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# Response of *Lagerstroemia* x 'Tuscarora' to Pistill and Atrimmec<sup>1</sup>

Glenn B. Fain<sup>2</sup>, Charles H. Gilliam<sup>3</sup>, and Gary J. Keever<sup>3</sup>

Department of Horticulture  
Alabama Agriculture Experiment Station  
Auburn University, AL 36849

## Abstract

A study was conducted in 1997, 1998 and 1999 to determine the effect of Pistill (ethephon) at rates of 333, 667 or 1000 ppm and Atrimmec (dikegulac-sodium) at rates of 723, 1446 or 2176 ppm on flower abortion, fruit set and axillary shoot stimulation of *Lagerstroemia* x *fauriei* Koehne 'Tuscarora' when applied at full flower. Flower abortion increased from 16.7% (1998) and 2.1% (1999) for the control to 84.2% and 64.4% respectively for Pistill (1000 ppm) at 7 days after treatment (DAT). Pistill similarly caused a significant decrease in fruit set during all three experiments with fruit set as low as 2.2% at 14 DAT in 1997 compared to 69.4% for the control. Atrimmec had no effect on flower abortion at 7 DAT in any year except 1999 with 11.3% at the 2176 ppm rate vs 2.1% for the control. Atrimmec also had little effect on fruit set except during 1998 when fruit set at 14 DAT was approximately 40% for all rates of Atrimmec compared to 65% for the non-treated control. Pistill applications resulted in more new shoots than Atrimmec in 1997, and the control in all years. Applications of Pistill at full flower can be an effective tool to abort crapemyrtle flowers resulting in reduced fruit set and increased number of new shoots.

**Index words:** plant growth regulator, branching, fruit set.

**Growth regulators used in this study:** Atrimmec (dikegulac-sodium), 2,3:4,6 bis-O-(1-methylethylidene)- $\alpha$ -L-xylo-2-hexofluranosonic acid; Pistill (ethephon), [(2-chloroethyl)phosphonic acid]\*.

**Species used in this study:** 'Tuscarora' crapemyrtle (*Lagerstroemia* x *fauriei* Koehne 'Tuscarora').

## Significance to Industry

Crapemyrtle is a vigorous grower in the southern United States; however, it blooms beginning in early summer directing plant energy into flowering and reducing vegetative growth. With some cultivars a proliferation of flowering followed by extensive fruit set reduces or eliminates additional vegetative growth for the remainder of the growing season. One option for growers to address this problem is removal of flowers by manual pruning. However, this is labor intensive and usually results in minimal vegetative re-growth followed by re-flowering. In this study the plant growth regulator Pistill applied at 1000 ppm resulted in 84.4% (1997), 64.4% (1998) and 84.2% (1999) flower abortion compared to 17.1%, 16.7% and 2.1% for the control, respectively. Pistill at 1000 ppm also resulted in 2.2% (1997), 27.8% (1998) and 14.5% (1999) fruit set compared to 69.4%, 65.0% and 55.4% for the control, respectively. Applications of Pistill also caused an increase in the number of new shoots when compared to the non-treated control, although these shoots were not ter-

minal and did not increase plant height. Atrimmec did not significantly affect flower abortion and only slightly reduced fruit set during the 1998 experiment. Applications of Pistill at full flower can be an effective tool to cause flower abortion resulting in reduced fruit set. While not directly studied in these experiments, a potential benefit of Pistill reducing flowers and fruit is a reduction in plant breakage and blow over during production.

## Introduction

*Lagerstroemia* spp. are major crops in the nursery industry in both container and field production. Plants are grown in many sizes from small liners to large specimens and may be in production at nurseries for several years before being marketed. Most cultivars of *Lagerstroemia* are vigorous growers under nursery conditions; however, some cultivars begin flowering by early summer, resulting in termination of the current year's growth. Flowers are born in terminal panicles which, depending on cultivar, are up to 36 cm (14 in) long and 23 cm (9 in) wide (2). These large panicles can result in weighted down branches during irrigation and precipitation events, leading to split trunks, an undesirable growth habit, and an increase in blow-over in container production. Similarly, the abundance of heavy fruit causes the

<sup>1</sup>Received for publication March 5, 2001; in revised form June 12, 2001.

