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Response of Growth and Flowering Characters of *Jasminum sambac* (L.) to Modified Planting System and Pruning Schedule

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ABSTRACT

Background: The study on the effect of varied plant density with different pruning levels on growth and flower yield in *Jasminum sambac* (L.) was carried out at the Department of Floriculture and Landscape Architecture, TNAU, Coimbatore during 2021-2022.

Methods: The experiment was laid out in Factorial Randomized Block Design (FRBD) with eight treatment combinations and replicated thrice. The treatments comprised of T_1 (D_1P_1)- Control = One plant pit^{-1} + one pruning year^{-1}, T_2 (D_1P_2) = One plant pit^{-1} + two prunings year^{-1}, T_3 (D_2P_1) = Two plants pit^{-1} + one pruning year^{-1}, T_4 (D_2P_2) = Two plants pit^{-1} + two prunings year^{-1}, T_5 (D_3P_1) = Three plants pit^{-1} + one pruning year^{-1}, T_6 (D_3P_2) = Three plants pit^{-1} + two prunings year^{-1}, T_7 (D_4P_1) = Four plants pit^{-1} + one pruning year^{-1}, T_8 (D_4P_2) = Four plants pit^{-1} + two prunings year^{-1} respectively. Pruning treatments were imposed on one year after planting of *J. sambac* (L.) a new clone (nine budded clone) which is prolific and high yielder. Most of the growth and yield parameters were significantly influenced by increased plant densities and pruning levels.

Result: Considering the growth and flowering traits in Jasmine, the pooled data indicated that the treatment T_6 (D_3P_2) *i.e.* three plants pit^{-1} + two prunings year^{-1} was found superior for growth and flowering parameters namely plant height (84.47 cm), canopy spread (0.350 m^2), number of primary branches plant^{-1} (16.27), number of secondary branches plant^{-1} (36.73), number of cymes plant^{-1} (1989.7), number of nine budded cymes plant^{-1} (911.0), number of flower buds plant^{-1} (2875.0), flower yield plant^{-1} (730.3 g) and flower yield ha^{-1} (5071.0 kg) whereas, lowest yield (3241.5 kg/ha) was observed in T_1 (D_1P_1) *i.e.* one plant pit^{-1} + one pruning year^{-1}. But the parameter on days taken for first harvest of flower buds, number of flower buds cyme^{-1} and weight of hundred flower buds was found to be non-significant. The results might be due to increased plant density combined with alteration in pruning have enhanced not only speedy plant growth and vast canopy spread but also other yield attributing parameters such as increased number of cymes with nine buds per hectare which in turn might have resulted in higher flower production when compared to conventional planting.

Key words: Jasmine, Planting density, Pruning level, Vegetative, Yield characters.

INTRODUCTION

Jasmine is one of the auspicious crops grown in India for centuries and Tamil Nadu ranks first in production because of its distinctive fragrance and peculiar flowering habit during summer and winter months. Off season flower production in *J. sambac* has become inevitable to the farmers because the price during the off season is manifold when compared to the prices obtained during peak flowering. During winter months, there occurs a dearth of flowers because the yield is very low and the flowering is not continuous and does not supply uniform flowers during this period and thus the price of Jasmine attains highest in the flower market which even touches as high as Rs. 5000 per kg due to the non-availability of flowers.

Pruning is the foremost important operation which builds a good frame work, produces new flowering shoots which can be tailored for planned flower production. So, the farmers are ready to prune the plants in early winter months to get flowers during off season (Krishnamoorthy, 2014) in order to take advantage of the higher price. Many pruning studies have been carried out in Jasmine aiming to find out ideal time of pruning. But there is a need to focus on standardization of improved production technologies like modified planting system by planting more than one plant per pit which is a novel concept in Jasmine and has not been reported till date. This study aimed to induce flowers throughout the year without affecting the quality of flowers as well as to increase flower yield compared to conventional system of planting. Keeping this in view, the present study was

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conducted on combined effect of modified planting system and pruning intervals to explore the possibility of increasing the number of shoots per plant and hence the flower yield.

