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Study of physiological and biochemical parameters of seven prominent jasmine varieties of Tamil Nadu

Monika Patel and M Ganga

Abstract
The study was conducted at the Department of Floriculture and Landscaping, Tamil Nadu Agricultural University, Coimbatore from April 2022 to April 2023. The study involved seven commercial varieties of jasmine, *viz*., Ramanathapuram Gundumalli, Madanban, Single Mohra and Ramabanam of the species *Jasminum sambac*, CO.1 Mullai and Parimullai of *Jasminum auriculatum* and CO.1 Pitchi of *Jasminum grandiflorum*. The study was conducted with two year old plants grown under open field condition, adopting all the recommended cultural practices. The statistical design adopted was RBD. Observations were taken during the critical stages of growth and development namely, pre flowering, flowering, peak flowering and lean flowering stages for all the parameters. Total chlorophyll content and relative water content were highest during the peak flowering satge (Stage III). There were significant differences among all the seven varieties for relative water content (RWC) parameter. The rates of physiological loss in weight **(**PLW) were less immediately after harvest and they rose afterwards. The highest ethlylene evolution rates were found after 20 hrs of harvesting. The study helps us to understand the physiological and biochemical parameters of seven varieties.

Keywords: Jasmine, RWC, ethylene, chlorophyll content

Introduction
Jasmine (*Jasminum* spp.) belongs to the family Oleaceae and is a native of South and Southeast Asia. Though jasmines are distributed in tropical and subtropical countries of the world, a large number of species are centred around the regions comprising India, China and Malaysia (Anon., 1959) [1]. It is one of the oldest cultivated traditional flowering crops. For the past several centuries, jasmines adorned the gardens of Central Asia, Afghanistan, Iran, Nepal and many other tropical and subtropical countries. The attractive foliage, elegant white flowers with a rich fragrance make jasmine a highly valued ornamental plant for home gardens and commercial cultivation as well. Jasmine is grown commercially in India, Thailand, China, Sri Lanka and the Philippines for its fresh flowers. In India it is cultivated largely in South India, with Tamil Nadu occupying the first position among the states in production. It exports to many foreign countries. Many varieties of the commercial *Jasminum* species are cultivated in Tamil Nadu and some of them taken here for study are Ramanathapuram Gundumalli, Madanban, Ramabanam, Single Mohra, CO.1 Mullai, Parimullai, CO.1 Pitchi and CO.2 Pitchi. However, there is less or no scientific evidence available on physiological and biochemical parameters of the various types under field cultivation.

Materials and Methods
Location: The study was done from April 2022 to April 2023 in the laboratory of Department of Floriculture and Landscaping, Tamil Nadu Agricultural University, Coimbatore. The soil in the experimental field is sandy loam.

Plant Material: Two year old bushes of seven commercially cultivated varieties of three *Jasminum* species formed the plant material. The varieties studied were Ramanathapuram Gundumalli, Madanban, Ramabanam and Single Mohra of *J.sambac*, CO.1 Mullai and Parimullai of *J. auriculatum* and CO.1 Pitchi of *J.grandiflorum.* CO.1 Mullai and CO.1 Pitchi are varieties evolved by TNAU.
Climate: In open field condition, the maximum temperature fluctuated between 25 °C and 35 °C with a mean of 30 °C. Minimum temperature ranged between 17 °C and 23.5 °C with a mean of 20 °C. Relative humidity ranged between 60 and 90 percent with a mean of 75 percent.

Cultural Operations

Pruning: Plants of the varieties belonging to *J. sambac* were pruned during the last week of November, *J. auriculatum* during the last week of January and *J. grandiflorum* during the last week of December.

Irrigation: The crop was irrigated depending upon the soil moisture status at an interval of 7 to 10 days.

Weeding: Hand weeding was carried out as and when required.

Manure and Fertilizer Application: In *J. sambac*, FYM 10 kg + NPK @ 60:120:120 g per plant was applied in 2 split doses-after pruning in November and in June while in *J. auriculatum*, FYM 10 kg + NPK @ 120:240:120 g per plant was applied in 6 split doses at bimonthly intervals. In *J. grandiflorum*, FYM 10 kg + NPK @ 60:120:120 g per plant is applied in 2 split doses-after pruning in December and in June.

Harvesting

Flower buds from different varieties of jasmine were harvested daily by hand plucking at fully developed tight bud stage during morning hours up to the end of flowering season and post harvest parameters were recorded and assessed.