<sup>2</sup>Graduate research assistant.

<sup>3</sup>Professor.

same problem later in the season. One possible solution to heavy flowering and fruiting would be flower removal.

Ethylene induced floral senescence was first reported by Crocker and Knight in 1908 (1). The plant growth regulator (PGR) ethephon, a compound used to release ethylene, was first synthesized by Kabachnik and Rossiiskaya (4). Mango (*Mangifera indica* L.) flowers treated with 400 or 800 ppm ethephon caused wilting followed by necrosis of 97.9–100% of flower panicles (9). Ethephon at 1000 ppm applied at full bloom eliminated fruit formation in *Pyrus calleryana* Decaisne (flowering pear) and 99% of fruit formation in *Liquidambar styraciflua* L. (sweetgum) (7). Ethephon also caused 88.9–100% flower abortion and 91.2–95.8% reduction in seed formation in three cultivars of *Kalmia latifolia* L. (5). Woolf et al. (11) indicated that flower buds of *Camellia* L. could be selectively removed with applications of 1000–2000 ppm ethephon with minimal abscission of other plant organs. Kiyomoto (5) also showed that ethephon significantly stimulated shoot production and elongation in cultivars of *Kalmia latifolia*. The effects of ethephon on crapemyrtle have not been determined. The PGR dikegulac-sodium reduces or eliminates apical dominance and induces growth of axillary buds (8). Dikegulac-sodium has been shown to increase lateral branching in several woody and non-woody plant species (3, 6, 10), but not crapemyrtle. Therefore, the objective of this study was to evaluate the effects of the PGRs Pistill (ethephon) and Atrimmec (dikegulac-sodium) on flower abortion, fruit set and lateral branching in crapemyrtle, with the

ultimate goal of addressing several production-related problems.

## Materials and Methods

This study was comprised of three experiments conducted in 1997, 1998 and 1999. *Lagerstroemia* x 'Tuscarora' were grown in 3.8-liter (#1) (1997 and 1998) or 11.4-liter (#3) (1999) containers in a pinebark:sand substrate (6:1 by vol) amended per m<sup>3</sup> (yd<sup>3</sup>) with 8.3 kg (14 lb) of 17N–3.1P–10K (Osmocote 17–7–12, The Scotts Company, Marysville, OH), 0.9 kg (1.5 lb) Micromax (The Scotts Company), and 3.0 kg (5.0 lb) dolomitic limestone. Plants were selected for uniformity from a stock block, and grown outdoors in full sun. Plants received 1.27 cm (0.5 in) water daily split into two applications using overhead irrigation at a rate of 2.54 cm (1 in) per hour.

Plants were treated when flowers were at or near full bloom. In 1997 and 1999, plants had gone beyond full bloom; therefore, they were pruned in late June to remove inflorescences, and subsequent blooms were treated. Treatment dates were August 5, 1997, July 2, 1998, and August 6, 1999. PGRs were applied to dry foliage using a CO<sub>2</sub> sprayer with a flat fan nozzle at 1.4 kg/cm<sup>2</sup> (20 psi); all shoots were sprayed until wet. Irrigation was withheld overnight. Treatments included Atrimmec at 723 (1997 and 1998 only), 1445, or 2176 parts per million (ppm); pruning plus Atrimmec at 1445 ppm or 2176 ppm (1999 only), shoots were manually pruned

**Table 1. Percent flower abortion, percent fruit set and new shoots for *Lagerstroemia* x 'Tuscarora' treated with Pistill and Atrimmec, 1997.**

Treatment	Rate (ppm)	% Flower abortion 7 DAT <sup>y</sup>	% Fruit set 14 DAT	New shoots <sup>z</sup> 14 DAT
Control	0	17.1	69.4	4.9
Atrimmec	723	20.0	71.7	2.3
Atrimmec	1445	12.8	47.2	9.9
Atrimmec	2176	38.9	62.2	6.2
Significance <sup>x</sup>		NS	NS	NS
Pistill	333	56.7	25.6	14.9
Pistill	667	52.2	13.9	12.0
Pistill	1000	84.4	2.2	18.3
Significance		L**	L***	NS
Pruned		— <sup>w</sup>	—	11.6
<b>Contrast<sup>v</sup></b>				
Atrimmec vs Pistill		***	***	***
Atrimmec vs prune		—	—	NS
Atrimmec vs control		NS	NS	NS
Pistill vs prune		—	—	NS
Pistill vs control		***	***	**

<sup>z</sup>New lateral shoots on whole plant.

