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# Effect of physical and chemical interventions on flowering and quality parameters of jasmine (*Jasminum sambac* Ait.) cv. Ramanathapuram Gundumalli during off season

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**Abstract**
A field experiment was conducted at the Department of Horticulture, Agricultural College and Research Institute, Madurai, Tamil Nadu Agricultural University during 2017-2018 to study the effect of physical and chemical interventions on flowering and quality parameters of *Jasminum sambac* Ait. cv. Ramanathapuram Gundumalli during off season (Nov-Feb). The experiment was laid out in Randomized Block Design (RBD) with six treatment combinations. Among the treatment combinations the plants treated with 0.5% Thiourea along with pruning during last week of September significantly increased flowering and quality parameters *viz*., days taken to initiate flowering (29 days), diameter of the flower buds (2.91 cm), corolla tube length (1.22 cm), total flower bud length (2.53 cm), number of cymes plant$^{-1}$ (104.25), number of flower buds plant$^{-1}$ (230.43), yield (55.60 g/plant), individual flower bud weight (0.2931 g) and freshness index under refrigerated condition (47.70%) in *Jasminum sambac*.

**Keywords:** pruning, off season, Thiourea, Ramanathapuram Gundumalli and freshness index

## Introduction
Jasmine (*Jasminum sambac* Ait.) stands first among the fragrant loose flowers. Jasmine is a very important group of plants which is extensively cultivated in India especially in Tamil Nadu. India is one of the centers of origin of jasmine. The white and fragrant flowers of jasmine are symbol of purity, eternal love, nobility and also symbolizes the beauty of a girl. It is offered to God and used for worshiping and hence, these are preferably planted in Hindu temple garden and Moghul gardens. Jasmine (*Jasminum sambac* Ait.) belongs to family Oleaceae and is of about 200 species which are mainly shrubs and climbers (Taj & Naik, 2013) [1]. The term jasmine is probably derived from the Persian name "Yasmyn" and Arabic word "*Jessamine*" meaning "fragrance" (Bailey, 1947) [2]. Jasmine is cultivated commercially for its fresh flowers and it is used for various purposes viz., making bouquet, decorating hair by women, religious offerings *etc.* It is also used for extract of Jasmine concrete which is used in cosmetics and perfumery industries. In China, *Jasminum sambac* flowers are used for flavoring (Gao *et al*., 2011) [3]. Jasmine oil has a wide range of medicinal applications and is used in perfumery, soaps, flavouring and cosmetic industry.

Jasmine require temperature of 27–32°C during day time and 21–27°C at night is ideal for good flowering. In off season temperature between 15 and 17°C during night shuts the flowering for a week (Leonhardt and Teves, 2002) [4]. Low winter temperature causes ultra-structural cellular changes in single whorled cultivars of *Jasminum sambac* and reduction in quality of flower (Su and Wang, 2001) [5]. Pruning (Physical intervention) is a cultural operation being followed in jasmine. It is a useful method since antique times for restarting growth of plants (Parsons, 1956) [6]. As a result of pruning, number of new shoots get increased which resulted in increased flower quality by activation of physiological activity. Plant growth and differentiation are regulated by phytohormones that presumably exert their influence on particular metabolic reactions in the target tissue *via* receptor molecules. Besides the natural phytohormones, a group of off season inducing chemicals modifies the plant in its growth and developmental behaviour without inducing phytotoxic or malformative effects.

It has been reported that the demand for jasmine is increasing due to its unique fragrance but there is a huge demand-supply gap of fresh flowers during off season. During regular season, the cost of flower is between Rs. 40-120/kg. During the off season the cost of flower increases

ten to fifteen times than normal price. This results in scarcity during the lean season and glut during the peak season creating a wide fluctuation in price. The present research on induction of off season flowering in Gundumalli through physical and chemical interventions *ie*. Pruning and application of off season flower inducing chemicals helps in improving the economic status of jasmine growers and will meet the increased demand of flowers during the auspicious occasions in South India.

