PINCHING, PHOTOPERIOD, AND FERTILIZATION ON GROWTH AND FLOWERING OF LAGERSTROEMIA L., 'VICTOR' AND 'ZUNI'

by Richard L. Harkess and James M. Rawson, Mississippi State

Three experiments were conducted using *Lagerstroemia* 'Victor' and 'Zuni', one on pinching, another on photoperiod and the third on fertilization. Liners were potted either one or three per container. In the pinching experiment, treatments combined pinches (0, 1, 2, 3, or 4) with their timing (0, 2, 4, or 6 weeks after planting). In the photoperiod experiment, the plants were exposed to 0, 4, 8, or 12 weeks of short days before being moved to long days. In the fertilizer experiment the plants were fertilized at 0, 200, 400, 600, or 800 mg@Liter^{-1} Nitrogen from 20N-4.3P-16.6K liquid feed and 0 or 6 grams per container of 15N-4.7P-10.8K slow release fertilizer. The number and timing of pinches had no effect on overall growth. For both 'Victor' and 'Zuni', three liners per container resulted in plants that were wider and shorter than those with only one liner. Short days prevented vegetative growth and floral development in both cultivars. 'Victor' grew and flowered best after receiving 8 weeks of short days before moving to long days. 'Zuni' grew and flowered best when moved directly to long days after potting. Victor' and 'Zuni' had the greatest growth indexes, floral, and branch rating when grown at 200 mg@Liter^{-1}N liquid feed.

Crapemyrtle, one of the South's most popular and versatile landscape plants, is a deciduous shrub to small tree native to southeast Asia and introduced to the Southern United States over 150 years ago. Breeding programs have resulted in plants of many shapes, sizes, and colors including dwarf cultivars for colorful groundcovers or container plants, and miniatures for hanging specimens (Knox, 1994).

A survey conducted using crapemyrtle as a florist crop found red and purple preferred with Mother's Day the targeted holiday (Guidry and Einert, 1975). Crapemyrtle blooms in the summer on current season's growth. Vegetative growth and flowering are thought to be regulated by photoperiod, accumulated light intensity, and temperature (Stimart, 1986; Lin and Molnar, 1982; Goi and Tanaka, 1976). Guidry (1977) reported that forcing as a florist crop requires multiple pinches and long photoperiods for vegetative growth. Rapid flowering has been achieved using high temperatures (21EC night/29EC day) and 16 hour photoperiods. Goi and Tanaka (1976) reported that 13 hour days were required for flowering. Under 11 hour photoperiods, growth was retarded and flowering prevented. In contrast to recent reports that *Lagerstroemia* has low salt tolerance and a low fertility requirement in the landscape (Knox, 1994; Francois, 1982), high fertility rates of surface applied Osmocote 18N-3.9P-10.8K supplemented with a liquid feed of 20N-8.6P-16.6K at 700 mg@Liter^{-1}N have been used during forcing (Guidry, 1977; Einert, 1976).

The number and timing of pinching and the number of liners per container were examined as a means of developing a compact plant grown in a 15-cm diameter container. The purpose of this study was to further define the pinching, fertilizer and photoperiod requirements of crapemyrtle grown as a florist crop.

Materials and Methods

Pinching Experiment.

Either 1 or 3 actively growing rooted liners of *Lagerstroemia* 'Victor', red, or 'Zuni', purple, were planted on 20 July into 1500 ml (15-cm diameter) containers in a pine bark (~65mm particle size): peat moss (3:1 v/v) substrate amended with 6 kg@m^{-3} MicroMax plus (Scotts Company, Inc., Marysville, Ohio). The plants were top dressed with 10 g SierraBlen 17N-2.6P-10K (Scotts Company, Inc., Marysville, Ohio) slow release. Plants were pinched 0, 1, 2, 3, or 4 times starting 0, 2, 4, or 6 weeks after potting in all combinations. There were 32 pinching treatments with 5 replications. All plants were pinched to a height of 10 cm on the first pinch. The second, third, and fourth pinches, if appropriate, removed about 2.5 cm of growth. The plants were grown outside in a completely random experimental design until September 30th when they were moved into a greenhouse and grown under long day conditions and 21EC minimum temperature. Long days were provided by using a night interruption from 2200 to 0200 HR. Data was collected on 13 November.

Photoperiod Experiment.