MATERIALS AND METHODS

The present investigation was carried out at the Department of Floriculture and Landscape Architecture, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore from January, 2021 to November, 2022 to study the response of *J. sambac* (L.) to modified planting system and pruning schedule on growth and flowering characters with eight treatment combinations in factorial randomized block design (FRBD) and replicated thrice. The treatments comprised of four levels of plant density *viz.*, D_1- one plant pit^{-1} (control), D_2- two plants pit^{-1}, D_3- three plants pit^{-1}, D_4- four plants pit^{-1} and two levels of prunings *viz.*, P_1- one pruning year^{-1}(control), P_2- two prunings year^{-1}. One pruning year^{-1} was done in the month of November 2021 (farmer's practice) and two prunings year^{-1} was done in the months of November 2021 and May 2022.

J. sambac rooted plants a new clone (Acc. Js-36) has been evolved by the Department of Floriculture and Landscape Architecture of TNAU, Coimbatore. This Gundumalli clone is claimed to produce more number of cymes with nine buds when compared to other genotypes of Gundumalli and the growers typically call it as 'nine budded Gundumalli' (Fig 1). Plants were planted in the main field at a spacing of 1.2 × 1.2 m at four different plant densities per pit namely, one plant pit^{-1}, two plants pit^{-1}, three plants pit^{-1} and four plants pit^{-1}.



Fig 1: Nine budded Gundumalli.

Pruning treatment was commenced one year after planting. Pruning was done manually to a height of 50 cm from the ground level with pruning shears in the last week of November and May. After pruning, Farm Yard Manure (FYM) and chemical fertilizers were applied 20 cm away from the main stem in 15 cm deep rings. Urea, single super phosphate and muriate of potash were used as the sources of nutrient elements *i.e.,* 100% RDF for one plant pit^{-1} and 100% RDF + 25% increased dosage for two, three, four plants pit^{-1}. All the cultural operations *viz.,* weeding, irrigation, pest control *etc.* were carried out as and when required as per the recommendations of the Crop Production Guide of TNAU and the Tamil Nadu State Department of Horticulture and Plantation Crops.

The pruned plants were examined for the major traits of economic importance which comprised of vegetative growth parameters like plant height (cm), canopy spread (m^2), number of primary branches plant^{-1}, number of secondary branches plant^{-1} and yield attributing parameters *viz.,* days taken for first harvest of flower buds (days), number of flower buds cyme^{-1}, weight of hundred flower buds (g), number of cymes plant^{-1}, number of nine budded cymes plant^{-1}, number of flower buds plant^{-1}, flower yield plant^{-1} (g), flower yield ha^{-1} (kg). Five randomly selected plants were tagged per replication in each treatment and observations were recorded.

To perform data analysis, R statistical package (Version 4.2.1) downloaded from http://cran.r project.org was used. The Doebioresearch package was used for analysis of factorial randomized block design (FRBD) for 2 factors. This function gives ANOVA, Shapiro - Wilk normality test (p-value) of residuals, SEd (standard error of difference), CD (critical difference) P=5%, interpretation of ANOVA results and multiple comparison test (LSD test) for means.

RESULTS AND DISCUSSION

Vegetative growth characters

The results on various vegetative parameters were recorded from Dec'2021- Nov'2022 and the pooled analysis data are presented in Fig 2 and Table 1.

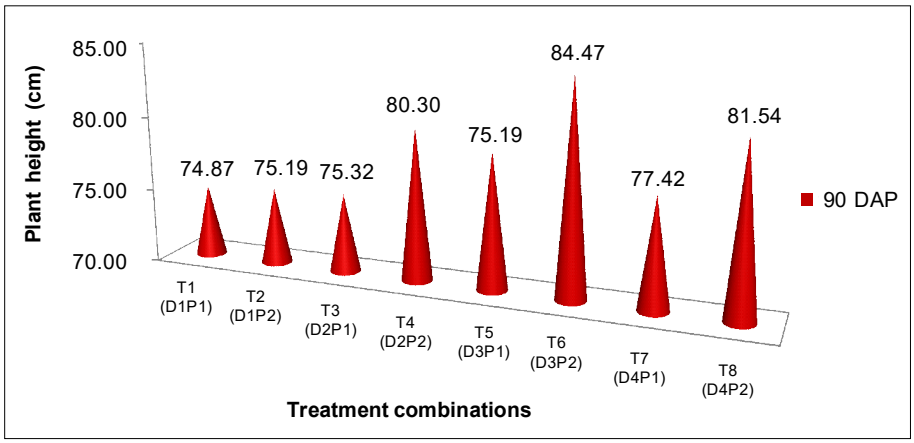


Fig 2: Influence of planting density and pruning schedule on plant height (cm) in *J. sambac* (L.).

