A Leaf Interveinal Chlorosis-necrosis Disorder in Crape Myrtle

Raul I. Cabrera and R. E. Lopez
Texas A&M University Agricultural Research and Extension Center, 17360 Coit Rd., Dallas, TX 75252
r-cabrera@tamu.edu

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Significance to Industry: Growers of crape myrtles (*Lagerstroemia* spp.) as well as horticulturists throughout the southeastern US have noticed and informally discussed about a foliage (leaf) disorder that is characterized by a sudden and acute interveinal chlorosis, followed by necrosis of in flushes of growth that occur in the early to mid-summer but not in the initial spring flush. Our preliminary research confirms that this disorder mainly affects container-grown cultivars of *L. fauriei* and the interspecific hybrids *L. indica* X *L. fauriei*. An evaluation of leaf (foliage) nutrient profiles in 13 crape myrtle cultivars revealed that leaf zinc (Zn) nitrogen concentrations below 90-100 ppm were strongly associated with this disorder and suggest a Zn deficiency condition in the affected cultivars. Furthermore, the tissue analyses also revealed rather large concentrations of manganese (200 to 600 ppm Mn) that were differentially observed across the evaluated *Lagerstroemia* species, but their contribution to the disorder is unclear.

Nature of Work: Crape myrtles (*Lagerstroemia* spp.) are a favorite landscape plant and staple nursery crop for most of the southeastern US (1, 2). While cultivars of the common crape myrtle (*L. indica*) have been the most widely grown and used, the relatively recent introduction of interspecific hybrids of *L. indica* and the Japanese *L. fauriei* (1, 4), has brought significant improvements to cold hardiness, bark & foliage characteristics plus resistance to powdery mildew and certain insects (1, 2, 3, 4, 6).

In recent years growers and horticulturists have been anecdotally reporting and commenting about an apparent and sort of transient physiological disorder in crape myrtles that has not yet affected the sales and popularity of this species. This foliage (leaf) disorder is characterized by a sudden and acute interveinal chlorosis that is followed by necrosis. Leaf size can be reduced moderately to severely, but some leaves may retain their normal size (compared to symptomless leaves of the same age). In the necrosis stage the disorder may resemble damage caused by an insect like a leafminer, with interveinal perforations (holes) observed in the middle of the necrotic tissue. This disorder is expressed in the flushes of growth subsequent to the initial spring flush (early to mid-summer) and sort of fades or dissipates as the season progresses and masked by the growth of new symptom-less foliage. Interestingly, the chlorotic tissue may recover its normal green color later in the season. This disorder has been primarily observed in container-grown crape myrtles, and mostly in the widely popular *L. indica* X *L. fauriei* hybrids. Conversations with growers, researchers and extension specialist from several states confirm these observations and have identified ‘Tuskegee’, Muskogee’, ‘Miami’ and ‘Natchez’ as some of the hybrid cultivars most vividly expressing the symptoms of this disorder.

While establishing an experiment to evaluate the salinity tolerance of crape myrtle cultivars we observed the differential expression of this disorder and decided to document it along with the collection and analyses of leaf tissue to explore whether a nutrient disorder (deficiency or toxicity) may be involved in its development.

Rooted liners of 13 crape myrtle cultivars representing *L. indica*, *L. fauriei*, *L. indica* X *L. fauriei* hybrids and L. speciosa (Table 1), were transplanted, on late May into 4-gallon containers filled with a peat: pine bark: sand (2:1:1 v/v) medium amended with dolomitic limestone (5.0 lbs/yd^3), Micromax (1.0 lbs/yd^3) and the wetting agent Aquagro (1.0 lbs/yd^3). Following transplant the pots were topdressed with 10.4 lbs/yd^3 of the controlled-release fertilizer Osmocote 18-6-12 (The Scotts Co.) The plants were placed in gravel beds lined with weed barrier fabric. A total of 30 plants per each cultivar were arranged in a completely randomized block design. The plants were micro-irrigated with tap water using Roberts spitters (one per plant). Applied water volumes were based on evapotranspiration measurements done (gravimetrically) in control plants (2-3 times a week), with enough water to produce a target leaching fraction of 25%. The plants were grown from late May to October and the chlorosis-necrosis disorder symptoms reached a maximum expression during the fist weeks of July, when the number affected plants from each cultivar were tabulated at this time. The plants were destructively harvested October 10-14 and the whole leaf tissues of eight randomly chosen plants were subjected to full nutrient analyses at the Agricultural Analytical Services Laboratory of Pennsylvania State University.

Results and Discussion: The chlorosis-necrosis disorder was observed in most plants of the hybrid crape myrtle cultivars (grand average of 97.5%) as well as in the Japanese *L. fauriei* cultivars (grand average of 94.4%), whereas only a few plants of the *L. indica* cultivars 'Dallas Red' (6.7%) and 'Country Red' (13.3%) showed some mild symptoms and none in the other cultivars (Table 1). These observations confirm the anecdotal reports from growers and horticulturists and suggest a strong genetic linkage to the *L. fauriei* species and its progeny, in a similar fashion to the strong differential resistance of these cultivars to powdery mildew (6) and the *Altica* flea beetle (3).

