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Influence of time of pruning and plant growth retardants on growth and off season flower production in *Jasminum sambac* (L.)

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Abstract
An experiment was conducted at the Botanic Gardens, Department of Floriculture and Landscaping, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore during 2016 - 2017 to study the influence of time of pruning and plant growth retardants on growth and off-season flower production in *Jasminum sambac* (L.). The study was conducted using Factorial Randomized Block Design (FRBD). The results revealed that the plant spread (73.21 cm), number of primary branches (12.90), number of secondary branches (31.90) and number of flower buds per cyme (7.70), weight of 100 flower buds (28.00 g), flower yield per plant (222.47 g) and flower yield per ha (1423.81 kg) registered its superiority in the plants pruned during last week of September with the combination of foliar spray of mepiquat chloride @ 150 ppm. However, increased plant height (96.05 cm) recorded in the plants pruned during last week of August without any growth retardant spray. With respect to earliness in flowering, the number of days taken for first harvest of flower buds was registered earliest (28.00 days) in the plants pruned during last week of September along with foliar spray of mepiquat chloride @ 50 ppm. Thus, plants pruned during last week of September along with the foliar spray of mepiquat chloride @ 150 ppm not only enhanced many growth parameters but also increased the flower production during off season (December - February) which enable the growers to obtain premium price in the market, during off season.

Keywords: Jasmine, pruning, growth retardants, performance, off season

1. Introduction
Jasmine is one of the oldest fragrant flowers belongs to the family Oleaceae and is native to India, China and Iran (Ambika, 2012) [1]. In *Jasminum sambac*, the economic yield starts from the month of March and continuous up to August. The flower production is reduced during winter months, leading to hike in price, which can be termed as “off season”. There is no continuous and uniform supply of flowers to the market during this period because of the peculiar flowering habit. Apart from the low production, the quality of flowers also found to be poor during off season. This trend results in scarcity of flower arrival to market during the lean months and glut during the peak season creating a wide fluctuation in price, demand and supply. In jasmine, flowering habit is terminal and axillary. Hence, increasing the number of shoots per plant is essential which ultimately would increase the yield for which pruning is required. It is done to maintain the growth and vigour of the plants. By pruning the crop, the vegetative and flowering phase can be balanced. The factors which influence the growth and yield of plants are mainly of genetic and cultivation management practices Sujatha *et al.* (2009) [2]. Plant growth retardants modify the plant physiological processes within the plant, which ultimately suppress the plant growth and development, improve the flower production (Joshi and Reddy, 2006) [3]. Hence, considering the above facts the present research has been carried out to find out an ideal time of pruning and identifying a suitable growth retardant for increasing the growth and yield in Gundumalli.

2. Materials and Methods
The experiment was conducted at the Botanic Gardens, Department of Floriculture and Landscaping, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore. A variety chosen for this study is a local type of Gundu Malli (*Jasminum sambac* L. cv. Ramanathapuram gundumalli). This experiment was carried out in

Factorial Randomized Block Design, replicated twice with four different time of pruning along with foliar spray of plant growth retardants. The rooted cuttings were planted in the main field with the spacing of 1.25 × 1.25 m. Recommended dose of NPK (60: 120: 120 g per plant per year) and other inputs were applied at appropriate time. Irrigation was withheld for 2-3 days before pruning. In this study, pruning operation was done during last week of every month starting from August to November in two year old plants as per the treatment schedule. It was done at the height of 45 cm above the ground level. The plant growth retardants *viz*., chloro choline chloride @ 500, 1000 and 1500 ppm, paclobutrazol @ 100, 200 and 300 ppm, mepiquat chloride @ 50, 100 and 150 ppm were used. Chloro choline chloride and mepiquat Chloride were applied as foliar spray and paclobutrazol was applied as soil drenching to the respective plots as per treatment schedule on fifteen days after pruning. Observations made on the important plant growth parameters *viz*., plant height (cm), plant spread (cm)**,** number of primary branches per plant, number of secondary shoots per plant and yield parameters *viz.*, days taken for first harvest of flower bud, number of flowers per cyme, weight of 100 flower buds, flower yield per plant (g) and estimated flower yield per ha (kg) in five randomly selected and tagged plants per replication in each treatment. The statistical analysis was done following the method of Panse and Sukhatme (1978) [4].