The results at 90 days after pruning (DAP) indicated that the interaction effect of modified planting system and pruning schedule was found to be significant (P<0.05) in all the growth parameters *viz.,* plant height (cm), canopy spread (m^2), number of primary branches $plant^{-1}$ and number of secondary branches $plant^{-1}$.

The highest plant height (84.47 cm) was noted in D_3P_2 treatment (Three plants pit^{-1} and two prunings $year^{-1}$) and then followed by treatment D_4P_2 (four plants pit^{-1} + two prunings $year^{-1}$) recorded the plant height of 81.54 cm and was on par with D_2P_2, whereas, the control D_1P_1 (One plant pit^{-1} and one pruning $year^{-1}$) registered the lowest plant height of 74.87 cm respectively. The plants that were pruned twice a year recorded significantly higher plant height than plants pruned once a year. The plant height is mainly influenced by a number of factors which include pruning intensity and time of pruning. These findings are in accordance with the findings of Notoni *et al.* (2014) in *Rosa Indica* (L.). Nair *et al.* (2009) findings is also in support who elaborated that increased pruning at periodic intervals will make the plants being able to receive longer photoperiodic stimulus than the plants left without pruning resulted in stunted growth in *J. sambac*. However, high planting density promotes the growth of roots which improves photosynthesis; influences plant height, architecture and synthesis of chlorophyll. Thus, higher plant growth rate in correspondance with the increase in planting density is in agreement with the findings of Wu *et al.* (2020) in perilla sprouts (*Perilla friesians* L.).

Among the interaction effects, highest canopy spread (0.350 m^2), number of primary branches (16.27) and number of secondary branches per plant (36.73) were observed in D_3P_2 followed by D_4P_2 which recorded values of 0.329 m^2, 15.63, 32.43 respectively. Whereas, D_1P_1 plants produced the lowest canopy spread (0.130 m^2), number of primary branches (7.93) and number of secondary branches (18.13). Pruning practice increased the plant spread in both the directions which might be due to suppression of apical dominance that produced greater number of main and lateral branches, resulting in increased canopy spread as observed by Kalaimani *et al.* (2017) and Kumaresan (2016) in *J. sambac*. Increase in plant density also favours the production of more number of shoots per plant which increases the primary and secondary branches.

Flowering characters

From the results (Fig 3), it was observed that the interaction effect of modified planting system and pruning schedule on the days taken for first harvest of flower bud was non-significant (P>0.05). The earliest first harvest of flower buds of 32.00 days was observed in D_3P_2 followed by D_4P_2 which recorded values of 32.50 days. The treatment D_1P_1 (Control) showed higher number of days taken for first harvest of flower bud with the value of 35.67 days. Earliest days taken for first harvest of the flower bud after pruning varied significantly with pruning practice and increased plant density. 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. The variations in bud initiation may also be due to influence of solar radiation and temperature as reported by Harris and Scott (1969) in carnation (*Dianthus sp.*). Accumulation of more carbohydrate in plant body lead to early flower bud initiation as well as bud opening, later which resulted in lengthening of flowering span (Sainath, 2009) as reported in annual chrysanthemum (*Chrysanthemum coronarium* L.).