While the nutrient analyses data was taken from all the whole plant leaf tissue (not just the affected leaves) about 12 weeks after the disorder symptoms were fully expressed and tabulated, we thought that the nutrient concentrations and profiles of these cultivars may yield clues as to which, if any, nutrients could be involved. As expected, there were significant differences among cultivars in the concentration of all nutrients (Table 1), although most of them fell within the ranges reported in the literature for the genus *Lagerstroemia* (7). Across species the most remarkable macronutrients concentration differences were the extraordinarily high calcium (Ca) concentrations in the hybrid 'Tuscarora' and the significantly lowest Ca concentrations for all the Japanese (*L. fauriei*) cultivars.

Given the symptoms of the chlorosis-necrosis disorder, we hypothesized that a nutrient disorder or more specifically a metallic (Fe, Mn, Cu, Zn) micronutrient deficiency may be involved. While there were statistical differences for leaf iron (Fe) and boron (B) concentrations among all the cultivars (Table 1), these were fairly well clustered within the reported normal ranges (9) and did not show any

trend or pattern that could be associated with the disorder. Across species, manganese (Mn) concentrations were significantly differentiated, with *L. indica* having the highest average concentrations (505 ppm), *L. fauriei* averaging the lowest (199 ppm), and *L. indica* X *L. fauriei* and L. speciosa having intermediate concentrations (382 and 322 ppm, respectively). These concentrations not only exceeded the reported Mn deficiency levels of 10-20 ppm (8), but approached and/or exceeded the toxicity ranges reported for some plant species (5). On the other hand, an extensive survey of leaf nutrient concentrations in ornamental crops (9) shows *Lagerstroemia* cultivars having a Mn concentration range of 105-828 ppm. While it has been reported that high levels of Mn can produce deficiencies of other elements like iron (Fe), with typical chlorosis symptoms (7), further research attention is needed to ascertain whether Mn is involved in the chlorosis-necrosis disorder in crape myrtles.

Similar to Mn, leaf zinc (Zn) concentrations were differentially expressed across the *Lagerstroemia* species, with *L. indica* having an average concentration of 105 ppm compared to the 71 ppm averaged for the rest of the species (Table 1). While the critical concentrations of 15-20 ppm associated with Zn deficiency (8) were exceed in this study, closer examination of the data reveals that 'Country Red' and 'Dallas Red', the only *L. indica* expressing (albeit moderately) the chlorosis-necrosis disorder, had Zn concentrations similar to all the disorder-affected *L. fauriei* and *L. indica* X *L. fauriei* cultivars. Based on our raw data, the chlorosis-necrosis disorder was associated almost exclusively with plants having leaf Zn concentrations below 90-100 ppm. Further research is needed to confirm that a critical leaf Zn concentration of <90-100 ppm is associated with the chlorosis-necrosis disorder.

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Table 1. Occurrence of chlorosis-necrosis disorder in 13 crape myrtle cultivars and their leaf tissue nutrient concentrations.

Species & Cultivar	Disorder[y]	N[z]	P	K	Ca	Mg	Fe	B	Mn	Zn
		(% DW)					(ppm)			
L. indica										
Carolina Beauty	0	2.94 a	0.36 a	2.18 ab	1.83 bcd	0.42 de	109 a	73 b	596 ab	162 a
Country Red	13.3	2.37 bc	0.29 abc	1.76 cdef	1.79 bcde	0.54 abc	86 ab	75 b	432 bcd	59 d
Dallas Red	6.7	2.45 bc	0.29 abc	1.94 bcd	1.64 cde	0.58 ab	93 ab	68 bc	469 bcd	68 cd
Dynamite	0	2.47 bc	0.28 abc	2.27 a	1.76 bcde	0.37 e	85 ab	112 a	380 cde	113 b
Red Rocket	0	2.53 bc	0.31 ab	1.53 fg	1.93 bc	0.55 abc	82 ab	69 bc	646 a	124 b
Species average	***4.0***	***2.55***	***0.31***	***1.93***	***1.79***	***0.49***	***91***	***79***	***505***	***105***
L. indica X fauriei										
Basham's Party Pink	100	2.47 bc	0.20 c	1.83 cde	1.83 bcd	0.48 bcde	87 ab	40 e	295 def	60 d
Biloxi	93.3	2.69 ab	0.30 ab	1.53 fg	1.76 bcde	0.55 abc	97 ab	62 bcd	325 def	64 cd
Natchez	96.7	2.45 bc	0.26 bc	1.47 fg	1.99 b	0.61 a	92 ab	42 de	401 cde	76 cd
Tuscarora	100	2.96 a	0.34 ab	1.92 bcde	2.75 a	0.42 de	108 a	60 bcde	507 abc	76 c
Species average	***97.5***	***2.64***	***0.27***	***1.69***	***2.08***	***0.51***	***96***	***51***	***382***	***69***
L. fauriei										
Fantasy	93.3	2.43 bc	0.25 bc	1.70 defg	1.30 f	0.50 abcd	79 b	50 cde	168 f	49 d
Kiowa	90.0	3.00 a	0.29 abc	1.88 cde	1.28 f	0.37 e	81 ab	46 de	193 f	95 bc
Townhouse	100	2.95 a	0.31 ab	1.65 efg	1.45 ef	0.47 cde	80 b	45 de	235 ef	75 cd
Species average	***94.4***	***2.80***	***0.28***	***1.74***	***1.34***	***0.45***	***80***	***47***	***199***	***73***
L. speciosa	0	2.25 c	0.31 ab	2.03 abc	1.52 def	0.57 abc	41 c	38 e	322 def	74 cd

[z] Nutrient concentration values are averages of 8 plants.

[y] Percentage of plants (30 per cultivar) showing the disorder symptoms.