Before planting, the liners were pruned to about 10 cm from the soil line. On 3 January, actively growing rooted liners were planted in 1500 ml (15 cm diameter) containers in Sunshine Mix 1 (Sun Gro Horticulture, Bellevue, WA). Treatments consisted of one or three liners per pot, and 0, 4, 8, or 12 weeks of short days before providing long days. One set of plants was held under continuous short days. The 10 treatments were in a split plot arrangement by photoperiod. Long days were provided by a night interruption from 2000 to 0200 HR. Short days were maintained by covering the plants with black cloth from 1700 to 0800 HR. A minimum 20EC at night was maintained. Plants were fertilized with Osmocote 15N-4.7P-10.8K (The Scotts Co., Marysville, OH) at 6 g/15 cm pot and 200 mg@Liter^{-1} N liquid feed once per week from Peter's peat lite 20N-4.3P-16.6K (The Scotts Co., Marysville, OH). Five replications were used. Data was collected when the plants reached 75% full bloom.

Fertilizer Experiment.

On 3 January, 3 actively growing rooted liners were planted in 1500 ml (15-cm diameter) containers in Sunshine Mix 1 (Sun Gro

Horticulture, Bellevue, WA). Fertilizer treatments consisted of Peter's peat lite 20N-4.3P-16.6K weekly liquid feed at 0, 200, 400, 600, or 800 mg@Liter^{-1} N, and Osmocote 15N-4.7P-10.8K surface applied at either 0 or 6 g/15 cm pot. Treatments were arranged by liquid fertilizer rate in a split plot design. There were four replications per treatment. All plants were pruned to 25 cm height to create a uniform shape and vegetative growth on 15 March. Data was collected 2 May, when 90% had reached 75% full flowering.

Data Collection

In all three experiments plant height, width, and visual plant form ratings were collected. A growth index representing the plant space volume was calculated via height and width data, as follows: 3.14@(width/2)^2@height. Plant form ratings were based on the following scale: 1- few to no side branches, unbalanced plant; 2- minimal side branch development, overall plant unbalanced; 3- uneven branch development, overall plant unbalanced; 4- uniform branch development, overall plant may be unbalanced; 5- uniform, dense branch development, overall plant balanced. In the photoperiod and fertilizer experiments, a visual floral rating was also recorded and based on the following scale: 1- few, small inflorescences; 2- few, small inflorescences unevenly distributed; 3- even distribution of small inflorescences; 4- even distribution of inflorescences, some with large numbers of florets; 5- even distribution of inflorescences with large numbers of florets. In the photoperiod experiment, number of days to 75% full bloom was recorded. Dry weight was measured in the fertilizer experiment only. Analysis of variance was performed using the General Linear Models procedure of the SAS statistical software (SAS Institute, Cary, N.C.).

Results and Discussion

There was no difference in plant size or plant form rating of 'Victor' for number or timing of pinches or for number of liners per pot. 'Zuni' had better form ratings and larger size when grown with 3 liners (Table 1) but neither timing nor pinching were significant (data not shown).

Table 1. The effects of pinching and liner number on growth of crapemyrtle 'Victor' and 'Zuni'. Main effect of pinching was not significant, data was pooled for analysis by liner number.

	Growth Index[Y]		Plant Form Rating[X]	
Liners (No.)	'Victor'	'Zuni'	'Victor'	'Zuni'
1	5247[z]	6249	2.1	2.0
3	4666	9723	2.0	2.9
LSD $P<0.05$	1428	1475	0.3	0.2
Significance				
Pinching	ns	ns	ns	ns
Liners	ns	***	ns	***
Pinching x Liners	ns	ns	ns	ns

[z] means separation within column by cultivar using Student-Newman-Kuels' $P<0.05$.
ns, *** Nonsignificant or significant at $P<0.001$ respectively.
[Y] Growth index = 3.14A(width/2)^{2}Aheight.
[X] Visual rating of plant form is on a scale of 1 to 5 (5 best).

In the photoperiod experiment, the number of liners per pot did not affect growth index of 'Victor' (Table 2). However, the plants with three liners were shorter and wider than those with one. Flowering in 'Victor' was not affected by number of liners but plant form was improved when planted three liners per pot. The number of liners per pot did not affect the number of days to flowering for 'Victor'.