The increased number of flower buds $cyme^{-1}$ and weight of 100 flower buds differed significantly among the different seasons (off, peak and lean seasons) of harvesting. But the interaction effects among the treatments in three seasons were non-significant (Table 2). The increased number of flower buds $cyme^{-1}$ (7.00, 8.20 and 7.70) and weight of 100 flower buds (22.80, 28.60, 26.50 g) was recorded in D_3P_2 during off, peak and lean seasons which were followed by D_2P_2. The lowest number of flower buds $cyme^{-1}$ (6.60, 7.90 and 7.20) and weight of 100 flower buds (20.40, 26.00 and

Table 1: Influence of planting density and pruning schedule on canopy spread (m^2), number of primary branches $plant^{-1}$ and secondary branches $plant^{-1}$ at 90 DAP in comparison with conventional planting in *J. sambac* (Pooled means).

Treatment	Canopy spread (m^2)			No. of primary branches $plant^{-1}$			No. of secondary branches $plant^{-1}$		
	P_1	P_2	Mean	P_1	P_2	Mean	P_1	P_2	Mean
D_1	0.130	0.242	0.186	7.93	12.13	10.03	18.13	27.6	22.86
D_2	0.247	0.317	0.282	12.87	15.53	14.2	30.27	32.37	31.32
D_3	0.311	0.350	0.330	15.00	16.27	15.63	32.33	36.73	34.53
D_4	0.268	0.329	0.299	14.33	15.63	14.98	31.73	32.43	32.08
Mean	0.239	0.309		12.53	14.89		28.11	32.28	
Factors	D	P	D × P	D	P	D × P	D	P	D × P
SEd	0.003	0.002	0.004	0.121	0.085	0.171	0.479	0.338	0.677
CD (P=0.05)	0.007	0.005	0.010	0.259	0.183	0.367	1.02	0.726	1.45
p-value		0.627			0.171			0.885	

*D_1- One plant pit^{-1}, D_2- Two plants pit^{-1}, D_3- Three plants pit^{-1} and D_4- Four plants pit^{-1}.

*P_1- One pruning $year^{-1}$ and P_2- Two prunings $year^{-1}$.

*DAP- Days after pruning.

Table 2: Influence of planting density and pruning schedule on number of flower buds cyme^{-1} and weight of hundred flower buds (g) in comparison with conventional planting in *J. sambac*.

Treatment	Number of flower buds cyme^{-1}									Weight of 100 flower buds (g)								
	Off season		Mean	Peak season		Mean	Lean season		Mean	Off season		Mean	Peak season		Mean	Lean season		Mean
	P_1	P_2		P_1	P_2		P_1	P_2		P_1	P_2		P_1	P_2		P_1	P_2	
D_1	6.60	6.70	6.65	7.90	8.00	7.95	7.20	7.30	7.25	20.40	21.20	20.80	26.00	26.50	26.25	24.10	24.80	24.45
D_2	6.70	6.90	6.80	8.00	8.10	8.05	7.30	7.60	7.45	21.50	22.30	21.90	26.70	28.30	27.50	25.00	26.20	25.60
D_3	6.90	7.00	6.95	8.10	8.20	8.15	7.50	7.70	7.60	22.20	22.80	22.50	28.00	28.60	28.30	26.10	26.50	26.30
D_4	6.90	6.90	6.90	8.10	8.10	8.10	7.40	7.60	7.50	21.70	22.50	22.10	27.10	28.40	27.75	25.40	26.40	25.90
Mean	6.77	6.87		8.02	8.10		7.35	7.55		21.45	22.20		26.95	27.95		25.15	25.97	
Factors	D	P	D × P	D	P	D × P	D	P	D × P	D	P	D × P	D	P	D × P	D	P	D × P
SEd	0.095	0.067	0.134	0.125	0.088	0.177	0.120	0.085	0.170	0.344	0.243	0.486	0.432	0.305	0.611	0.246	0.174	0.348
CD (P=0.05)	0.204	0.144	0.289	0.269	0.190	0.381	0.258	0.182	0.365	0.737	0.521	1.04	0.926	0.655	1.31	0.528	0.373	0.747
p-value		0.071			0.213			0.708			0.964			0.184			0.721	

*D_1- One plant pit^{-1}, D_2- Two plants pit^{-1}, D_3- Three plants pit^{-1} and D_4- Four plants pit^{-1}.

*P_1- One pruning year^{-1} and P_2- Two prunings year^{-1}.

