Evaluation of Insecticides for Suppression of Japanese Beetle, *Popillia japonica* Newman, and Crapemyrtle Aphid, *Tinocallis kahawaluokalani* Kirkaldy[1]

Gretchen V. Pettis, S. Kristine Braman, L. Paul Guillebeau and Beverly Sparks[2]
Department of Entomology, University of Georgia
1109 Experiment St., Griffin, GA 30223-1797

Abstract

Crapemyrtle aphid, *Tinocallis kahawaluokalani* (Kirkaldy), and Japanese beetle, *Popillia japonica* Newman, cause extensive damage to crapemyrtle, *Lagerstroemia* spp., in both the landscape and the nursery. We evaluated foliar and systemic insecticides for control of these two important pests in a field trial. Aphid control was also evaluated in a separate screen house trial on five cultivars of crapemyrtle. Talstar GH (bifenthrin), Scimitar GC (lambda-cyhalothrin), Merit 75WP (imidacloprid) and Flagship (thiamethoxam) were among the most effective of eleven insecticides tested in the field trial for suppression of concurrent populations of aphids and beetles. Greatest reduction in Japanese beetle damage alone was evident with bifenthrin and lambda-cyhalothrin. Aphid numbers were lowest on plants treated with Orthene TTO (acephate), Merit 75 WP and Flagship in the field trial and Flagship, Talstar GH and Scimitar GC in the screen house trial. Aphid numbers, among the five cultivars included in the screen house evaluations, were highest on 'Hopi' and lowest on 'Acoma'.

Index words: crapemyrtle aphid, Japanese beetle, insecticides, pest management.

Species used in this study: crapemyrtle (*Lagerstroemia* spp.), 'Muskogee', 'Dwarf Pink', 'Dwarf White', 'Pecos', 'Acoma', and 'Hopi'.

Chemicals used in this study: Azatin XL (azadirachtin), Dursban 50W (chlorpyrifos), 0,0-diethyl 0-(3,5,6-trichloro-2-pyridinyl); Flagship (thiamethoxam), 4H-1,3,5-oxadiazin-4-imine, 3-[(2-chloro-5-thiazolyl) methyl] tetrahydro-5-methyl-N-nitro; Merit 75 WP, (imidacloprid), 1-6[(6-chloro-3-pyridiyl)methyl]-N-nitro-2-imidazolidinimine; Orthene TTO (acephate), O,S-dimethyl-acetylphosphoroamidothioate; Scimitar (lambda-cyhalothrin), [1 alpha(S*), 3 alpha(Z)]-(±)-cyano(3-phenoxyphenyl) methyl-3-(2-chloro-3,3,3-trifluoro-1propenyl)-2,2-dimethylcyclopropanecarboxylate; Sevin SL, Sevin 80 WSP, (carbaryl) 1-naphthyl N-methylcarbamate); Talstar GH (bifenthrin), ((2-methyl [1,1'-biphenyl]-3-yl) methyl-3-(2-chloro-3,3,3-trifluoro-1-propenyl)-2,2-dimethylcyclopropane carboxylate); Tame 2.4 EC (fenpropathrin), alpha-cyano-3-phenoxybenzyl 2,2,3,3-tetramethylcyclopro-panecarboxylate; Tempo 20 WP (cyfluthrin), cyano(4-fluoro-3-phenoxyphenyl) methyl 3-(2,2-dichloroethenyl)-2,2-dimethylcyclopropanecarboxylate; Horticultural oil; Insecticidal soap.

Significance to the Nursery Industry

Crapemyrtle aphid, *Tinocallis kahawaluokalani* (Kirkaldy), with its associated sooty mold, *Capnodium* spp., is one of the most significant pests of crapemyrtle, *Lagerstroemia* spp. (2). Japanese beetle, *Popillia japonica* Newman, another important crapemyrtle pest, annually causes extensive defoliation (7). Because of the popularity of this woody plant to the nursery industry and in the landscape, it is often necessary to manage these key pests to avoid significant economic or aesthetic injury. This study provides the nursery and landscape industries with information on the most efficacious insecticides for suppressing crapemyrtle aphid and Japanese beetle adults on crapemyrtle.

Introduction

Beautiful and abundant summer flowers and interesting growth characteristics make crapemyrtle one of the most popular ornamental plants in the southern United States (USDA hardiness zones 7–10). Crapemyrtle is a widely used woody ornamental in southern landscapes because it is easy to propagate and grows under a wide range of site and soil conditions, with sizes ranging from dwarf shrubs to small trees (6). While few other insects cause problems on this exotic flowering plant, two pests, Japanese beetle and crapemyrtle aphid, can cause significant aesthetic and economic damage.