**Materials and Methods**

The experiment was laid out in Randomized Block design with four replications and six treatments. Pruning was done at a height of 45 cm above the ground level during last week of September. After pruning, fertilizers were applied at the rate of 2.5 kg farmyard manure (FYM) and 60:120:120g NPK plant$^{-1}$ in 2 splits (1/2 N+ full P: K at pruning and remaining 1/2 N was applied after first flush of flowering). Crop was irrigated once in a week depending upon the water requirement. The pruning operation was done in four years old plants manually with pruning shears. Pruning is done in the last week of September, 2017. Pruning along with 1.5% potassium nitrate ($T_1$), 200 ppm nitrobenzene ($T_2$), 0.5% thiourea ($T_4$), 100 ppm ethrel ($T_5$) were applied as foliar spraying and 300 ppm paclobutrazol ($T_3$) was applied as soil drenching and control (Pruning alone) ($T_6$). Drenching and spraying was done 20 days after pruning, when the plants attain sufficient number of fresh leaves and the freshly prepared paclobutrazol was drenched at 10 cm from the nearby areas and hand sprayer was used for spraying plants. Foliar spray was given once in fifteen days upto the end of February (off season). The treated plants were observed for flowering and quality parameters *viz*., diameter of the flower buds (mm), corolla tube length (cm) and weight of hundred flower buds (g) were taken at monthly intervals. The data were subjected to analysis of variance (ANOVA), and the mean values were compared using standard procedures of (Gomez and Gomez, 1984) [7] at P=0.05 level.

**Results and Discussion**

The results indicated that, pruning + 0.5% Thiourea ($T_4$) applied as foliar spray took 29 days to initiate flowering. Number of days for first flowering is an important criterion that governs the earliness of a crop. It is influenced by diverse factors like genetic, environmental, physiological, nutritional, hormonal and cultural. Pruning done at right time and in specific amount provide fuel for the initiation of flowering by sufficient ventilation leading to least susceptibility of plant to diseases.

This might be attributed to the fact that the environmental conditions associated with the month of September would have been favourable for inducing the required metabolic and physiological processes needed for the flower bud initiation. The variations in bud initiation may also be due to influence of solar radiation and temperature as reported by (Harris & Scott, 1969) [8] in carnation, (Nair *et al*., 2009) [9], (Jennoah, 2012) [10] in *Jasminum sambac*.

These results may be due to the fact that plants treated with thiourea have built up sufficient food reserves at initial stages due to suppression of apical dominance, increased number of leaves and mobility of photosynthates from source to sink. This reserve food has been utilized for reproductive purpose with a restriction on vegetative growth which decreases days to flowering. This trend is in concurrence with the findings of (Kalicharan, 2012) [11] in Moringa. It also accumulates more carbohydrate in plant body which leads to early flower bud initiation as well as bud opening, later which results in lengthening of flowering span in annual chrysanthemum (Sainath, 2009) [12]. Further support for this observation comes from earlier bud formation and flower picking report of (GuruSaraswathi.M, 2002) [13] in *J. sambac*, who observed that advanced bud formation and onset of flowering may be due to enhanced growth, differentiation and induction of flower primordial at lower nodes. Earlier cessation of vegetative phase and initial spurt in net assimilation rate, crop growth rate and dry matter production could have contributed to the advancement of flowering. This was concurred with the observations reported by (Velmurugan & Vadivel, 2003) [14], (Gupta & Sharma, 1972) [15].

Diameter of the flower buds varied significantly among all the treatments. Treatment $T_4$ (Pruning + 0.5% Thiourea) showed flowed flower bud diameter of around 2.91 cm during December. The total flower bud length and corolla tube length varied significantly. The highest total flower bud length of 2.53 cm found in $T_4$ (Pruning + 0.5% Thiourea) during February and the highest corolla tube length of 1.22 cm found in $T_4$ (Pruning + 0.5% Thiourea) during February. This might be due to the environmental factors, better vegetative growth and the production of larger quantities of reserve food in the plants during November to February sprayed plants compared to the plants sprayed during other months.