Stages of Observation

Stage	Description of stags
Stage I	Pre flowering
Stage II	Flowering
Stage III	Peak flowering / Peak season
Stage IV	Lean flowering / Lean season

The three species of *Jasminum* considered for the present study vary in their seasonal response with respect to growth and flowering. The following are the critical stages of growth and development of the three species.

The following are the critical stages of growth and development of the three species

Species	Critical stage	Duration of the stage
Jasminum sambac	Pre flowering	November-January
	Flowering	February-April
	Peak flowering / Peak season	May-August
	Lean flowering / Lean season	September-October
Jasminum auriculatum	Pre flowering	January-March
	Flowering	April-May
	Peak flowering / Peak season	June-September
	Lean flowering / Lean season	October-December
Jasminum grandiflorum	Pre flowering	December-February
	Flowering	March-June
	Peak flowering / Peak season	July-October
	Lean flowering / Lean season	November

Physiological and Biochemical parameters of plants

Total chlorophyll content

The chlorophyll 'a' and 'b' and total chlorophyll contents were estimated in a fully expanded leaf by adopting the procedure of Yoshida *et al*. (1971) [8] and the contents were expressed as mg g^{-1} of fresh tissue.

Relative Water Content (RWC)

The relative water content of leaves was calculated as per the method of Barrs and Weatherley (1962) [2] to find out the percentage of water held by leaves relative to fully turgid tissue. Leaves were punched uniformly and the fresh weight of the punches (30 numbers) was taken. The punches were made to float in water for 2 hours, after which the turgid weight was recorded after removing the excess water by blotting them thoroughly. The dry weight was found out after drying in an oven at 70 °C. The RWC was calculated using the formula given below and expressed in percentage.

$$RWC = \frac{\text{Fresh weight-dry weight}}{\text{Turgid weight-dry weight}} \times 100$$

Physiological and Biochemical parameters of flowers

Relative water content (RWC)

The relative water content of flower was calculated as per the method of Barrs and Weatherley (1962) [2] to assess the percentage of water held by the flowers relative to fully turgid tissue. Flowers were punched uniformly and the fresh weight of the punches (30 numbers) was taken. Then the punches were made to float in water for two hours, after which the turgid weight was recorded after removing the excess water by blotting them thoroughly. The dry weight was found out after drying in an oven at 70 °C.

The RWC of the flowers was expressed in percentage (%) and the mean of replicated flowers was calculated using the formula:

$$RWC = \frac{\text{Fresh weight-dry weight}}{\text{Turgid weight-dry weight}} \times 100$$

Physiological loss in weight (PLW)

The PLW (%) of whole flowers was calculated from the mean of the replicated packages using the formula:

$$PLW = \frac{\text{Fresh weight (I day)-Weight (II day)}}{\text{Fresh weight (I day)}} \times 100$$

Ethylene evolution rate

Ethylene release from flowers was calculated using a hand held portable Ethylene Analyzer (Bioconservacion Food Safety Technology, Spain). Ethylene measurement was made directly by injecting the sensor needle into the package *via*. a rubber septum and expressed in ppm. The pump flow rate was typically 0.8 l/min for a response time of 40 seconds.

Results and Discussion

Physiological and Biochemical parameters of plants

During the critical growth stages, significant differences for chlorophyll content were observed among the varieties. The total chlorophyll content ranged from 1.367 mg g^{-1} to 1.793 mg g^{-1}, 1.3018 mg g^{-1} to 1.618 mg g^{-1}, 1.133 mg g^{-1} to 1.285 mg g^{-1}, 1.123 mg g^{-1} to 1.663 mg g^{-1}, 1.114 mg g^{-1} to 1.538 mg g^{-1}, 1.128 mg g^{-1} to 1.353 mg g^{-1} and 1.447 mg g^{-1} to 1.

834 mg g^{-1} respectively for Ramanathapuram Gundumalli, Madanban, Single Mohra, Ramabanam, CO.1 Mullai, Parimullai and CO.1 Pitchi (Table.1).

There were significant differences in RWC among varieties. Relative water content ranged from 81.63% to 87.88%, 84.18% to 86.89%, 76.63% to 81.62%, 82.12% to 84.59% for Ramanathapuram Gundumalli, Madanban, Single Mohra and Ramabanam respectively. In CO.1 Mullai, Parimullai and CO.1 Pitchi RWC observed ranged between 81.89% and 84.80%, 78.21% and 82.33% and 81.95% and 89.62% respectively (Table.2).