Crapemyrtle aphid is host specific to crapemyrtle in the United States and was apparently introduced to the U.S. mainland along with the plant (2). It was first described from the Hawaiian Islands, but can be found throughout the entire range of its host (2). The aphid, which has a tremendous reproductive capacity (1), produces a prodigious amount of honeydew while feeding. The honeydew, in turn provides a substrate on the crapemyrtle leaves for the growth of sooty mold. (5). This black mold covers all parts of the plant, potentially inhibiting photosynthesis and causing premature foliage drop, and may render plants unsalable by mid summer.

Eleven insecticides were evaluated in a field trial for the suppression of naturally occurring Japanese beetle and crapemyrtle aphid populations on containerized 'Muskogee' crapemyrtles. Plants were visually rated for Japanese beetle damage. In addition, seven insecticides were evaluated in a screen house trial on five cultivars of crapemyrtle ('Dwarf Pink', 'Dwarf White', 'Pecos', 'Acoma', and 'Hopi'). In both the field trial and the screen house trial, numbers of crapemyrtle aphids present on two terminal leaves were counted.

Materials and Methods

Experiment 1 — Field trial. One-year-old rooted cuttings of 'Muskogee' crapemyrtle were planted in 11.36 liter (3 gal)

[1]Received for publication July 21, 2004; in revised form May 13, 2005.
[2]IPM Program Assistant, Professor, Associate Professor, and IPM Coordinator and Professor and Extension District Head, respectively.

pots and arranged on 0.91 m (3 ft) centers on black weed barrier on May 9, 2000, in Griffin, GA. 'Muskogee' crapemyrtles were chosen based on previous trials, which showed them to be highly susceptible host plants for Japanese beetles (unpublished data), in hopes of inducing maximum beetle pressure from endemic populations. Plants were of uniform size (approx 2 ft tall at the beginning of the study) and were arranged in a randomized complete block design with six replications of 12 treatments. They were containerized in MetroMix 300 potting soil with starter fertilizer (Scotts-Sierra Horticulture, Marysville, OH). No additional fertilizer was applied to the plants during the period of the study. Plants were watered as needed with drip irrigation to prevent wilt symptoms. Six Japanese beetle floral lures (SureFire™ Products Japanese Beetle Trap, Consep, Inc., Bend, OR) were placed at regular intervals on 1.07 m (3.5 ft) tall wooden stakes along the periphery of the experimental plot. Crapemyrtle aphids were allowed to develop from natural infestations.

Insecticide treatments were applied on Day 0 (May 9) and Day 14 (May 23) at the recommended label rates (Table 1). The insecticides used were: Azatin XL (azadirachtin), Dursban 50W (chlorpyrifos), Flagship (thiamethoxam), Merit 75 WP, (imidacloprid), Orthene TTO (acephate), Scimitar (lambda-cyhalothrin), Sevin SL, Sevin 80 WSP (carbaryl), Talstar GH (bifenthrin), Tame 2.4 EC (fenpropathrin), and Tempo 20 WP (cyfluthrin). Plants receiving the same treatment were removed from the blocks and insecticides were applied to plants until total leaf wetness (approx. 0.1 liter/plant) at a rate of 378.5 liters/A (100 gal/A). A CO_2 pressurized backpack sprayer with a fan-type nozzle was used for all applications at a pressure of 30 psi. Treated plants were then placed back into the randomized complete block design. Insecticides were applied on Day 0 (May 9) and Day 14 (May 23) at the recommended label rates (Table 1).

Crapemyrtles were evaluated weekly from the date of the initial insecticide treatment for Japanese beetle damage. Two evaluators made visual ratings based on percent defoliation. Ratings were averaged for subsequent analysis. Crapemyrtle aphid populations, which developed from natural infestations, were evaluated at the conclusion of the experiment. Two fully expanded leaves were taken from the terminal end of each plant and placed in 0.12 liter (4 oz) plastic cups with lids and taken back to the lab. Total numbers of aphids per leaf were counted under 10X magnification. Aphids that had migrated off of the leaves and into the container during transport were also counted. Data on Japanese beetle damage were arcsine transformed and subjected to analysis of variance using the general linear models (GLM) procedure of SAS (8). Mean separation was by Fisher's protected least significant difference test (Fisher's LSD). Untransformed means are presented here. Data for crapemyrtle aphid populations were also analyzed using the GLM procedure and means separated by Fisher's protected LSD.

