# Impact of plant growth regulators and pruning on flowering in Jasmine (*Jasminum sambac* L.)

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**Abstract**

An investigation was carried out at Department of Floriculture and Landscape Architecture, College of Agriculture Vellanikkara to evaluate the effects of growth regulators and pruning on induction of off-season flowering in jasmine (*Jasminum sambac* L.). The experiment was laid out in randomized block design (with two factors) *viz*. time of pruning (factor 1) - last week of September, last week of October and last week of November, and application of growth regulators (factor 2) such as cycocel (1000 ppm, 1500 ppm), paclobutrazol (200 ppm, 300 ppm), mepiquat chloride (150 ppm, 300 ppm) $GA_3$ (100 ppm, 150 ppm), with two replications. In the present study, P x G interaction had a significant effect on the days to bud initiation, number of cymes per plant and number of buds per plant. The treatment combination $P_1$ x $G_1$ (pruning during last week of September along with application of cycocel 1000 ppm) was found to give better flower yield during offseason.

**Key words:** Cycocel, $GA_3$, Growth regulators, *Jasminum sambac,* Mepiquat chloride, Paclobutrazol, Pruning

## Introduction

*Jasminum sambac* is an important commercial loose flower crop. Among 200 species of the genus of *Jasminum*, *Jasminum sambac* is the species most suited for cultivation in Kerala. In South India the usual flowering season ranges from March to October (Dhanasekaran, 2019). As there is an ever increasing demand for fresh flowers, efforts are being made to increase the yield of jasmine by developing high yielding varieties and incorporating improved agro-techniques such as nutrient management, application of growth regulators and staggered pruning (Lokhande et al., 2015).

In Kerala, there is a high demand for *Jasminum sambac* flowers during festive seasons and special occasions (Sobhana, 2014). The peak season of flowering is from March-October, and the off season is December-March, when flower production declines. Jasmine being a seasonal crop, during offseason there is a great demand in market. To avoid this demand-supply imbalance in the market there is a need to increase the production during offseason. Pruning is an important practice that helps in manipulation of growth and flowering in jasmine (Pal, 2017). Regulation of plant growth and development using natural growth regulators is usually used for the increase in flower production in many horticultural crops. As in the case of any other loose flowers, the production of jasmine crop should coincide with the market demand of the flowers. But the additional benefit from the cultivation of crop lies in the off-season production and supply of flowers during the lean periods during July to October (Krishnamoorthy, 2014). It is in this respect that the possibility of using the combination of pruning with plant growth regulators for regulation of flowering in jasmine assumes significance.

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## Materials and methods

The present investigation was carried out in the Department of Floriculture and Landscape Architecture, College of Agriculture, Vellanikkara, Kerala during the period September 2020- June 2021. One year old *Jasminum sambac* plants were used for the study. The experiment was conducted in open field condition and laid out in randomized block design with 27 treatment combinations and two replications. Each treatment consisted of pruning and application of growth regulators. Pruning was done at a height of 45 cm above the ground level during three different time of the year *viz.* pruning during last week of September ($P_1$), pruning during last week of October ($P_2$) and pruning during last week of November ($P_3$). Growth regulators were applied at the rate of 100 ml/ plant with the respective concentration such as cycocel at 1000 ppm ($G_1$) and 1500 ppm ($G_2$), paclobutrazol at 200 ppm ($G_3$) and 300 ($G_4$) ppm, mepiquat chloride at 150 ppm ($G_5$) and 300 ppm ($G_6$), $GA_3$ at 100 ppm ($G_7$) and 150 ppm($G_8$). The plants subjected only to pruning were taken as control ($G_9$). All growth regulators except paclobutrazol were applied as foliar spray whereas paclobutrazol was applied as soil drenching. Uniform management practices were given for all treatments. The observations on yield and quality parameters were recorded at monthly intervals.