The number of cymes per plant varied significantly among all the treatments. In January the highest number of cymes/plant was recorded in $T_4$ (Pruning + 0.5 % Thiourea) with 104.25. This may be due to the fact that nitrogen is a major nutrient which is responsible for carrying out several metabolite activities in plants and influencing in the vegetative growth of plant and in turn their increased number of flowers. These results are in agreement with the findings of (Nijjar & Rehalia, 1977) [16] in rose, (Gupta & Sharma, 1972) [15], (Arkhangel'skij, Smirnov, & Arkhangel'skaya, 1975)[17], (Hopping, 1977) [18], (Snir, 1983) [19] in raspberry, (Sahu & Singh, 1995) [20].

It is also due to the production of more number of leaves in September pruned plants resulting in increased photosynthesis and a large reserve food source leading to production of more number of cymes and flower buds per plant as reported by (Abdou & Badran, 2003) [21] and (Nair *et al*., 2009) [9] in *Jasminum sambac*. This might be due to higher production of photosynthates resulting in increased production of cymes, flower buds per cyme and thereby increased yield per plant. The conducive climatic condition would also have improved the cymes and flower buds as reported by (Jennoah, 2012) [10] in *Jasminum sambac*.

Number of flower buds per plant varied significantly among all the treatments. The highest number of flower buds/plant of 230.43 was found in T4 (Pruning + 0.5 % Thiourea) during February. This increase in number of flowers per plant might be due to increased number of branches which ultimately enhanced the flower production. Increase in flower yield might be due to reduced plant height by suppressing the apical dominance, increased the main and secondary branching, thereby increasing the flower number which ultimately resulted in increased yield. The results are in conformity with the findings of (Kanthaswamy, 2006) [22] in Moringa. The highest individual flower bud weight of 0.2931 g was found in T4 (Pruning + 0.5 % Thiourea) during February. Plants pruned during last week of September increased the flower bud weight. Pruned plants produced more number of leaves per branch and increased the plant spread that would have

helped for maximum absorbtion of solar energy leading for higher photosynthesis. This in turn is responsible for increased flower bud weight. The results are in conformity with (A. H. a. U. G. N. Hugar, 1994) [23] in *Jasminum auriculatum* and (Jennoah, 2012) [10] in *Jasminum sambac*. The plants which pruned before start of winter season produced maximum fresh weight of flowers as reported by (Nair *et al*., 2009) [9] in *Jasminum sambac* who concluded that plants pruned in early winter season produced maximum fresh weight of flowers. The increase in flower bud weight maybe due to better translocation of photosynthates by shortening the plant size. The efficiency of translocation depends on the distance between the source and sink and it is inversely related i.e., shorter the distance, better will be the translocation and vice versa (Pando & Srivastava, 1987) [24], (Patil & Dhomne, 1997) [25].

The flower yield varied significantly among all the treatments. The highest flower yield of 55.60 g/plant was found in $T_4$ (Pruning + 0.5 % Thiourea) during February. Foliar spray at vegetative and flowering stages with different concentration of thiourea also influences the crop growth, yield and quality. The variation in bud break along the length is typically the consequence of apical dominance where the terminal bud develops at the expense of adjacent lateral buds. This is in accordance with the results of (Weaver *et al*., 1961) [26] (Biggs, 1966) [27]; (Erez *et al.*, 1971) [28] in grapes and (Balasubrahmanyam, Khanduja, & Abbas, 1975), (Hopping, 1977) [30], (Jagetiya & Kaur, 2006) [31] (Khandelwal *et al*., 2002) [32] in henna, (Garg, Burmin, & Kathju, 2005) [33] in cluster beans. During off season from December to February, the plants received optimum temperature and relative humidity. It was helpful to increase the cyme and flower buds in these months. Finally the plants recorded highest yield in the month of February, because the plants experienced higher heat units and clear sunshine during their ontogeny, while rainy and winter season had experienced cloudy weather and low temperature regimes, as reported by (Nair *et al.*, 2009) [9] in *Jasminum sambac*.