Experiment 2 — Screen house trial. Five cultivars of one-year-old rooted cuttings of crapemyrtle (approx. 2 ft tall at the beginning of the experiment) infested with naturally occurring crapemyrtle aphid populations were planted in 11.36 liter (3 gal) pots. The varieties used were 'Dwarf Pink', 'Dwarf White', 'Pecos', 'Acoma' and 'Hopi'. Plants were containerized with MetroMix 300 potting soil with starter fertilizer and watered as needed to prevent wilt symptoms. No additional fertilizer was applied to the plants during the period of the study. Plants were maintained on black shade cloth in a screen house in Griffin, GA, at the UGA Experiment Station. Insecticide treatments were applied on Day 0 (June 14, 2000) and Day 7 (June 21, 2000) to the point of total leaf wetness as in Experiment 1. The insecticides used were 2% horticultural oil, 2% insecticidal soap, Orthene TTO, Sevin 80WSP, Talstar GH, Scimitar GC, Flagship and a water control. Plants were arranged in a randomized complete block with five replications. One plant of each variety counted as a replication. Each of five adjoining rooms of the screen house containing the seven treatments was considered a block.

Aphid counts were taken before the application of insecticide treatments on Day 0 using the same method as in Experiment 1 and were counted on Days 5, 7, 12 and 14 after the initial insecticide treatment. Data were subjected to analysis of variance using the GLM procedure of SAS (8). Mean separation was by Fisher's protected LSD test.

Results and Discussion

Experiment 1 — Field trial. Thirty-one days after the initial insecticide treatment, all materials except Dursban provided significant reduction in Japanese beetle damage compared to the water control (Table 1). Crapemyrtles treated with Scimitar and Talstar averaged 11 and 15% defoliation, respectively, while defoliation in the untreated controls averaged 43%. Application of Orthene, Flagship, Merit, Talstar, Scimitar and Tame resulted in suppression of crapemyrtle aphids. These insecticides were not significantly different in their management of aphid populations, with mean aphid numbers ranging from 1–75.5 aphids/sample in comparison with a mean of 241 aphids/sample in the water control. Talstar, Scimitar, Merit and Flagship were among the most effective treatments for Japanese beetle and crapemyrtle aphid, each providing good to excellent control of both pests concurrently in this trial. Tame reduced beetle damage in our study and in previous work (12). Neem based material (azatin) in our study was not different from the control for aphid density at the conclusion of the study.

Experiment 2 — Screen house trial. Aphid density was high during this trial. Pretreatment numbers of aphids were not statistically different (Table 2) and averaged between approximately 200 and 400 aphids per two-leaf sample. All insecticides applied during this experiment significantly reduced the number of crapemyrtle aphids relative to the untreated control by five days after treatment (Table 2). All products provided statistically similar levels of control on day 5 and day 7 post-treatment. Treatments could not be statistically separated during the second week post application because of a substantial decline in aphid numbers, due to unknown causes, on the untreated controls, although the lowest numbers of aphids were still observed on plants treated with Scimitar and Flagship as in Experiment 1. Among the five cultivars used in this trial, 'Hopi' had the most aphids and 'Acoma' had the fewest but were not statistically different.

A number of reasons may explain why some of the chemical treatments, such as Sevin and insecticidal soap, were more prone to subsequent aphid populations. These factors include weather, systemic and residual activity of the pesticide and degeneration of the chemical by sunlight. Individual treatments may also have disrupted beneficial insect populations.

Table 1. Japanese beetle damage or number of crapemyrtle aphids after application of products for insect control on crapemyrtle.

