growth, resulting in greater plant spread. Similar findings were reported by Shanan *et al.*, (2014) in chrysanthemum and by Sharifuzzaman *et al.*, (2011) and Bordoloi and Talukdar (2019) in chrysanthemum and anthurium, respectively.

Plant spread (North-South)

Significant differences were observed among treatments for plant spread (N-S) at 40, 60 and 80 DAT (Table 1). The maximum plant spread was recorded with T₂ (GA₃ 250 ppm) at 40 DAT (17.1 cm), 60 DAT (20.4 cm) and 80 DAT (22.7 cm) and it was significantly superior to most other treatments. At 40 DAT, T₈ (15.4 cm) was on par with T₃ (15.3 cm), while the minimum spread was recorded in T₄ (8.8 cm). At 60 DAT, T₁ (17.4



Fig. 1: Effect of plant growth regulators on growth of *Petunia* (*Petunia × hybrida*) var. Surfinia Burgundy.

cm) followed T_2 , while at 80 DAT, T_1 (20.7 cm) was on par with T_5 (20.8 cm). The minimum spread at 60 and 80 DAT was recorded in T_4 (11.2 and 15.2 cm, respectively).

The maximum plant spread (N-S) with GA_3 at 250 ppm may be attributed to its stimulatory effect on cell division and elongation, which enhanced lateral vegetative growth and canopy development. GA_3 also promotes rapid expansion of plant tissues, resulting in greater plant spread. Similar findings were reported by Shan *et al.*, (2014) in chrysanthemum and Sharifuzzaman *et al.*, (2011) and Bordoloi and Talukdar (2019) in ornamental crops.

Number of branches per plant

Significant differences were observed among the treatments for number of branches per plant at 40, 60 and 80 DAT (Table 1). The maximum number of branches was recorded in T_2 (GA_3 250 ppm) with 8.8, 16.4 and 18.4 branches at 40, 60 and 80 DAT, respectively. At 40 DAT, T_1 and T_8 (8.2 each) were statistically on par, while at 60 DAT, T_5 and T_8 (15.4 each) were on par. At 80 DAT, T_5 recorded 17.4 branches. The minimum number of branches at all stages was recorded in T_4 (Paclobutrazol 30 ppm), with 5.0, 8.2 and 10.0 branches, respectively.

The highest number of branches with GA_3 at 250 ppm may be attributed to its stimulatory effect on cell division and meristematic activity, promoting vigorous vegetative growth and formation of more lateral branches. Conversely, the minimum branches under paclobutrazol may be due to its growth-retarding effect. Similar findings were reported by Maitra and Maitra (2015) in ornamental plants, Sethy *et al.*, (2016) in sunflower, Bordoloi and Talukdar (2019) in anthurium and Sekhar (2020) in jasmine.

Leaf area (cm²)

Significant differences were observed among treatments for leaf area at 40, 60 and 80 DAT (Table 1 and Fig. 2). The maximum leaf area was consistently recorded in T_2 (GA_3 250 ppm), with 709.1, 753.2 and 378.4 cm² at 40, 60 and 80 DAT, respectively. It was followed by T_5 (NAA 50 ppm + CCC 300 ppm) at 40 and 60 DAT and T_6 (GA_3 250 ppm + CCC 300 ppm) at

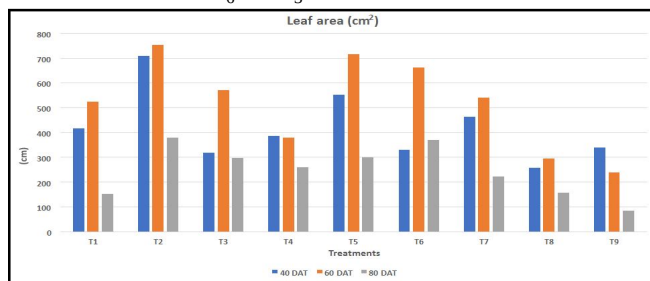


Fig. 2: Effect of plant growth regulators on leaf area (cm²) of petunia var. Surfinia Burgundy.

80 DAT. The minimum leaf area was recorded in the control (T_9) (242.8, 239.0 and 84.8 cm²).

The highest leaf area with GA_3 at 250 ppm may be attributed to its stimulatory effect on cell division and enlargement, promoting leaf expansion and increased photosynthetic surface area. This resulted in vigorous vegetative growth and larger leaves. Similar findings were reported by Sharifuzzaman *et al.*, (2011) in chrysanthemum and Bordoloi and Talukdar (2019) in anthurium.

Stem girth (mm)

Significant differences were observed among treatments for stem girth at 40, 60 and 80 DAT (Table 1). The maximum stem girth was recorded in T_7 (NAA 50 ppm + Paclobutrazol 30 ppm) at 40 DAT (6.0 mm) and 60 DAT (8.4 mm), while at 80 DAT T_7 recorded the highest value (10.5 mm), which was on par with T_2 (GA_3 250 ppm) (10.2 mm). The minimum stem girth was consistently observed in the control (T_9), with values of 4.2, 5.6 and 7.3 mm at 40, 60 and 80 DAT, respectively. The highest stem girth with NAA 50 ppm + paclobutrazol 30 ppm may be attributed to their synergistic effect on cambial activity and cell division, promoting radial stem growth and vascular tissue development. Similar findings were reported by Sudhakar and Kumar (2012) in gladiolus and Ghadage *et al.*, (2013) in Gaillardia.