As was observed by Goi and Tanaka (1976), continuous short days (CSD) restricted vegetative growth and prevented floral development (Table 2). Plant width was narrowest when grown in CSD or 12 weeks short days (SD). Plant height was greatest when plants were grown in SD for 12 weeks before long days (LD). The greatest growth indexes for 'Victor' were in treatments receiving 4 or 8 weeks of SD before being moved to LD. Floral rating in 'Victor' was greater after receiving 8 weeks of SD (before LD) than when receiving only 4 weeks of SD but was not greater than when plants

where never grown in SD. Plant form in 'Victor' was rated higher when grown under CSD than under continuous LD. Under continuous LD, plant form was not different than in any treatments receiving SD before transfer to LD. However, as the number of weeks of SD before transfer to LD increased, the number of days to flowering also increased.

Table 2. The effects of liner number and number of weeks of short days (before transfer to long days) on growth of crapemyrtle 'Victor'.

'Victor'	Width (cm)	Height (cm)	Growth Index[Y] (cm^3)	Floral Rating[X]	Plant Form Rating[X]	Days to Flower
Liners (No.)				Visual Ratings[X]		
1	34[z]	29	27639	2.6	3.1	110
3	41	24	32640	2.9	4.3	106
LSD $P<\_0.05$	4	3	6804	0.5	0.5	6
Weeks of Short days						
0	38[z]	22	25065	3.8	2.9	73
4	47	26	46171	3.4	3.7	114
8	44	27	42252	4.3	4.0	115
12	31	35	27001	2.3	3.6	134
CSD[V]	26	22	10605	–	4.3	–
LSD $P<\_0.05$	6	5	10763	0.8	0.9	9
Significance						
Liners	***	**	ns	ns	***	ns
Weeks SD	***	***	***	***	*	***
Liners x SD	ns	ns	ns	ns	ns	ns

[z]means separation within column using LSD $P<\_0.05$. ns, *, **, *** not significant, significant at $P<\_0.05$, 0.01, or 0.001 respectively.
[Y] Growth index = 3.14A(width/2)²Aheight.
[X] Floral and plant form ratings on a scale of 1 to 5 (5 best).
[V] CSD= continuous short days. These plants did not flower.

'Zuni' planted three liners per pot were wider than when planted with only one liner (Table 3). The number of liners did not affect height. This resulted in a greater growth index when planted three liners per pot. An improved floral rating and plant form rating was also obtained in 'Zuni' when planted with three rather than with one liner per pot. The number of liners per pot did not affect the number of days to flowering.

Growing under 12 weeks or continuous SD reduced the width of 'Zuni' plants but not the height (Table 3). The widest plants were grown with 8 weeks SD and the tallest plants with 12 weeks SD before LD. The greatest growth index was obtained when plants were grown in SD for 8 weeks before LD. As observed with 'Victor', flowering was prevented under CSD conditions. Floral rating in 'Zuni' was improved by growing the plants under 12 weeks SD before transfer to LD. Plant form ratings were less when grown in SD for 12 weeks before LD than when grown under continuous LD or CSD. Days to flowering increased in 'Zuni' with increasing weeks of SD received. However, when the number of SD are subtracted from the number of days to flower, the length of time to flower from the start of LD was almost equal until reaching 12 weeks of SD when flowering occurred earlier upon movement to LD (data not shown).

Table 3. The effects of liner number and number of weeks of short days (before transfer to long days) on growth of crapemyrtle 'Zuni'.

'Zuni'	Width (cm)	Height (cm)	Growth Index[Y] (cm^3)	Floral Rating[X]	Plant Form Rating[X]	Days to Flower
Liners (No.)				Visual Ratings[X]		
1	16[z]	37	9795	1.6	1.0	101
3	29	34	21877	2.1	2.1	104
LSD $P<\_0.05$	4	6	6548	0.3	0.3	7
Weeks of Short days						
0	24[z]	23	12897	2.0	1.9	64
4	24	26	12597	2.2	1.7	98
8	32	33	31488	2.2	1.5	119
12	17	68	16276	2.7	1.2	130
CSD[V]	16	26	5491	–	1.7	–
LSD $P<\_0.05$	6	10	10360	0.5	0.4	10
Significance						
Liners	***	ns	***	**	***	ns
Weeks SD	***	***	***	***	*	***
Liners x SD	ns	ns	ns	ns	ns	ns

[z] means separation within column by cultivar using Student-Newman-Kuels' $P<\_0.05$. ns, *, **, *** not significant, significant at $P<\_0.05$, 0.01, or 0.001 respectively.
[Y] Growth index = 3.14A(width/2)²Aheight.
[X] Floral and plant form ratings on a scale of 1 to 5 (5 best).
[V] CSD= continuous short days. These plants did not flower.