3. Research findings and Discussion

3.1. Influence of pruning and plant growth retardants on vegetative growth parameters

The results from Fig. 1 and Table 1 indicated that the interaction effect of different time of pruning and plant growth retardants was found significant in all the growth parameters *viz*., plant height, plant spread, number of primary branches per plant and number of secondary branches per plant during the off season (December to February).

The data presented in Fig. 1. For the plant height showed that the treatment combination P_1T_{10} (pruning during last week of August without any growth retardant spray) registered the tallest plants (96.05 cm). The next best treatment for increased plant height was P_2T_{10} (pruning during last week of September without any growth retardant spray) which registered values of 83.07 cm. The effect of early pruning during August last week to make the plants being able to receive longer photoperiodic stimulus than the late pruned ones where the day lengths were shorter and there was a drastic reduction in the mean temperatures which resulted in stunted growth is in agreement with the findings of Sujatha *et al*. (2009) [2], Jennoah, 2012 [5] in *Jasminum sambac*. Whereas P_4T_6 (pruning during last week of November with paclobutrazol drenching) produced the shortest plants (57.83 cm) at flowering stage. This might be due to the effect of paclobutrazol, an anti - gibberellin compound which restrict the cell enlargement. This finding is in consonance with the result of Kumaresan, 2016 [6] in *Jasminum sambac.*

A perusal of data presented in Table 1 clearly indicated that significant differences with respect to vegetative parameters (plant spread, number of primary branches and secondary branches per plant) observed during the interaction effect of pruning and application of plant growth retardants.

Among the interaction effects, maximum plant spread (73.21 cm), number of primary branches (12.90) and number of secondary branches per plant (31.90) were observed in P_2T_9 (pruning during last week of September with the foliar spray of MC @ 150 ppm) followed by P_1T_9 (pruning during last week of August with the foliar spray of MC @ 150 ppm) which recorded values of 63.92 cm, 11.20 and 27.10 respectively and was on par with P_3T_6 (pruning during last week of October with PBZ @ 300 ppm) registered the values of 61.80 cm, 11.00 and 27.00. Whereas in P_4T_{10} (pruning during last week of November without any growth retardant spray) plants produced the minimum plant spread (37.28 cm), primary branches (5.00) and secondary branches per plant (17.50) at flowering stage.

Pruning treatments significantly increased the plant spread which might be due to suppression of apical dominance that produced greater number of main and lateral branches, resulting in increased plant spread in both the directions was observed by Kumaresan, 2016 [6] in *Jasminum sambac*.. Due to the effect of application of growth retardants the biosynthesis of gibberellins get inhibited, which is a hormone that promotes cell elongation. With reduced concentration of gibberellins, there is less elongation of cells in the stem which restrict the vertical growth and increased the plant spread in both the directions due to the suppression of apical dominance.