Table 1: Total chlorophyll content (mg g^{-1}) of jasmine varieties

S. No.	Varieties	Total chlorophyll content (mg g^{-1})			
		Stage I	Stage II	Stage III	Stage IV
1.	Ramanathapuram Gundumalli (*Jasminum sambac*)	1.367	1.538	1.793	1.392
2.	Madanban (*Jasminum sambac*)	1.301	1.407	1.618	1.321
3.	Single Mohra (*Jasminum sambac*)	1.133	1.240	1.286	1.213
4.	Ramabanam (*Jasminum sambac*)	1.123	1.398	1.663	1.186
5.	CO.1 Mullai (*Jasminum auriculatum*)	1.114	1.228	1.538	1.118
6.	Parimullai (*Jasminum auriculatum*)	1.128	1.293	1.353	1.138
7.	CO.1 Pitchi (*Jasminum grandiflorum*)	1.447	1.690	1. 834	1.538
	SEd CD (P=0.05)	0.010 0.021	0.013 0.028	0.017 0.037	0.012 0.026

Table 2: Relative water content (%) of plants of jasmine varieties

S. No.	Varieties	Relative water content (%)			
		Stage I	Stage II	Stage III	Stage IV
1.	Ramanathapuram Gundumalli (*Jasminum sambac*)	81.63	83.32	87.88	86.5
2.	Madanban (*Jasminum sambac*)	84.18	85.44	86.89	85.44
3.	Single Mohra (*Jasminum sambac*)	76.63	79.12	81.62	81.10
4.	Ramabanam (*Jasminum sambac*)	82.12	84.34	84.59	83.52
5.	CO.1 Mullai (*Jasminum auriculatum*)	81.89	82.98	84.80	83.45
6.	Parimullai (*Jasminum auriculatum*)	78.21	81.89	82.33	81.91
7.	CO.1 Pitchi (*Jasminum grandiflorum*)	81.95	85.24	89.62	84.78
	SEd CD (P=0.05)	0.146 0.318	0.082 0.180	0.126 0.275	0.115 0.252

In the present study, chlorophyll content of plants varied significantly among the varieties during critical stages of growth. Chlorophyll content is the major factor which influences flower yield. The highest chlorophyll content was noticed in peak flowering stages than other stages. Similar have been reported by Bini Sundar (2011) [3] and Jennoah (2012) [6] in Ramanathapuram Gundumalli of *J. sambac*.

Photosynthetic efficiency which directly influences the yield of a plant is positively correlated with the relative water content of the plant. In the present study, RWC was highest in CO.1 Pitchi, followed by Ramanathapuram Gundumalli and it was lowest in Single Mohra. A similar trend was observed for flower bud yield. The relative water content was highest at the peak flowering period (Stage III) and lowest at lean flowering stage (Stage IV) for all the varieties.

Pysiological and Biochemical parameters of flowers

There were significant differences among all the seven varieties for relative water content (RWC) parameter (Table.3). The rates of physiological loss in weight **(**PLW) were less immediately after harvest and they rose to 25.65%, 24.80%, 20.28%, 22.46%, 32.54%, 30.38% and 27.87% at 30 hrs after harvest in Ramanathapuram Gundumalli, Madanban, Single Mohra, Ramabanam, CO.1 Mullai, Parimullai and CO.1 Pitchi respectively (Table.4). The highest ethlylene evolution rates were found after 20 hrs of harvesting. The values recorded at 20 hrs after harvest were 37.9, 36.0, 28.6, 34.8, 44.6, 46.2 and 41.7 ppm for the above varieties respectively (Table.5).

Table 3: Relative water content (%) of flowers after harvesting

S. No.	Varieties	Relative water content (%)			
		Immediately after harvest	10 hrs after harvest	20 hrs after harvest	30 hrs after harvest
1.	Ramanathapuram Gundumalli (*Jasminum sambac*)	93.38	90.81	82.43	75.76
2.	Madanban (*Jasminum sambac*)	96.88	92.08	84.98	76.87
3.	Single Mohra (*Jasminum sambac*)	98.15	94.57	86.63	80.89
4.	Ramabanam (*Jasminum sambac*)	97.77	92.63	83.14	78.55
5.	CO.1 Mullai (*Jasminum auriculatum*)	94.97	84.94	78.25	68.65
6.	Parimullai (*Jasminum auriculatum*)	93.64	86.63	76.33	70.58
7.	CO.1 Pitchi (*Jasminum grandiflorum*)	95.60	88.69	79.58	73.47
	SEd CD (P=0.05)	0.201 0.439	0.238 0.518	0.276 0.602	0.328 0.715