Product	Active ingredient	Rate (as per label)	Japanese beetle damage				No. aphids
			week 1	week 2	week 3	week 4	
Flagship	thiamethoxam	0.32 L/1000 L (4 fl oz/100 gal)	11.7[z] ± 7.2bcd	15.7 ± 5.3a	14.5 ± 6.1cd	17.7 ± 4.5bcd	5.0 ± 2.6c
Sevin SL	carbaryl	2.55 L/1000 L (32.67 fl oz/100 gal)	4.7 ± 2.6bcd	24.5 ± 6.8a	19.3 ± 4.9bcd	22.5 ± 3.6bcd	183.0 ± 54.8ab
Sevin 80WSP	carbaryl	1.45 kg/1000 L (1.25 lb/100 gal)	4.7 ± 1.5bcd	24.0 ± 6.7a	22.2 ± 5.6bc	23.2 ± 6.5bcd	99.5 ± 19.3abc
Azatin XL	azadirachtin	1.25 L/1000 L (16 fl oz/100 gal)	6.2 ± 2.4bcd	19.5 ± 5.5a	22.5 ± 2.8bc	27.5 ± 3.1bc	202.2 ± 96.4ab
Talstar GH	bifenthrin	23.44 mL/1000 L (0.3 fl oz/100 gal)	2.2 ± 1.6cd	11.5 ± 5.6a	13.8 ± 5.4cd	15.0 ± 4.2bcd	75.5 ± 24.1bc
Dursban 50W	chlorpyrifos	1.80 kg/1000 L (1.5 lb/100 gal)	12.7 ± 5.2abc	16.5 ± 4.8a	30.0 ± 4.8ab	36.8 ± 6.2ab	108.0 ± 56.9abc
Tempo 20WP	cyfluthrin	145.30 g/1000 L (0.12 lb/100 gal)	15.1 ± 7.2ab	20.2 ± 7.9a	18.2 ± 6.6bcd	25.3 ± 6.6bc	171.0 ± 63.9ab
Scimitar GC	lambda-cyhalothrin	117.19 mL/1000 L (1.5 fl oz/100 gal)	3.8 ± 2.4cd	6.3 ± 1.2a	6.8 ± 1.5d	11.2 ± 2.2	66.0 ± 33.8bc
Tame 2.4 EC Spray	fenpropathrin	832.82 mL/1000L (10.66 fl oz/100 gal)	6.0 ± 2.3bcd	12.2 ± 5.2a	11.8 ± 3.5cd	18.3 ± 6.1bcd	90.8 ± 24.1bc
Orthene TTO	acephate	1.66 L/1000 L (21.3 fl oz/100 gal)	3.1 ± 1.9cd	12.5 ± 5.0a	21.7 ± 5.1bc	23.0 ± 3.4bcd	1.2 ± 0.8c
Merit 75WP	imidacloprid	36.98 g/1000 L (0.03 lb/100 gal)	1.1 ± 0.3d	6.6 ± 2.5a	16.7 ± 4.0bcd	19.2 ± 2.1bcd	20.7 ± 10.4c
Water	N/A	N/A	23.3 ± 6.0a	25.0 ± 3.4a	39.2 ± 5.2a	43.3 ± 3.6a	241.3 ± 102.1a
$F_{5,11}$			2.8	1.5	3.0	3.2	2.4
P			0.01	0.2	0.003	0.002	0.02
LSD			11.2	—	13.9	13.3	146.52

[z]Mean S.E. for percent damage.

Table 2. Number of crapemyrtle aphids on crapemyrtle after application of insecticides.

Chemical common name	Active ingredient	Rate	Number of aphids on X day post treatment (dpt)				
			pretreatment	5 dpt	7 dpt	12 dpt	14 dpt
Horticultural oil	horticultural oil	20 L/1000 L (2 gal/100 gal)	275.8[z] ± 73.2a	19.4 ± 15.4b	49.8 ± 38.1b	39.8 ± 20.1a	53.2 ± 43.8a
Insecticidal soap	insecticidal soap	20 L/1000 L (2 gal/100 gal)	394.0 ± 135.6a	46.0 ± 28.5b	21.6 ± 18.1b	78.0 ± 53.9a	74.4 ± 39.3a
Flagship	thiamethoxam	0.32 L/1000 L (4 fl oz/100 gal)	214.8 ± 91.5a	0.8 ± 0.4b	0.8 ± 0.6b	0.8 ± 0.8a	0.0a
Sevin 80WSP	carbaryl	1.45 kg/1000 L (1.25 lb/100 gal)	317.0 ± 102.1a	21.6 ± 11.9b	23.0 ± 9.1b	70.2 ± 57.3a	43.6 ± 31.6a
Talstar GH	bifenthrin	23.44 mL/1000 L (0.3 fl oz/100 gal)	295.6 ± 45.8a	0.0b	0.0b	0.8 ± 0.4a	8.2 ± 7.2a
Scimitar GC	lambda-cyhalothrin	117.19 mL/1000 L (1.5 fl oz/100 gal)	227.2 ± 80.3a	0.0b	0.0b	0.6 ± 0.6a	0.2 ± 0.2a
Orthene TTO	acephate	1.66 L/1000 L (21.3 fl oz/100 gal)	255.8 ± 119.1a	0.0b	0.6 ± 0.4b	1.6 ± 0.7a	15.6 ± 14.8a
Water	N/A	N/A	315.8 ± 74.1a	349.8 ± 81.7a	149.4 ± 33.2a	22.6 ± 5.9a	24.6 ± 8.3a
$F_{5,11}$			0.8	14.5	6.7	0.2	0.1
P			—	0.0001	0.0001	—	—
LSD			—	91.6	57.8	—	—

[z]Mean S.E.