## Results and discussion

*Effect on days taken to bud initiation*

Earliness of flowering is a desirable feature for seasonal flowering plants. By observing the number of days taken for bud initiation (time taken for first flower bud to appear after each set of treatment combinations expressed in days), the treatment taking least number of days for bud initiation can be taken as superior with respect to other treatments. P x G interaction effect had a significant effect on the number of days taken for bud initiation in jasmine. The days for bud initiation ranged from 8.33 days to 59.33 days. Treatments $P_1$ x $G_3$ (pruning during last week of September along with drenching of paclobutrazol at 200 ppm), $P_1$ x $G_4$ (Pruning during last week of September along with drenching of paclobutrazol 300 ppm), $P_2$ x $G_1$ (pruning during last week of October along with spraying of cycocel at 1000 ppm), $P_2$ x $G_2$ (Pruning during last week of October along with cycocel at 1500 ppm), $P_2$ x $G_3$ (pruning during last week of October along with paclobutrazol 200 ppm), $P_2$ x $G_4$ (Pruning during last week of October along with paclobutrazol at 300 ppm), $P_3$ x $G_3$ (Pruning during last week of November along with paclobutrazol 200 ppm) and $P_3$ x $G_4$ (Pruning during last week of November along with paclobutrazol at 300 ppm) were found to be on par for this parameter (8.66, 11.38, 13.5, 12.16, 8.33, 10.16, 10.16 and 11.5 days respectively). (Table 1.). Pruning is one of the important cultural operations in cultivation of jasmine, as it eliminates unwanted shoots and encourages growth of new healthy shoots which bear more flowers than old shoots by diverting sap flow towards flowering shoots (Muthuswami et al., 1973). The research on *Jasminum multiflorum* conducted by Murali and Gowda (1987) at Bangalore revealed that cycocel at 1000 ppm brought the plants to flowering within 34.5 days. Similar results of early flowering were noticed in *Jasminum multiflorum* (Bhattacharjee, 1994).

*Effect on number of cymes per plant*

Number of cymes per plant directly influences the total yield per plant. The number of cymes per plant was found to be significantly influenced during the months of January and April. In January the number of cymes per plant ranged from 9.67 to 87.83 and in April it ranged from 11.95 to 96.88. During the month of January, $P_1$ x $G_1$ (pruning during last week of September along with cycocel at 1000 ppm), $P_1$ x $G_3$ (pruning during last week of September along with paclobutrazol at 200 ppm), $P_1$ x $G_6$ (pruning during last week of September along with mepiquat chloride at 150 ppm), $P_2$ x $G_1$ (pruning during last week of October along with cycocel 1000 ppm), $P_1$ x $G_3$ (pruning during last week of October along with paclobutrazol 200 ppm), $P_2$ x $G_5$ (pruning

during last week of October along with mepiquat chloride at 150 ppm), $P_3$ x $G_1$ (pruning during last week of November along with cycocel 1000 ppm) and $P_3$ x $G_3$ (pruning during last week of November along with paclobutrazol at 200 ppm) were found to be on par (87.83, 73.33, 57.08, 57.16, 61.41, 56, 65.16, and 56. 85 respectively) with respect to number of cymes per plant. During the month of April $P_1$ x $G_1$ (pruning during last week of September along with cycocel at 1000 ppm), $P_1$ x $G_3$ (pruning during last week of September along with paclobutrazol at 200 ppm), $P_3$ x $G_3$ (pruning during last week of November along with paclobutrazol at 200 ppm), $P_3$ x $G_4$ (pruning during last week of November along with paclobutrazol at 200 ppm), $P_3$ x $G_5$ (pruning during last week of November along with mepiquat chloride at 150 ppm), $P_3$ x $G_6$ (pruning during last week of November along with mepiquat chloride 300 ppm), $P_3$ x $G_7$ (pruning during last week of November along with $GA_3$ at 100 ppm) and $P_3$ x $G_8$ (pruning during last week of November along with $GA_3$ at 150 ppm) found to be on par (96.88, 79.83, 82.33, 81.91, 98.25, 91.75, 76.16, 77.5 and 82.16 respectively). (Table 1). Exogenous application of growth regulators might have caused polymerization of sugars that are utilized for vegetative growth. Due to polymerization, sugars are converted to storage carbohydrates, resulting in plant growth (Cohen,1978). These reserved carbohydrates might have been utilized for reproductive growth. Application of cycocel also might have caused reduction in the level of endogenous gibberellin, leading to early bud initiation and flowering. Similar results were reported in *J. multiflorum* (Bhattacharjee, 1994) and in *J.sambac* (Gowda et al., 1991).