Freshness index was recorded on a daily basis. During day 13, treatment $T_4$ (Pruning + 0.5% Thiourea) showed maximum freshness index of about 47.70% under refrigerated condition in 200 gauge PE bags. It may also be due to the compound thiourea which exhibited cytokinin like activity, the substances with high cytokinin activity also brought about increased accumulation of N in *Raphanus sativus* (Vassilev & Mashev, 1974) [34]. In the present study, a respiratory climacteric rise from the initial level and a decline thereafter was noticed with all the treatments. With regard to *J. sambac* under ambient conditions a similar trend was noticed, recording minimum rate of respiration rate and sufficient amount of carbohydrate levels. These significant levels of carbohydrates might have served as the substrate for respiration for a longer duration.

Moreover, increased respiratory activity leads to the formation of free radicals with high oxidation potential and these free radicals have been found to promote senescence in the tissues, associated with an increased sensitivity to ethylene (Baker, Want, Lieberman, & Hardenburg, 1977) [35], (Kar & Mishra, 1976) [36]. Also it was observed that as the flowers started showing symptoms of wilting, there was a rise in level of ethylene emission rate. Since no reports were available on Jasminum spp. with respect to ethylene evolution, however some records on wilting of flowers other than Jasmine caused by ethylene had been discussed (Torre *et al*., 1999) [37].

## Conclusion

From the above results, it was concluded that, the September pruning along with application of Thiourea 0.5% as foliar spray at an interval of 15 days upto February can be recommended to enhance the growth, yield and quality of *Jasminum sambac* Ait. cv. Ramanathapuram Gundumalli during off season production (November to February)

**Table 1:** Effect of physical and chemical interventions on days taken for first flowering of jasmine (*Jasminum sambac* Ait.) cv. Ramanathapuram Gundumalli during off Season

| Treatments | Days |
|---|---|
| T1 | 30.88 |
| T2 | 30.25 |
| T3 | 30.31 |
| T4 | 29.00 |
| T5 | 31.88 |
| T6 | 29.63 |
| Mean | 30.33 |
| $SE_d$ | 0.4822 |
| CD(p=0.05) | 1.0279** |

Where T1 - Pruning + 1.5% Potassium nitrate
T2 - Pruning + 200 ppm Nitrobenzene
T3 - Pruning + 300 ppm Paclobutrazol
T4 - Pruning + 0.5% Thiourea
T5 - Pruning + 100 ppm Ethrel
T6 - Pruning + Control

**Table 2:** Effect of physical and chemical interventions on diameter of the flower bud of jasmine (*Jasminum sambac* Ait.) cv. Ramanathapuram Gundumalli during off season

| Treatments | Nov | Dec | Jan | Feb |
|---|---|---|---|---|
| T1 | 2.71 | 2.68 | 2.71 | 2.72 |
| T2 | 2.26 | 2.31 | 2.24 | 2.25 |
| T3 | 2.58 | 2.61 | 2.56 | 2.59 |
| T4 | 2.81 | 2.91 | 2.85 | 2.79 |
| T5 | 2.15 | 2.19 | 2.18 | 2.20 |
| T6 | 2.55 | 2.57 | 2.59 | 2.61 |
| Mean | 2.51 | 2.55 | 2.52 | 2.53 |
| $SE_d$ | 0.1069 | 0.1956 | 0.1509 | 0.1510 |
| CD(p=0.05) | 0.2279** | 0.4170* | 0.3216** | 0.3218** |