Growth index of 'Victor' was greater when fertilized at 200 mg@Liter^{-1} than at 0, 600, or 800 mg@Liter^{-1} but was not greater than at 400 mg@Liter^{-1}(Table 4). The application of a slow release fertilizer did not affect either growth index nor dry weight of 'Victor'. Plant dry weight was greater when plants received liquid fertilizer at 200 or 400 mg@Liter^{-1}N than when no liquid fertilizer was applied. Floral and plant form ratings were higher when osmocote was used than when no fertilizer was applied. At 200, 400, 600, or 800 mg@Liter^{-1}N liquid fertilization, additional fer-

tilizer supplied using osmocote did not improve floral or plant form ratings. Floral rating was lowest when no fertilizer was applied.

Table 4. Interactions of fertilization (weekly liquid feed) and surface applied Osmocote on crapemyrtle 'Victor'.

Fertilizer rate (mg@Liter^{-1})	Growth Index[Y] (cm^3)	Dry Weight (g)	Floral Rating Osmocote 0g	Floral Rating Osmocote 6g	Plant Form Osmocote 0g	Plant Form Osmocote 6g
'Victor'			Visual Ratings[X]			
0	23456	24	0.3	4.3	2.5	4.5
200	34139	31	4.0	4.8	3.5	4.3
400	26743	34	3.8	4.0	3.8	4.0
600	17213	27	2.8	3.0	3.5	3.0
800	23202	30	3.5	3.5	3.5	4.3
LSD $P<\_0.05$	8469	6	1.1		1.0	
Significance[z]						
Fertilizer (FT)	**	*	***		ns	
Osmocote (OS)	ns	ns	***		**	
FT x OS	ns	ns	***		*	

[z]ns, *, **, *** not significant, significant at $P<\_0.05$, 0.01, or 0.001 respectively.
[Y] Growth index = 3.14A(width/2)^{2}Aheight.
[X] Floral and plant form ratings on a scale of 1 to 5 (5 best).

Growth index of 'Zuni' fertilized at 200 mg@Liter^{-1}N was greater than all other treatments and decreased with the addition of osmocote (Table 5). At 400, 600, or 800 mg@Liter^{-1}N liquid fertilization, the addition of osmocote did not affect the growth index. With no liquid fertilizer applied, the application of osmocote increased the growth index. Plant dry weight of 'Zuni' was greater when fertilized at 200 or 400 mg@Liter^{-1}N than at 800 mg@Liter^{-1}N. As was observed in 'Victor', 'Zuni' floral ratings were lowest when no fertilizer was applied. The floral ratings did not differ between liquid fertilizer rates when no osmocote was applied. When fertilized at 200, 400, 600, or 800 mg@Liter^{-1}N, floral ratings were not improved with the application of osmocote. Plant form ratings were better for plants receiving 200 or 400 mg@Liter^{-1}N liquid feed alone than if no fertilizer was applied. At 600 or 800 mg@Liter^{-1}N, plant form was not better than at 0 mg@Liter^{-1}N. The application of osmocote reduced plant form ratings over all treatments.

Table 5. Interactions of fertilization (weekly liquid feed) and surface applied Osmocote on crapemyrtle 'Zuni'.

Fertilizer rate (mg@Liter^{-1})	Growth Index[Y] (cm^3) Osmocote 0g	Growth Index[Y] (cm^3) Osmocote 6g	Dry Weight (g)	Floral Rating Osmocote 0g	Floral Rating Osmocote 6g	Plant Form
'Zuni'				Visual Ratings[X]		
0	11280	24811	23	0.6	2.6	2.3
200	39393	24586	25	3.6	3.6	3.1
400	18843	21325	25	3.4	3.6	3.0
600	17896	15451	22	3.2	2.6	2.4
800	12157	16286	20	3.6	3.6	2.9
LSD $P<\_0.05$	12008		4	0.9		0.6
Osmocote 0g	–		–	–		3.0
6g	–		–	–		2.5
LSD P=0.05	–		–	–		0.4
Significance[z]						
Fertilizer (FT)	**		*	***		*
Osmocote (OS)	ns		ns	ns		*
FT x OS	*		ns	**		ns

[z]ns, *, **, *** not significant, significant at $P<\_0.05$, 0.01, or 0.001 respectively.
[Y] Growth index = 3.14A(width/2)^{2}Aheight.
[X] Floral and plant form ratings on a scale of 1 to 5 (5 best).