Table 3: Influence of planting density and pruning schedule on yield attributing parameters in comparison with conventional planting in *J. sambac* (Pooled data).

Treatment	Cumulative number of nine budded cymes plant^{-1} from Dec' 21-Nov'22		Mean	Cumulative number of flower buds plant^{-1} from Dec' 21-Nov'22		Mean	Cumulative flower yield plant^{-1} (g) from Dec' 21-Nov'22		Mean	Cumulative flower yield ha^{-1} (kg) from Dec' 21-Nov'22		Mean
	P_1	P_2		P_2	P_2		P_1	P_2		P_1	P_2	
D_1	521.9	602.9	562.4	2144.3	2303.6	2224.0	495.5	547.0	521.2	3440.8	3798.8	3619.8
D_2	655.8	840.4	748.1	2386.6	2646.9	2516.8	574.1	658.1	616.1	3986.9	4570.3	4278.6
D_3	790.3	911.0	850.7	2525.3	2875.0	2700.1	622.1	730.3	676.2	4320.3	5071.0	4695.6
D_4	736.0	862.2	799.1	2464.0	2744.6	2604.3	600.3	685.5	642.9	4168.6	4760.5	4464.6
Mean	676.0	804.1		2380.0	2642.5		573.0	655.2		3979.2	4550.2	
Factors	D	P	D × P	D	P	D × P	D	P	D × P	D	P	D × P
SEd	7.53	5.32	10.65	35.80	25.31	50.63	8.39	5.93	11.87	59.85	42.32	84.65
CD (P=0.05)	16.16	11.43	22.86	76.79	54.30	108.6	18.00	12.73	25.46	128.3	90.78	181.56
p-value		0.045			0.782			0.945			0.682	

*D_1- One plant pit^{-1} D_2- Two plants pit^{-1}, D_3- Three plants pit^{-1} and D_4- Four plants pit^{-1}.

*P_1- One pruning year^{-1} and P_2- Two prunings year^{-1}.

24.10 g) was observed in D_1P_1 during off, peak and lean seasons respectively. This may be due to the production of more number of leaves in 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 and Badran (2003) in *J. sambac*. The increased plant density also contributes to higher production of photosynthates resulting in increased production of cymes, flower buds per cyme and thereby flower yield per plant is increased. The increased flower bud weight is due to varied pruning levels which is attributed to the production of leaves and shoot per branch and increased plant spread that would have helped for better photosynthesis which is in conformity with Hugar and Nalawadi (1994) in *J. auriculatum*.

The data pertaining to Dec' 21-Nov' 22 (Fig 4 and Table 3) showed significant differences among all the treatments with respect to interaction effect of increased planting density and pruning schedule for all the yield parameters. The highest number of cymes plant^{-1} (1989.7), number of nine budded cymes plant^{-1} (911.0), number of flower buds plant^{-1} (2875.0), flower yield plant^{-1} (730.3 g) and flower yield ha^{-1} (5071.0 kg) were observed in D_3P_2. The next best treatment was D_4P_2 which recorded values of 1921.9, 862.2, 2744.6, 685.5 g per plant and 4760.5 kg per ha respectively. The lowest values of 1248.4, 521.9, 2144.3, 495.5 g per plant and 3440.8 kg per hectare was observed in the control plants (D_1P_1). It is very essential to choose the optimum planting density for the crop without affecting the yield and quality of flowers. So, in this study the number of plants per pit has been increased which results in higher number of branches which ultimately produce higher number of cymes (more number of nine budded cymes) and in turn flower buds. Thus, flower yield is greatly influenced by number of branches per plant. The present findings are supported by results of Chaudhuri and Baruah (2010) in banana (*Musa sp.*) cv. 'Jahaji' (AAA) who reported that three suckers per pit (2 m × 3 m) was found to be most suitable and recorded the highest benefit cost ratio of 5.20. Mandal and Sharma (1999) also elaborated that increase the number of plants per unit area resulted in higher yield in robusta banana (Musa AAA) at high densities. Jennoah (2012) in *J. sambac* also reported that production of more number