**Table 3:** Effect of physical and chemical interventions on corolla tube length of jasmine (*Jasminum sambac* Ait.) cv. Ramanathapuram Gundumalli during off season

| Treatments | Nov | Dec | Jan | Feb |
|---|---|---|---|---|
| T1 | 1.16 | 1.18 | 1.12 | 1.21 |
| T2 | 1.15 | 1.06 | 1.07 | 1.18 |
| T3 | 1.14 | 1.08 | 1.06 | 1.19 |
| T4 | 1.18 | 1.20 | 1.16 | 1.22 |
| T5 | 1.05 | 1.05 | 0.99 | 1.16 |
| T6 | 1.12 | 1.13 | 1.10 | 1.18 |
| Mean | 1.13 | 1.12 | 1.08 | 1.19 |
| $SE_d$ | 0.0299 | 0.0116 | 0.0254 | 0.0076 |
| CD(p=0.05) | 0.0636** | 0.0246** | 0.0541** | 0.0163** |

**Table 4:** Effect of physical and chemical interventions on total flower bud length of jasmine (*Jasminum sambac* Ait.) cv. Ramanathapuram Gundumalli during off season

| Treatments | Nov | Dec | Jan | Feb |
|---|---|---|---|---|
| T1 | 2.38 | 2.38 | 2.36 | 2.44 |
| T2 | 2.33 | 2.35 | 2.28 | 2.35 |
| T3 | 2.32 | 2.38 | 2.30 | 2.39 |
| T4 | 2.42 | 2.51 | 2.42 | 2.53 |
| T5 | 2.15 | 2.26 | 2.09 | 2.22 |
| T6 | 2.28 | 2.31 | 2.26 | 2.38 |
| Mean | 2.31 | 2.37 | 2.29 | 2.39 |
| $SE_d$ | 0.0658 | 0.0317 | 0.0392 | 0.0416 |
| CD(p=0.05) | 0.1402* | 0.0676** | 0.0836** | 0.0887** |

**Table 5:** Effect of physical and chemical interventions on number of cymes plant$^{-1}$ of jasmine (*Jasminum sambac* Ait.) cv. Ramanathapuram Gundumalli during off Season

| Treatments | Nov | Dec | Jan | Feb |
|---|---|---|---|---|
| T1 | 6.50 | 35.56 | 39.63 | 26.94 |
| T2 | 8.56 | 52.19 | 53.94 | 52.44 |
| T3 | 8.75 | 64.00 | 85.81 | 55.13 |
| T4 | 9.75 | 82.81 | 104.25 | 61.75 |
| T5 | 4.06 | 31.88 | 36.00 | 23.00 |
| T6 | 7.06 | 43.63 | 48.69 | 37.25 |
| Mean | 7.45 | 51.68 | 61.39 | 42.75 |
| $SE_d$ | 0.6305 | 2.1215 | 2.3001 | 1.6458 |
| CD(p=0.05) | 1.3438** | 4.5220** | 4.9026** | 3.5080** |

**Table 6:** Effect of physical and chemical interventions on number of flower buds plant$^{-1}$ of jasmine (*Jasminum sambac* Ait.) cv. Ramanathapuram Gundumalli during off Season

| Treatments | Nov | Dec | Jan | Feb |
|---|---|---|---|---|
| T1 | 188.46 | 192.31 | 195.88 | 193.58 |
| T2 | 161.05 | 165.79 | 166.54 | 167.06 |
| T3 | 141.57 | 143.86 | 145.20 | 153.26 |
| T4 | 218.50 | 225.17 | 229.37 | 230.43 |
| T5 | 129.33 | 130.28 | 131.75 | 129.47 |
| T6 | 133.47 | 137.28 | 138.59 | 139.19 |
| Mean | 162.06 | 165.78 | 167.89 | 168.83 |
| $SE_d$ | 2.7821 | 2.8208 | 2.6416 | 2.7818 |
| CD(p=0.05) | 5.9299** | 6.0125** | 5.6305** | 5.9293** |