Crapemyrtle branched freely and did not increase branching due to pinching treatments. Multiple liners per container should be used to obtain greater plant size and more uniform plant shape. It was found that growing the plants under SD for 8 weeks before transfer to LD for flowering increased the plant size. Crapemyrtle did not respond well to the high fertility levels previously reported (Guidry, 1977; Einert, 1976) for forcing crapemyrtle. When

forcing crapemyrtle, liquid fertilizer at 200 mg@Liter^{-1}N would be recommended and long photoperiods maintained for continuous growth and flowering. Because crapemyrtle initiate flowers on its current season's growth, uniform vegetative growth is needed for a uniform floral display. Early flowering by growing under LD conditions may increase sales during the spring planting season. Being able to control flowering may enable sales of crapemyrtle in markets where crapemyrtle is not winter hardy and could be grown as a summer annual.

Literature Cited

Einert, A.E. 1976 The crepemyrtle. Hortic. Horizons in Oklahoma. 7:16-17.

Francois, L.E. 1982. Salt tolerance of eight ornamental tree species. J. Amer. Soc. Hort. Sci. 107(1)66-68.

Goi, M. and Tanaka, Y. 1976. The effect of temperature and photoperiod on growth and flowering in Lagerstroemia indica. Tech. Bul. Fac. Agric., Kagawa Univ. 27:77-83.

Guidry, R.K. 1977. Forcing dwarf crapemyrtles. M.S. Thesis, University of Arkansas, Fayetteville. pp. 45.

Guidry, R.K. and Einert, A.E. 1975. Potted dwarf crape myrtles: a promising new floriculture crop. Florist's Review 157(4066):30.

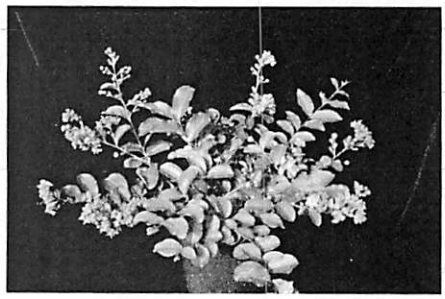
Knox, G. 1994. Crape myrtle in Florida. University of Florida Cooperative Extension Service Fact Sheet ENH-52.

Lin, W.C. and Molnar, J.M. 1982. Supplementary lighting and CO_2 enrichment for accelerated growth of selected woody ornamental seedlings and rooted cuttings. Can. J. Plant Sci. 62:703-707.

Stimart, D.P., 1986. Lagerstroemia. In: (A.H. Halevy, ed.) CRC Handbook of Flowering Vol. V. CRC Press, Boca Raton, Florida. pp. 187-190.

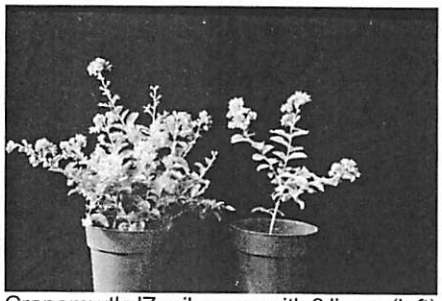
Crapemyrtle 'Victor' and 'Zuni' grown 3 liners per 6" container and pinched once. The plants were grown for 4 weeks in short days before transfer to long days.

Close up of Crapemyrtle 'Victor' with 3 liners per 6" container and grown for 4 weeks of short days before transfer to long days for fowering.



Crapemyrtle 'Zuni' grown for 8 weeks under short days before transfer to long days for flowering.

Crapemyrtle 'Victor' with 3 liners per 6" container and grown for 4 (left) or 12 weeks of short days before transfer to long days for flowering.



Crapemyrtle 'Zuni' grown with 3 liners (left) versus 1 liner (right) per 6" container.