Table 1. Effect of pruning and growth regulators on no.of cymes and no.of buds per plant in *Jasminum sambac* L.

| Treatments | Days to bud initiation | Number of buds per plant | | | | Number of cymes per plant | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Jan 21 | Feb 21 | Mar 21 | Apr 21 | Jan 21 | Feb 21 | Mar 21 | Apr 21 |
| $P_1$ x $G_1$ | 15.83 | 313.16 | 350.83 | 398.83 | 311.83 | 87.83 | 95.17 | 108.5 | 96.88 |
| $P_1$ x $G_2$ | 16.12 | 96.50 | 126.33 | 206.17 | 148.67 | 27.83 | 34.17 | 55.83 | 45.33 |
| $P_1$ x $G_3$ | 8.67 | 258.00 | 293.50 | 319.00 | 293.73 | 73.33 | 80.50 | 86.33 | 79.83 |
| $P_1$ x $G_4$ | 11.39 | 175.83 | 199.67 | 243.66 | 151.77 | 48.67 | 53.83 | 65.66 | 50.66 |
| $P_1$ x $G_5$ | 21.50 | 131.67 | 174.92 | 203.25 | 187.25 | 36.25 | 46.33 | 55.00 | 51.00 |
| $P_1$ x $G_6$ | 21.50 | 211.67 | 241.08 | 243.58 | 197.58 | 57.08 | 67.17 | 66.00 | 66.50 |
| $P_1$ x $G_7$ | 32.67 | 145.67 | 186.33 | 189.17 | 150.84 | 40.00 | 50.67 | 51.83 | 53.83 |
| $P_1$ x $G_8$ | 42.66 | 34.00 | 62.17 | 81.83 | 79.23 | 9.67 | 17.33 | 22.00 | 23.00 |
| $P_1$ x $G_9$ | 59.33 | 154.50 | 205.00 | 181.17 | 157.28 | 42.33 | 54.83 | 49.00 | 48.00 |
| $P_2$ x $G_1$ | 13.50 | 211.00 | 249.33 | 259.33 | 191.33 | 57.17 | 65.66 | 73.66 | 55.66 |
| $P_2$ x $G_2$ | 12.17 | 126.50 | 151.58 | 158.75 | 147.75 | 36.08 | 40.42 | 44.17 | 42.17 |
| $P_2$ x $G_3$ | 8.33 | 222.83 | 242.58 | 232.67 | 202.73 | 61.42 | 66.50 | 63.16 | 59.66 |
| $P_2$ x $G_4$ | 10.17 | 40.00 | 205.25 | 197.58 | 153.58 | 35.00 | 56.50 | 53.33 | 49.83 |
| $P_2$ x $G_5$ | 20.83 | 206.75 | 192.00 | 206.75 | 170.25 | 56.00 | 53.25 | 56.25 | 56.00 |
| $P_2$ x $G_6$ | 22.33 | 86.83 | 104.33 | 105.50 | 75.00 | 24.83 | 28.83 | 28.33 | 24.33 |
| $P_2$ x $G_7$ | 29.83 | 155.66 | 169.33 | 177.17 | 132.17 | 42.67 | 60.66 | 47.67 | 48.67 |
| $P_2$ x $G_8$ | 36.83 | 99.50 | 97.00 | 115.75 | 78.75 | 27.00 | 27.00 | 31.50 | 27.50 |
| $P_2$ x $G_9$ | 50.71 | 47.00 | 51.17 | 48.50 | 37.15 | 13.17 | 14.17 | 13.50 | 12.00 |
| $P_3$ x $G_1$ | 15.00 | 183.83 | 232.16 | 316.16 | 297.16 | 65.16 | 62.83 | 89.66 | 82.33 |
| $P_3$ x $G_2$ | 15.50 | 123.50 | 170.33 | 223.83 | 196.33 | 32.41 | 43.33 | 59.16 | 62.66 |
| $P_3$ x $G_3$ | 10.17 | 129.50 | 212.67 | 298.67 | 288.67 | 56.86 | 56.50 | 79.42 | 81.92 |
| $P_3$ x $G_4$ | 11.50 | 142.00 | 222.08 | 355.08 | 320.08 | 29.44 | 62.00 | 96.25 | 98.25 |
| $P_3$ x $G_5$ | 19.83 | 163.33 | 259.42 | 347.33 | 289.83 | 45.58 | 68.08 | 94.75 | 91.75 |
| $P_3$ x $G_6$ | 22.33 | 168.50 | 223.17 | 302.00 | 278.00 | 42.86 | 60.33 | 82.66 | 76.16 |
| $P_3$ x $G_7$ | 23.83 | 234.83 | 272.00 | 375.83 | 300.83 | 49.11 | 70.00 | 101.00 | 77.50 |
| $P_3$ x $G_8$ | 20.00 | 154.00 | 270.33 | 317.50 | 317.50 | 26.11 | 71.83 | 84.67 | 82.17 |
| $P_3$ x $G_9$ | 23.50 | 89.00 | 180.17 | 142.67 | 54.42 | 26.72 | 48.08 | 38.42 | 16.42 |
| CV | 13.86 | 37.41 | - | - | 22.57 | 16.96 | - | - | 23.88 |
| CD (0.05) | 6.29 | 117.02 | NS | NS | 89.54 | 32.32 | NS | NS | 28.36 |