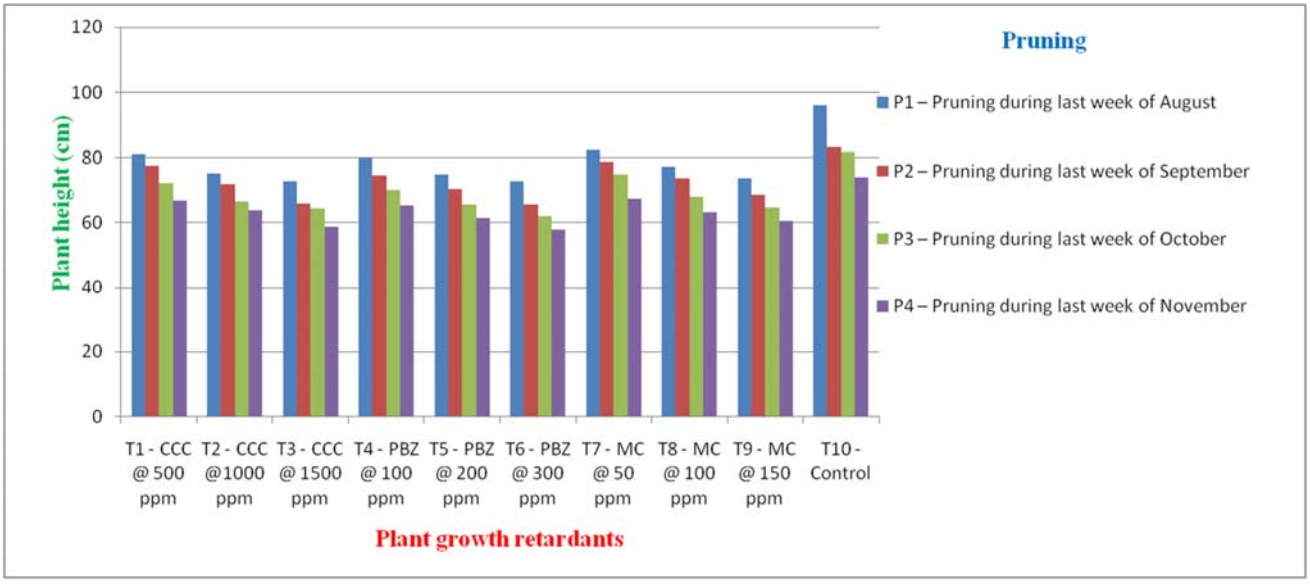

Fig 1: Influence of pruning and plant growth retardants on plant height in *Jasminum Sambac* L. during off season (December to February)

This favours for the production of primary and secondary branches. These findings are in accordance with the findings of Muthuswami *et al.* (1973) [7], Ratikanath *et al*. (2005) [8], Krishnamoorthy, 2014 [9] in *Jasminum sambac*, Mendhe *et al.* (2011) [10] in *Rosa indica* (L.) cv. Gladiator, Kashid *et al.*, 2010 [11] in sunflower, Rajesh *et al.*, 2014 [12] in green gram, Kalicharan, 2012 [13] and Kanthasamy 2006 [14] in moringa.

Table 1: Influence of pruning and plant growth retardants on vegetative parameters of *Jasminum Sambac* L. during off season (December to February)

Treatments	Plant spread (cm)				Mean	Primary branches				Mean	Secondary branches				Mean
	P_1	P_2	P_3	P_4		P_1	P_2	P_3	P_4		P_1	P_2	P_3	P_4	
T_1 - CCC @ 500 ppm	47.09	58.07	45.79	44.01	48.74	8.50	9.70	7.30	6.40	7.98	22.90	24.50	20.90	19.80	22.02
T_2 – CCC @ 1000 ppm	49.65	60.22	47.92	46.30	51.02	9.00	10.50	8.00	7.00	8.63	24.00	25.30	23.00	21.70	23.51
T_3 - CCC @ 1500 ppm	51.87	61.80	50.60	49.06	53.33	9.80	11.00	8.70	7.60	9.28	25.30	27.00	24.80	22.80	24.97
T_4 - PBZ @ 100 ppm	45.99	56.78	43.54	42.19	47.12	8.30	9.30	7.10	6.20	7.73	22.60	24.00	20.10	19.40	21.52
T_5 - PBZ @ 200 ppm	48.31	59.33	46.70	45.35	49.92	8.80	10.40	7.90	6.80	8.48	23.50	24.80	22.50	21.30	23.02
T_6 - PBZ @ 300 ppm	51.05	61.73	49.35	47.71	52.46	9.50	10.80	8.40	7.40	9.03	25.00	26.30	24.20	22.60	24.52
T_7 - MC @ 50 ppm	47.83	58.68	45.07	44.67	49.06	8.60	10.20	7.60	6.60	8.25	23.00	24.90	21.80	21.00	22.68
T_8 - MC @ 100 ppm	49.77	61.01	48.84	46.68	51.57	9.30	10.70	8.30	7.20	8.88	24.60	25.60	23.60	22.50	24.08
T_9 - MC @ 150 ppm	63.92	73.21	58.94	57.03	63.27	11.20	12.90	9.70	8.90	10.68	27.10	31.90	26.40	25.60	27.75
T_{10} - Control	43.00	54.01	40.52	37.28	43.70	7.90	8.70	6.90	5.00	7.13	19.80	22.40	18.80	17.50	19.62
Mean	49.84	60.48	47.72	46.03		9.09	10.42	7.99	6.91		23.78	25.67	22.61	21.43	
	SEd		CD (P=0.05)			SEd		CD(P=0.05)			SEd		CD (P=0.05)		
P	1.44		2.91			0.22		0.46			0.24		0.49		
T	2.28		4.61			0.35		0.72			0.39		0.78		
P×T	4.56		9.22			0.71		1.45			0.78		1.57		