<sup>y</sup>Days after treatment.

<sup>x</sup>Nonsignificant (NS), or linear (L) response at the 5% (\*), 1% (\*\*), or 0.1% (\*\*\*) level. Control included in regression (n = 9).

<sup>w</sup>No data was collected for pruned treatment for indicated response variable.

<sup>v</sup>Nonsignificant (NS), or significant at the 5% (\*), 1% (\*\*), or 0.1% (\*\*\*) level (n = 9).

**Table 2. Percent flower abortion, percent fruit set and new shoots for *Lagerstroemia* x 'Tuscarora' treated with Pistill and Atrimmec, 1998.**

Treatment	Rate (ppm)	% Flower abortion 7 DAT <sup>y</sup>	% Fruit set 14 DAT	New shoots <sup>z</sup> 14 DAT
Control	0	16.7	65.0	9.5
Atrimmec	723	16.7	42.0	15.7
Atrimmec	1445	45.0	38.3	17.5
Atrimmec	2176	34.0	42.5	22.2
Significance <sup>x</sup>		L*	NS	NS
Pistill	333	41.7	33.3	20.7
Pistill	667	60.0	27.5	20.5
Pistill	1000	84.2	14.5	21.5
Significance		L*	L*	NS
Pruned		— <sup>w</sup>	—	29.7
<b>Contrast<sup>v</sup></b>				
Atrimmec vs Pistill		*	*	NS
Atrimmec vs prune		—	—	**
Atrimmec vs control		NS	*	*
Pistill vs prune		—	—	NS
Pistill vs control		**	**	*

<sup>z</sup>New lateral shoots on whole plant.

<sup>y</sup>Days after treatment.

<sup>x</sup>Nonsignificant (NS), or linear (L) response at the 5% (\*), 1% (\*\*), or 0.1% (\*\*\*) level. Control included in regression (n = 9).

<sup>w</sup>No data was collected for pruned treatment for indicated response variable.

<sup>v</sup>Nonsignificant (NS), or significant at the 5% (\*), 1% (\*\*), or 0.1% (\*\*\*) level (n = 9).

**Table 3. Percent flower abortion, percent fruit set and new shoots for *Lagerstroemia x 'Tuscarora'* treated with Pistill and Atrimmec, 1999.**

Treatment	Rate (ppm)	% Flower abortion 7 DAT <sup>z</sup>	% Fruit set 14 DAT	New shoots/terminal 21 DAT	New shoots/ whole plant 21 DAT
Control	0	2.1	55.4	0.0	10.1
Atrimmec	1445	3.8	59.4	0.1	7.5
Atrimmec	2176	11.3	55.9	0.0	10.4
Significance <sup>y</sup>		L**	NS	NS	NS
Pruned	0	— <sup>x</sup>	—	5.2	32.1
Atrimmec + prune	1445	—	—	7.1	36.6
Atrimmec + prune	2176	—	—	6.1	40.4
Significance		—	—	NS	NS
Pistill	333	18.1	50.0	0.0	22.6
Pistill	667	45.6	35.6	0.1	39.1
Pistill	1000	64.4	27.8	0.2	45.1
Significance		L***	L*	NS	L*
<b>Contrast<sup>w</sup></b>					
Atrimmec vs Pistill		***	***	NS	***
Atrimmec vs prune		—	—	***	***
Atrimmec vs control		NS	NS	NS	NS
Atrimmec + prune vs control		—	—	***	***
Atrimmec + prune vs Atrimmec		—	—	***	***
Atrimmec + prune vs Pistill		—	—	***	NS
Atrimmec + prune vs prune		—	—	*	NS
Pistill vs prune		—	—	***	NS
Pistill vs control		***	**	NS	***

<sup>z</sup>Days after treatment.