Although beneficial arthropods were not directly evaluated, lady beetles (Coleoptera: Coccinellidae) and green lacewings (Neuroptera: Chrysopidae) were observed during the study. It has been shown that chemical sprays, particularly broad-spectrum insecticides, can have a negative impact on insect biodiversity (10). Often a rapid rebound of the target pest insect population results when pesticides used to 'control' the pest kill its predators and parasites, which as a result releases the herbivorous pest from its biological control.

Several insecticide chemistries were evaluated for their relative efficacy in controlling natural populations of Japanese beetle, as indicated by plant damage, and crapemyrtle aphid, indicated by numbers of aphids on a two-leaf sample, on containerized crapemyrtles in this study. Results from the two experiments demonstrated that Azatin, a neem extract, showed relatively low effectiveness for aphid control when compared to the other products. Greatest reduction in Japanese beetle damage was evident with Talstar (bifenthrin) and Scimitar (lambda-cyhalothrin). Tame (fenpropathrin), a synthetic pyrethroid, displayed moderate to good control of both pests.

Flagship, (thiomethoxam) and Merit (imidacloprid) belong to the relatively new neonicotinoid class of insecticides. These showed excellent potential in our trials for inclusion in Integrated Pest Management programs for crapemyrtle because of their low mammalian toxicity, low use rates, systemic action and excellent control of both aphids and Japanese beetles. These two materials have also been shown to provide effective control of a new beetle pest of viburnums (11) and other insect pests (3, 4, 9, 13).

Opportunities to develop and implement Integrated Pest Management (IPM) for nursery production and landscape plants increase with the identification of pest-resistant plants (5, 7) and availability of effective alternative chemistries. Evaluation of emerging chemistries against older products is important for informed decision making by the pest management practitioner.

Literature Cited

1. Alverson, D.R and R.K. Allen. 1991. Life history of the crapemyrtle aphid. Proc. S. Nurserymen's Assoc. Res. Conf. 36:164–167.

2. Alverson, D.R. and K.R. Allen. 1992. Bionomics of the crapemyrtle aphid (Homoptera: Aphididae). J. Entomol. Sci. 27:445–457.

3. Braman, S.K. 2002. Effects of cultivar and insecticide choice on oleander aphid management and arthropod dynamics on *Asclepias* species. J. Environ. Hort. 20:11–15.

4. Lawson, A.B. 2003. Evaluation of systemic insecticides as a treatment option in integrated pest management of the elm leaf beetle, Xanthogaleruca luteola (Muller) (Coleoptera: Chrysomelidae). J. Econ. Ent. 96:1455–1462.

5. Mizell, R.F. and G.W. Knox. 1993. Susceptibility of crapemyrtle, *Lagerstroemia indica* L., to the crapemyrtle aphid (Homoptera: Aphididae) in north Florida. J. Entomol. Sci. 28:1–7.

6. Mizell, R.F. III and G.W. Knox. 1999. Crapemyrtle — beauty with biological control. Hort. Digest August(10): http://www.hortdigest.com/archives/8-99/crape.htm.

7. Pettis, G.V., D.W. Boyd, Jr., S.K. Braman, and C. Pounders. 2004. Susceptibility of crapemyrtle cultivars to flea beetle (Coleoptera: Chrysomelidae) and Japanese beetle (Coleoptera: Scarabaeidae) damage in choice and no-choice trials and possible sources of resistance. J. Econ. Entomol. 97:981–992.

8. SAS Institute. 2003. SAS/STAT User's Guide 8.02 ed. SAS Institute, Inc. Cary, NC.

9. Torres, J.B. 2004. Toxicity of thiamethoxam and imidacloprid to *Podisus nigrispinus* (Dallas) (Heteroptera: Pentatomidae) nymphs associated to aphid and whitefly control in cotton. Neotropical Entomology. 33:99–106.

10. VanDrieshe, R.G and T.S. Bellows, Jr. 1996. Biological Control. Chapman and Hall, 539 pp. Florence, KY.

11. Weston, P.A, B. Esenhaur, J.M. Baird, and J.S. Lamboy. 2002. Evaluation of insecticides for control of larvae of *Pyrrhalta viburni*, a new pest of viburnums. J. Environ. Hort. 20:82–85.

12. Witt, J.D., S.L. Warren, T.G. Ranney and J.R. Baker. 1999. Biorational and conventional plant protectants reduce feeding by adult Japanese beetles. J. Environ. Hort. 17:203–206.

13. Yue, B. 2003. Evaluation of thiamethoxam and imidacloprid as seed treatments to control European corn borer and Indianmeal moth (Lepidoptera: Pyralidae) larvae. J. Econ. Ent. 96:503–509.