P1 – Pruning during last week of August P3 – Pruning during last week of October
P2 – Pruning during last week of September P4 – Pruning during last week of November

3.2. Influence of pruning and plant growth retardants on flowering parameters

From the results presented in Fig. 2, 3 and Table 2 it is observed that the interaction effect of pruning and plant growth retardants on flowering parameters (days taken for first harvest of flower bud, number of flowers per cymes, weight of 100 flower buds, flower yield per plant and estimated flower yield per ha) were found to be significant.

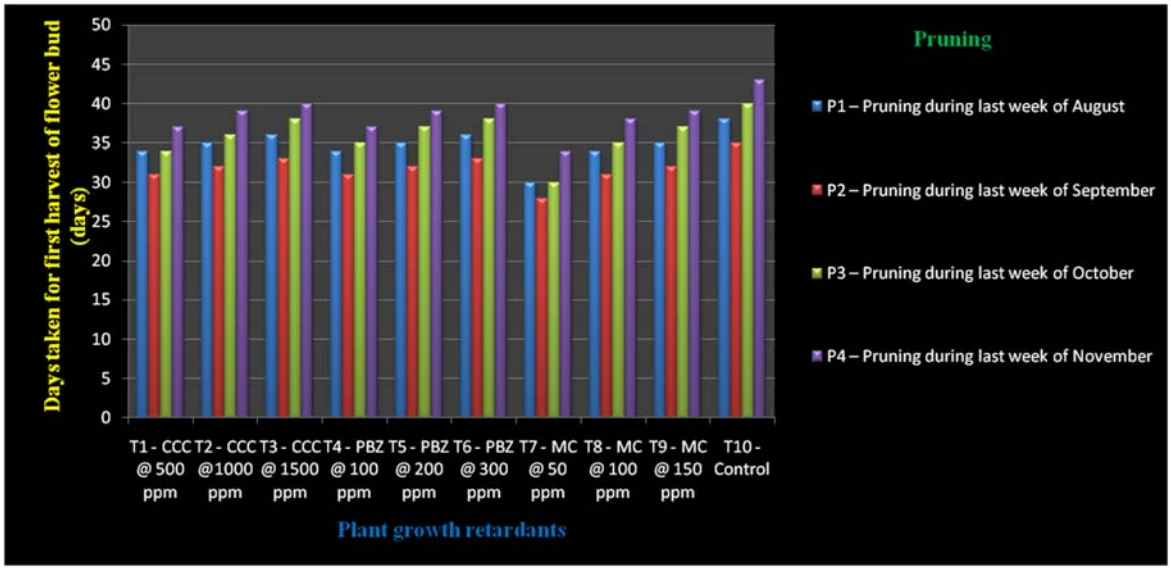

Fig 2: Influence of pruning and plant growth retardants on days taken for first harvest of flower buds in *Jasminum Sambac* L. during off season (December to February)