<sup>y</sup>Nonsignificant (NS), or linear (L) response at the 5% (\*), 1% (\*\*), or 0.1% (\*\*\*) level. Control included in regression (n = 8).

<sup>x</sup>No data was collected for any pruned treatment for indicated response variable.

<sup>w</sup>Nonsignificant (NS), or significant at the 5% (\*), 1% (\*\*), or 0.1% (\*\*\*) level (n = 8).

just below the inflorescence prior to application of Atrimmec); Pistill at 333, 667 or 1000 ppm; a pruned treatment (shoots were manually pruned just below the inflorescence) and a non-treated control.

The experimental design was a completely randomized design, with nine single plant replications in 1997 and 1998 and eight single plant replications in 1999. Two inflorescences per plant at full flower (~90% open flowers), but with no visible fruit, were tagged prior to treatment. Data collected were percent flower abortion 7 days after treatment (DAT), percent fruit set 14 DAT, axillary shoot count of whole plant 21 DAT (14 DAT in 1997) and axillary shoot count on terminal 30 cm (12 in) of two tagged shoots 21 DAT (1999). Data from all experiments were analyzed using linear regression analysis to determine rate response within PGRs with inclusion of control plants as a zero rate. Contrast analysis was conducted to determine differences in response among treatments.

## Results and Discussion

Pistill increased the percent flower abortion compared to the unpruned control and Atrimmec treatments in all three experiments (Tables 1, 2 and 3). Percent flower abortion 7 DAT increased linearly with increasing rates of Pistill during 1997, 1998 and 1999 to 84.4%, 84.2% and 64.4% for Pistill (1000 ppm) compared to 17.1%, 16.7% and 2.1% for the

non-pruned control, respectively. Pistill similarly caused decreased fruit set in response to rate as well as lowering percent fruit set when contrasted with Atrimmec during all three experiments. These results with Pistill are consistent with other studies using Pistill on other genera to abort flowers and reduce fruit set (5, 7, 9).

Flower abortion increased with increasing rate of Atrimmec at 7 DAT in 1998 and 1999 (Table 3). Atrimmec had little effect on fruit set except during the 1998 (Table 2) study when fruit set at 14 DAT was approximately 40% for all Atrimmec rate compared to 65% for the control.

With respect to new shoots in 1997, there was no rate response with either PGR tested. In 1997, when contrasted across all rates, Pistill resulted in more new shoots at 14 DAT (Table 1) than Atrimmec and the non-pruned control; however, there was no difference between Pistill and pruned plants. In the 1998 experiment, new shoots were counted at 21 DAT (Table 2), and results differed from 1997 with the pruning treatment yielding more new shoots than Atrimmec while not differing from the Pistill treatment. However, both Pistill and Atrimmec treatments yielded more new shoots than the non-pruned control plants.

Manual pruning combined with Atrimmec was added as a treatment in 1999. Data collection differed in the 1999 experiment in that new lateral shoots on the terminal 30 cm (12 in) of tagged shoots were counted as well as whole plant new shoots at 21 DAT. New shoots in the Atrimmec treat-

ments were not different from the control, while pruning again yielded more new shoots than Atrimmec (Table 3). Pistill again yielded the greatest number of new shoots on the whole plant when compared to Atrimmec or the non-pruned control plants but not the pruned plants. Atrimmec + pruning did not yield more new shoots than pruning alone; however, Atrimmec + pruning did yield more new shoots on the terminal 30 cm (12 in) of tagged shoots than other treatments. There were no phytotoxic effects from any treatment observed during these experiments.

These results indicate that applications of Pistill at full flower can be an effective tool to cause flower abortion resulting in reduced fruit set. Lateral branching can also be increased as a result of Pistill applications. This increase in lateral branching can increase the quality of plants as well as increase the number of cuttings that can be removed from plants without significantly reducing plant height. While not directly studied in these experiments, a potential benefit of Pistill reducing flowers and fruit is a reduction in plant breakage and blow over during production. Likewise, a reduction in the labor requirements would reduce production cost of *Lagerstroemia*.

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