Table 2. Effect of pruning and growth regulators on flower yield in *Jasminum sambac* L.

| Treatments | Yield during offseason (g) | Total flower yield per plant (g) | | | |
|---|---|---|---|---|---|
| | | Jan 21 | Feb 21 | Mar 21 | May 21 |
| $P_1$ x $G_1$ | 572.57 | 56.55 | 74.67 | 56.35 | 60.80 |
| $P_1$ x $G_2$ | 298.99 | 28.15 | 30.5 | 38.8 | 32.32 |
| $P_1$ x $G_3$ | 425.25 | 56.58 | 61.95 | 46.92 | 57.46 |
| $P_1$ x $G_4$ | 331.25 | 34.61 | 42.31 | 38.88 | 31.78 |
| $P_1$ x $G_5$ | 274.48 | 29.46 | 36.28 | 41.77 | 37.94 |
| $P_1$ x $G_6$ | 370.14 | 47.50 | 47.99 | 26.93 | 35.02 |
| $P_1$ x $G_7$ | 398.02 | 34.12 | 35.68 | 31.79 | 35.60 |
| $P_1$ x $G_8$ | 92.88 | 9.55 | 14.21 | 18.33 | 17.35 |
| $P_1$ x $G_9$ | 188.46 | 33.88 | 41.59 | 27.76 | 28.19 |
| $P_2$ x $G_1$ | 238.55 | 48.57 | 56.99 | 50.44 | 43.55 |
| $P_2$ x $G_2$ | 235.13 | 28.87 | 37.93 | 28.22 | 30.29 |
| $P_2$ x $G_3$ | 315.55 | 40.41 | 41.46 | 34.20 | 41.62 |
| $P_2$ x $G_4$ | 265.44 | 42.50 | 35.64 | 30.92 | 31.41 |
| $P_2$ x $G_5$ | 222.73 | 41.78 | 40.08 | 31.49 | 35.16 |
| $P_2$ x $G_6$ | 151.90 | 20.40 | 50.09 | 23.85 | 15.41 |
| $P_2$ x $G_7$ | 210.72 | 41.72 | 32.84 | 37.31 | 32.01 |
| $P_2$ x $G_8$ | 131.32 | 24.24 | 16.20 | 18.45 | 19.61 |
| $P_2$ x $G_9$ | 60.20 | 13.53 | 7.20 | 8.11 | 7.02 |
| $P_3$ x $G_1$ | 195.16 | 43.55 | 46.98 | 53.70 | 61.72 |
| $P_3$ x $G_2$ | 190.36 | 29.92 | 33.19 | 34.79 | 40.18 |
| $P_3$ x $G_3$ | 220.49 | 29.41 | 41.54 | 55.13 | 59.93 |
| $P_3$ x $G_4$ | 244.79 | 29.43 | 44.42 | 63.66 | 65.47 |
| $P_3$ x $G_5$ | 305.64 | 37.86 | 53.13 | 64.62 | 64.74 |
| $P_3$ x $G_6$ | 281.90 | 49.73 | 48.99 | 61.24 | 62.05 |
| $P_3$ x $G_7$ | 267.45 | 47.47 | 70.98 | 85.88 | 74.29 |
| $P_3$ x $G_8$ | 204.04 | 23.72 | 65.93 | 80.04 | 82.5 |
| $P_3$ x $G_9$ | 95.01 | 12.04 | 35.26 | 24.87 | 10.42 |
| CV | 17.81 | - | 29.43 | 13.20 | 25.04 |
| CD (0.05) | 92.09 | NS | 25.65 | 11.24 | 21.26 |