**Table 7:** Effect of physical and chemical interventions on yield of jasmine (*Jasminum sambac* Ait.) cv. Ramanathapuram Gundumalli during off Season

| Treatments | Nov | Dec | Jan | Feb |
|---|---|---|---|---|
| T1 | 41.50 | 42.25 | 44.88 | 46.63 |
| T2 | 35.75 | 36.25 | 37.50 | 38.97 |
| T3 | 28.00 | 29.75 | 31.13 | 32.52 |
| T4 | 47.50 | 52.50 | 53.25 | 55.60 |
| T5 | 15.50 | 16.38 | 18.04 | 19.76 |
| T6 | 23.00 | 24.13 | 25.81 | 28.65 |
| Mean | 31.88 | 33.54 | 35.10 | 37.02 |
| $SE_d$ | 2.1314 | 2.6331 | 1.4043 | 2.3053 |
| CD(p=0.05) | 4.5431** | 5.6124** | 2.9932** | 4.9137** |

**Table 8:** Effect of physical and chemical interventions on individual flower bud weight of jasmine (*Jasminum sambac* Ait.) cv. Ramanathapuram Gundumalli during off Season

| Treatments | Nov | Dec | Jan | Feb |
|---|---|---|---|---|
| T1 | 0.2475 | 0.2488 | 0.2494 | 0.2456 |
| T2 | 0.2618 | 0.2638 | 0.2619 | 0.2738 |
| T3 | 0.2650 | 0.2694 | 0.2706 | 0.2850 |
| T4 | 0.2874 | 0.2911 | 0.2924 | 0.2931 |
| T5 | 0.2114 | 0.2120 | 0.2132 | 0.2262 |
| T6 | 0.2794 | 0.2825 | 0.2831 | 0.2844 |
| Mean | 0.2588 | 0.2613 | 0.2618 | 0.2680 |
| $SE_d$ | 0.0141 | 0.0129 | 0.0107 | 0.0102 |
| CD(p=0.05) | 0.0300** | 0.0275** | 0.0229** | 0.0217** |

**Table 9:** Effect of physical and chemical interventions on freshness index (%) at refrigerated condition without vent of jasmine (*Jasminum sambac* Ait.) cv. Ramanathapuram Gundumalli during off Season

| Trt | Day 0 | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7 | Day 8 | Day 9 | Day 10 | Day 11 | Day 12 | Day 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T1 | 100 | 98.81 | 98.41 | 97.62 | 97.42 | 96.62 | 96.43 | 92.46 | 87.90 | 87.50 | 87.10 | 64.88 | 45.67 | 43.45 |
| T2 | 100 | 98.50 | 97.99 | 97.94 | 97.24 | 57.14 | 56.89 | 55.39 | 47.81 | 43.45 | 38.88 | 31.54 | 28.74 | 14.29 |
| T3 | 100 | 93.54 | 91.84 | 89.80 | 88.78 | 86.39 | 85.37 | 79.59 | 79.36 | 79.14 | 77.14 | 68.71 | 28.23 | 27.89 |
| T4 | 100 | 99.31 | 95.16 | 93.55 | 93.32 | 91.01 | 77.42 | 67.28 | 66.36 | 59.91 | 59.22 | 57.37 | 57.33 | 47.70 |
| T5 | 100 | 90.71 | 87.86 | 87.14 | 86.50 | 82.86 | 67.86 | 56.43 | 50.71 | 12.14 | 0 | 0 | 0 | 0 |
| T6 | 100 | 96.96 | 92.71 | 87.23 | 86.32 | 85.41 | 79.94 | 66.57 | 54.41 | 46.50 | 42.86 | 31.31 | 14.29 | 0 |
| Mean | 100.00 | 96.31 | 94.00 | 92.21 | 91.60 | 83.24 | 77.32 | 69.62 | 64.43 | 54.77 | 50.87 | 42.30 | 29.04 | 22.22 |
| $SE_d$ | 1.2216 | 1.2593 | 1.7966 | 0.6834 | 1.0110 | 1.5162 | 1.1736 | 0.6820 | 0.9118 | 0.7775 | 0.9643 | 0.5094 | 0.5376 | 0.4889 |
| CD(p=0.05) | 2.6038 | 2.6841** | 3.8295** | 1.4567** | 2.1549** | 3.2317** | 2.5016** | 1.4536** | 1.9436** | 1.6573** | 2.0555** | 1.0858** | 1.1458** | 1.0421** |

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