Table 4: Physiological loss in weight (%) of flowers after harvesting

S. No.	Varieties	Physiological loss in weight (%)			
		Immediately after harvest	10 hrs after harvest	20 hrs after harvest	30 hrs after harvest
1.	Ramanathapuram Gundumalli (*Jasminum sambac*)	5.93	10.76	19.85	25.65
2.	Madanban (*Jasminum sambac*)	4.95	8.36	16.88	24.80
3.	Single Mohra (*Jasminum sambac*)	3.27	7.45	14.12	20.28
4.	Ramabanam (*Jasminum sambac*)	4.25	8.12	16.60	22.46
5.	CO.1 Mullai (*Jasminum auriculatum*)	7.81	14.93	23.69	32.54
6.	Parimullai (*Jasminum auriculatum*)	9.18	16.64	25.05	30.38
7.	CO.1 Pitchi (*Jasminum grandiflorum*)	3.56	11.89	21.29	27.87
	SEd CD (P=0.05)	0.163 0.356	0.265 0.577	0.284 0.618	0.326 0.711

Table 5: Ethylene evolution rate (ppm) of flowers after harvesting

S. No.	Varieties	Ethylene evolution rate (ppm)			
		Immediately after harvest	10 hrs after harvest	20 hrs after harvest	30 hrs after harvest
1.	Ramanathapuram Gundumalli (*Jasminum sambac*)	2.8	12.6	37.9	4.2
2.	Madanban (*Jasminum sambac*)	2.2	10.8	36.0	3.8
3.	Single Mohra (*Jasminum sambac*)	1.7	8.5	28.6	2.1
4.	Ramabanam (*Jasminum sambac*)	2.0	9.5	34.8	2.9
5.	CO.1 Mullai (*Jasminum auriculatum*)	3.4	16.7	44.6	6.1
6.	Parimullai (*Jasminum auriculatum*)	4.9	18.5	46.2	8.2
7.	CO.1 Pitchi (*Jasminum grandiflorum*)	2.9	14.8	41.7	5.8
	SEd CD (P=0.05)	0.0796 0.173	0.278 0.606	0.459 0.999	0.155 0.337

Significant decrease in the relative water content of flowers were noticed after flower opening. For the parameters, Single Mohra had the highest values and the lowest was in Parimullai. Similar observations were recorded in China rose by Xue and Lin (1999) [7]. This may be due to senescence caused by the dehyadration of tissues wherein moisture content and RWC of petals decreased during wilting. Similar results were also reported by Zahed Hossain *et al*. (2006) [9] in Gladiolus flowers.

Membrane deterioration is evident during senescence. Wilting is most common and visible symptom of petal senescence, which results in loss of turgor pressure of cells. In the present

study,the lowest solute leakage was recorded in Single Mohra and the highest in Parimullai during all the ten hour intervals. Thus, flower buds of Single Mohra had the highest membrane Integrity while flowers of Parimullai had the lowest membrane Integrity, *i.e.*, rise in ethylene production preceded the rise in the level of ion leakage from petals. Increase in ethylene evolution was highest in Parimullai and lowest in Single Mohra and there was correlation of this with the membrane integrity. Similar observations have been reported earlier by Faragher and Mayak (1984) [5] in rose and Burger *et al.* (1986) [4] in Dianthus caryophyllus cv. White Sim. The rate of ethylene evolution increased rapidly from after harvest upto 20 hours, after which there was a decline. Among the varieties, the lowest ethylene evolution rates were recorded in Single Mohra where highest values were recorded in Parimullai.

Conclusion

The study helps us to understand the physiological and biochemical parameters of widely grown jasmine varieties Ramanathpuram Gundumalli of *J. sambac*, CO.1 Mullai of *J. auriculatum*, and CO.1 Pitchi of *J. grandiflorum*, other varieties including Madanban, Ramabanam and Single Mohra of J. sambac and Parimullai of J. Auriculatum. These parameters can be manipulated to lengthen the shelf life of flowers, so directly it will affect the commercial valueof flowers.

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