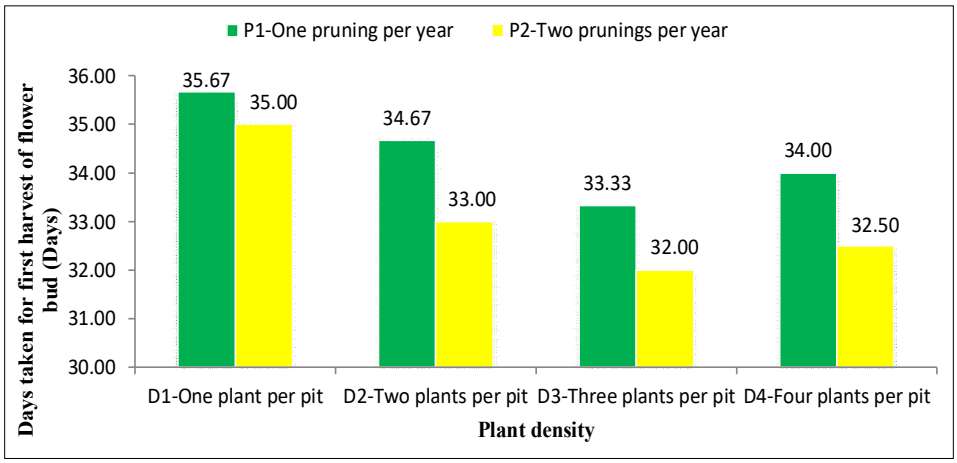


Fig 3: Influence of planting density and pruning schedule on days taken for first harvest of flower buds (days) in *J. sambac* (L.).

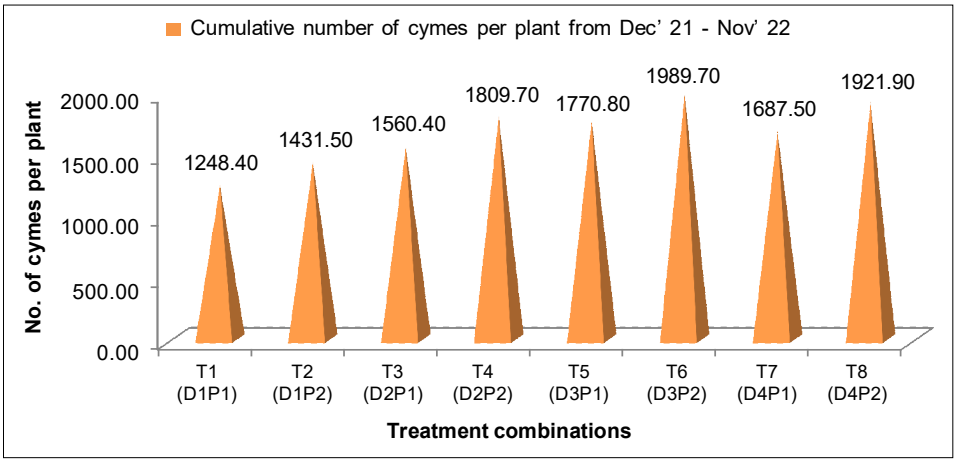


Fig 4: Influence of planting density and pruning schedule on number of cymes per plant in *J. sambac* (L.).

of leaves in pruned plants resulted in increased photosynthesis and ultimately a large reserve food source is stored leading to production of more number of flowers. York (1983) in cotton (*Gossypium hirsutum* L.) also reported that more number of branches and maximum plant spread would accumulate more carbohydrates through photosynthesis and were directly used for the production of more number of flowers which ultimately resulted in increased yield. Thus the findings of the present study with respect to growth and flowering characters are in line with the above reports.

CONCLUSION

In Jasmine, adoption of optimum plant density, planting system and pruning interval is very important to ensure rapid growth of plants and for bridging the gap between the actual yield and the potential yield of Jasmine from a unit area. From this study, it can be concluded that three plants pit^{-1} + two prunings $year^{-1}$ performed better in improving the growth and flower production in *J. sambac*. This strategy also has immense scope for inducing continuous flowering in Jasmine.

Conflict of interest: None.

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