The mean earliest days taken for first harvest of flower buds (28.00 days) was observed in P_2T_7 (pruning during last week of September with foliar spray of MC @ 50 ppm) followed by P_1T_7 (pruning during last week of August with foliar spray of MC @ 50 ppm). The increased number of flower buds per cyme (7.70), weight of 100 flower buds (28.00 g), flower yield per plant (222. 47 g) and estimated flower yield per ha (1423.81 kg) during off season were observed in P_2T_9. The next best treatment was P_1T_9 (pruning during last week of August with foliar spray MC @ 150 ppm which registered 6.70 flower buds per cyme, 100 flower buds weighing 24.20 g, flower yield of 192.64 g per plant and an estimated flower yield of 1232.90 kg per ha. The treatment P_4T_{10} (pruning during last week of November in control plants without any growth retardant spray) longest days taken for first harvest of flower buds (43.00 days), minimum number of flower buds per cyme (3.40), weight of 100 flower buds (15.70 g), flower bud yield per plant (52.62 g) and flower yield per ha (336.77 kg) were observed.

More number of branches ultimately resulted in increased yield of flower buds. Thus, it appears that flower yield depends on number of branches. Due to the production of

more number of leaves in September pruned plants, resulted in increased photosynthesis and ultimately a large reserve food source leading to production of more number of flowers as supported from the evidence of Sujatha *et al.* (2009) [2] and Jennoah, 2012 [5] in *Jasminum sambac*. The application of mepiquat chloride resulted in early flowering because it redirects carbohydrates away from vegetative to reproductive growth. The more number of branches and maximum plant spread in this treatment would have accumulated more carbohydrates through photosynthesis and were directly used for the production of more number of flowers which ultimately resulted in increased yield (Walter, *et al*., 1980 [15]; York, 1983 [16] and Kerby, 1985 [17]) in Cotton. The increase in number of flower buds and yield in growth retardant treatments may be due to better translocation of photosynthates by shortening the plant size.

Table 2: Influence of pruning and plant growth retardants on yield parameters of *Jasminum sambac* L. during off season (December - February)

Treatments	Number of flower buds cyme^{-1}				Mean	Weight of 100 flower buds (g)				Mean	Flower yield per plant (g)				Mean
	P_1	P_2	P_3	P_4		P_1	P_2	P_3	P_4		P_1	P_2	P_3	P_4	
T_1 - CCC @ 500 ppm	5.50	5.60	4.90	4.80	5.20	19.50	21.00	18.40	17.50	19.10	141.22	147.64	115.55	70.77	118.80
T_2 - CCC @1000 ppm	5.90	6.10	5.40	5.20	5.65	21.00	22.30	20.00	19.00	20.58	154.55	163.16	127.72	79.25	131.17
T_3 - CCC @ 1500 ppm	6.30	6.60	5.70	5.60	6.05	22.50	23.80	21.40	20.50	22.05	173.75	188.67	145.17	92.86	150.11
T_4 - PBZ @ 100 ppm	5.30	5.50	4.50	4.60	4.98	19.00	20.40	18.00	17.00	18.60	135.65	141.37	111.30	68.16	114.12
T_5 - PBZ @ 200p pm	5.70	5.90	5.30	5.00	5.48	20.50	21.90	19.40	18.50	20.08	149.10	156.11	123.43	75.75	126.10
T_6 - PBZ @ 300 ppm	6.10	6.40	5.60	5.40	5.88	22.00	23.10	21.00	20.50	21.65	164.59	173.58	137.50	86.00	140.42
T_7 - MC @ 50 ppm	5.60	5.70	5.10	4.90	5.33	20.00	21.50	19.00	18.00	19.63	146.58	153.31	121.05	72.90	123.46
T_8 - MC @ 100 ppm	6.00	6.30	5.50	5.30	5.78	21.50	22.70	20.50	19.50	21.05	160.15	167.86	133.05	83.15	136.05
T_9 - MC @ 150 ppm	6.70	7.70	6.20	6.10	6.68	24.20	28.00	23.00	22.50	24.43	192.64	222.47	159.40	106.06	170.14
T_{10} - Control	4.50	5.00	3.80	3.40	4.18	16.50	18.50	16.50	15.70	16.80	109.10	121.00	90.74	52.62	93.37
Mean	5.76	6.08	5.20	5.03		20.67	22.32	19.72	18.87		152.73	163.52	126.49	78.75	
	SEd		CD (P=0.05)			SEd		CD (P=0.05)			SEd		CD (P=0.05)		
P	0.14		0.29			0.55		1.11			3.75		7.58		
T	0.23		0.47			0.87		1.76			5.93		11.99		
P×T	0.47		0.95			1.74		3.53			11.86		23.99		