*Effect on number of buds per plant*

P x G interaction had a significant effect on the number of buds per plant during the months of January and April. In month of January $P_1$ x $G_1$ (pruning during last week of September along with cycocel at 1000 ppm) (313.16), $P_1$ x $G_3$ (pruning during last week of September along with paclobutrazol at 100 ppm) (258), $P_2$ x $G_1$ (pruning during last week of October along with cycocel at 1000 ppm) (211), $P_2$ x $G_5$ (pruning during last week of October along with mepiquat chloride at 150 ppm) (206.75) and $P_3$ x $G_7$ (pruning during last week of November along with $GA_3$ at 100 ppm) (234.83) were found to be on par. In the month of April, all treatments except $P_3$ x $G_2$ (pruning during the last week of November along with cycocel at 1500 ppm) and $P_3$ x $G_9$ (pruning during the last week of November without growth regulator application) were found to be significantly superior among $P_3$ x G combinations and was on par with $P_1$ x $G_1$ (pruning during last week of September along with cycocel at 1000 ppm) (311.83) and $P_1$ x $G_3$ (pruning during last week of September along with paclobutrazol at 100 ppm) (293.73) (Table 1). Paclobutrazol might have caused an increase in carbohydrate content of leaves, resulting in production and translocation of metabolites for production of flower buds. (El-Sadek, 2018). More leaf area as well as high chlorophyll content were observed under the significant treatments might have increased the rate of photosynthesis and formation of more cymes as well as flower buds.

*Effect on total flower yield per plant (g)*

A significant difference was noticed due to the interaction effect of pruning and growth regulators on total flower yield per plant. In the month of February, treatments *viz.* $P_1$ x $G_1$ (pruning during the last week of September along with cycocel at 1000 ppm) (77.66 g), $P_1$ x $G_3$ (pruning during the last week of September along with paclobutrazol at 200 ppm) (61.95 g), $P_2$ x $G_1$ (pruning during the last week of October along with cycocel at 1000 ppm) (56.99 g), $P_2$ x $G_6$ (pruning during the last week of October along with mepiquat chloride at 300 ppm) (50.10 g), $P_3$ x $G_7$ (pruning during the last week of November along with $GA_3$ at 100 ppm) (70.97 g) and $P_3$ x $G_8$ (pruning during the last week of November along with $GA_3$ at 150 ppm) (65.93 g) were found to be on par. $P_3$ x $G_7$ (pruning during the last week of November along with $GA_3$ at 100 ppm) and $P_3$ x $G_8$ (pruning during the last week of November along with $GA_3$ at 150 ppm) were on par in the month of March. In April $P_3$ x $G_1$ (pruning during the last week of November along with cycocel at 1000 ppm) (61.72 g), $P_3$ x $G_4$ (pruning during the last week of November along with paclobutrazol at 200 ppm) (65.47 g), $P_3$ x $G_5$ (pruning during the last week of November along with mepiquat chloride at 150 ppm) (64.74 g), $P_3$ x $G_6$ (pruning during the last week of November along

with mepiquat chloride at 300 ppm) (62.05 g), $P_3$ x $G_7$ (pruning during the last week of November along with $GA_3$ at 100 ppm) (74.29 g) and $P_3$ x $G_8$ (pruning during the last week of November along with $GA_3$ at 150 ppm) (82.50 g) were found to be on par. Flower yield is dependent on the number of flowering branches. Better vegetative growth and formation of large reserve food source might have lead to more yield of flowers, in treated plants when compared to control. This result agrees with the findings of Sobhana (2014) in *J. sambac. (Table* 2.).

*Effect on flower yield during offseason*

Jasmine being a seasonal crop, during offseason there is a great demand in market. Interaction of P x G was also found to have a significant effect with respect to flower yield during the offseason. $P_1$ x $G_1$ (pruning during the last week of September along with cycocel at 1000 ppm) gave a higher yield (572. 57 g) when compared with other treatment combinations (Table 2.). The lowest yield was noticed in $P_2$ x $G_9$ (pruning during the last week of October without application of growth regulators) (60.19 g). Flower yield is dependent on the number of flowering branches. Production of more foliage in September and November pruned plants might have resulted in increased photosynthesis and ultimately large reserve food source leading to production of more number of flowers (Kumaresan et al., 2017). Moreover, application of cycocel resulted in reduction of endogenous gibberellin which is a prerequisite for flower induction in flowering plants, when combined with early pruning (pruning during last week of September) gave sufficient time period for the plant to put energy into vegetative production and later flower production which can be stated as reason for more flower yield during off season in $P_1$ x G1 combination. Further it would have favoured the factors influencing floral initiation during peak season *ie*., carbohydrate pathway and photoperiodic pathway with $GA_3$ pathway (Dhanasekharan, 2018).Similar results were noticed in studies conducted by Nair et al. (2009), Jennoah (2012) and Kalaimani et al. (2018) in *Jasminum sambac.*

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