Number of nodes

Significant differences were observed among treatments for number of nodes at 40, 60 and 80 DAT (Table 1). The maximum number of nodes was recorded in T_2 (GA_3 250 ppm) at 40 DAT (13.8), 60 DAT (20.1) and 80 DAT (23.7), followed by T_7 (NAA 50 ppm + Paclobutrazol 30 ppm) with 13.2 and 19.2 nodes at 40 and 60 DAT, respectively. At 80 DAT, T_2 was on par with T_5 (NAA 50 ppm + CCC 300 ppm; 22.0) and T_3 (CCC 300 ppm; 21.4). The minimum number of nodes was consistently recorded in T_4 (Paclobutrazol 30 ppm), with 8.4, 12.9 and 15.7 nodes at 40, 60 and 80 DAT, respectively.

The maximum number of nodes with GA_3 at 250 ppm may be attributed to its ability to stimulate cell division, cell elongation and internodal development, thereby

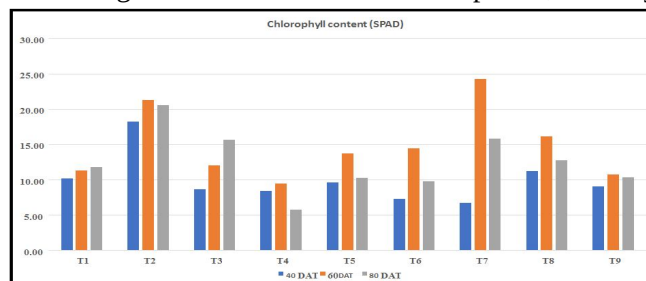


Fig. 3: Effect of plant growth regulators on chlorophyll content (SPAD) of petunia var. Surfinia Burgundy.

promoting active vegetative growth and increased node formation. GA₃ also enhances the differentiation of meristematic tissues and translocation of assimilates to actively growing regions, resulting in greater node production. Similar findings were reported by Shanan *et al.*, (2014) in carnation, Maitra and Roychowdhury (2015) in carnation, Bordoloi and Talukdar (2019) in Anthurium and Sekhar (2020) in jasmine.

Internodal length (cm)

Significant differences were observed among the treatments for internodal length at 40, 60 and 80 DAT (Table 1). The highest internodal length was consistently recorded in T₂ (GA₃ at 250 ppm), with values of 4.8, 6.5 and 7.7 cm, respectively, which was significantly superior to all other treatments. It was followed by T₆ (GA₃ at 250 ppm + CCC at 300 ppm), recording 4.2, 5.6 and 6.5 cm at the respective stages. The minimum internodal length was observed in T₄ (Paclobutrazol at 30 ppm), with values of 2.3, 3.2 and 3.7 cm, respectively.

The increased internodal length under GA₃ at 250 ppm may be due to enhanced cell elongation and increased plasticity of cell walls. GA₃ promotes active growth of stem tissues and efficient assimilate translocation, thereby favouring internodal extension and overall vegetative growth. Similar findings were reported by Maitra and Roychowdhury (2015) in carnation, Sethy *et al.*, (2016) in ornamental sunflower and Sekhar (2020) in jasmine.

Chlorophyll content (SPAD)

Significant differences in chlorophyll content (SPAD) were observed among the treatments at 40, 60 and 80 DAT (Table 1 and Fig. 3). At 40 DAT, the highest chlorophyll content (18.2 SPAD) was recorded in T₂ (GA₃ @ 250 ppm), while the lowest (6.7 SPAD) was observed in T₇. At 60 DAT, T₇ recorded the highest chlorophyll content (21.3 SPAD), which was on par with T₂ (20.3 SPAD), whereas the lowest value (9.4 SPAD) was recorded in T₄. At 80 DAT, T₂ again recorded the highest chlorophyll content (24.5 SPAD), followed by T₇ (15.8 SPAD), while the lowest value (5.7 SPAD) was observed in T₄.

The higher chlorophyll content with GA₃ at 250 ppm may be attributed to enhanced chlorophyll biosynthesis and delayed chlorophyll degradation, along with improved nutrient uptake and photosynthetic activity. This resulted in greater chlorophyll accumulation and healthier foliage. These findings are in agreement with the reports of Anjali (2013), Shanan *et al.*, (2014), Sethy *et al.*, (2016), Bordoloi and Talukdar (2019) and Sekhar (2020).

Conclusion

The present study revealed that plant growth regulators significantly influenced the vegetative growth

and plant architecture of *Petunia × hybrida* var. Surfinia Burgundy. Among the treatments, GA₃ at 250 ppm (T₂) proved to be the most effective, consistently recording superior plant height, plant spread, number of branches, leaf area, number of nodes, internodal length and chlorophyll content at different growth stages. NAA 50 ppm + paclobutrazol 30 ppm (T₇) recorded the maximum stem girth, indicating its potential for improving stem strength and sturdiness.

Overall, the results suggest that GA₃ at 250 ppm is a promising treatment for promoting vigorous vegetative growth and desirable plant architecture in Surfinia Burgundy. Its application can help in developing well-grown plants with better canopy development and ornamental appeal, making it suitable for quality pot plant production under the agro-climatic conditions of Telangana.

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