P1 – Pruning during last week of August
P2 – Pruning during last week of September
P3 – Pruning during last week of October
P4 – Pruning during last week of November

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 and Srivastava, 1987 [18] and Patil and Dhomne, 1997 [19] in sunflower).

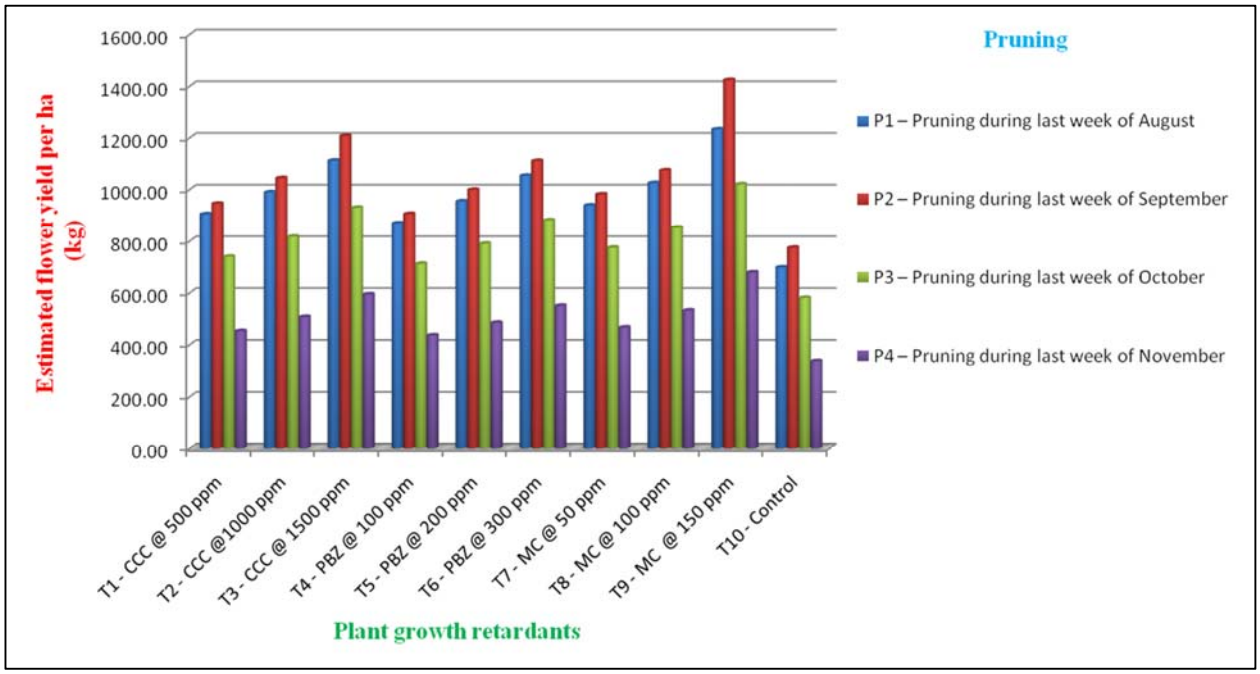

Fig 3: Influence of pruning and plant growth retardants on estimated flower yield per ha in *Jasminum Sambac* L. during off season (December to February)

4. Conclusion

From this study, it can be concluded that pruning during last week of September along with the foliar spray of mepiquat chloride @ 150 ppm proved to be the best in improving the growth and flower production of *Jasminum sambac* during off season (December to February).

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