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An Exotic Insect Pest, Crapemyrtle Bark Scale (*Acanthococcus lagerstroemiae*) (Hemiptera: Eriococcidae): Host Range and Acceptance Among 19 Plant Species

Bin Wu[1], Runshi Xie[1], Gary W. Knox[2], Madison Dinkins[3], Hongmin Qin[3], Mengmeng Gu[4]

[1]Department of Horticultural Sciences, Texas A&M University, College Station TX 77843, USA; [2]Department of Environmental Horticulture, University of Florida/IFAS North Florida Research and Education Center, Quincy, FL 32351; [3]Department of Biology, Texas A&M University, College Station 77840, USA; [4]Department of Horticultural Sciences, Texas A&M AgriLife Extension Service, College Station, TX 77843, USA

bin.wu@tamu.edu; mgu@tamu.edu

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Abstract

Crapemyrtle bark scale (CMBS), *Acanthococcus lagerstroemimae* (Hemiptera: Eriococcidae), is an introduced, sucking pest mainly found on crapemyrtle (*Lagerstroemia* spp. L.). CMBS has been reported in 14 U.S. states. Confirming the range of CMBS's acceptance of different plant species is necessary to estimate its potential in aggravating risks in ecology and losses for the ornamental industry. Hence, in this study, a multiple-choice test was conducted in a greenhouse for 3 months to investigate the host range of CMBS as well as its acceptance among 19 plant species. Based on the current observation record, CMBS's host plants included six *Lagerstroemia* species (*L. caudata*, *L. fauriei* 'Kiowa', *L. indica* 'Dynamite', *L. limii*, *L. speciosa*, and *L. subcostata*) and nine *Callicarpa* species (*C. acuminata*, *C. americana* 'Bok Tower', *C. bodinieri* 'Profusion', *C. dichotoma* 'Issai', *C. japonica* var. *luxurians*, *C. longissima* 'Alba' *C. pilosissima*, *C. randaiensis* and *C. salidifolia*). Evaluation with a one-way ANOVA (P<0.01) indicated that CMBS showed significant difference in accepting 19 plant species.

INTRODUCTION

Crapemyrtle bark scale (CMBS), *Acanthococcus* (syn. *Eriococcus*) *lagerstroemiae* (*Kuwana*), is an exotic felt scale in the family Eriococcidae (Wang et al., 2016). *Acanthococcus. lagerstroemiae* seriously threatens growth and development of certain ornamental plants and reduces aesthetic quality because it sucks phloem sap and secrets honeydew. This consequently leads to declining plant health and black sooty mold (Gu et al., 2014). In the summer of 2014, CMBS was initially discovered in Richardson, TX (Merchant et al., 2014). Currently, CMBS has rapidly spread into 14 states including: Alabama, Arkansas, Georgia, Kansas, Louisiana, Mississippi, New Mexico, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia (EDDMapS, 2019 and Washington (personal communication).

From the perspective of an herbivorous insect, "acceptance of a plant" means continuous food intake and oviposition occurs on the plant after the insect's central nervous system positively evaluates the plant (Schoonhoven et al., 2005). Schoonhoven et al. (2005) viewed "acceptance" as the pivotal decision taken during host-plant selection inasmuch as it directly makes the acquisition of nutrients and oviposition happen consequently. Thus, firstly confirming CMBS's acceptance of certain ornamental and crop plants is of utmost importance to assess potential ecological risks and economic losses Venette et al. (2010). Wang et al. (2019) reported that CMBS infestation was not only confined to crapemyrtle 'Natchez' (*Lagerstroemia indica* × *fauriei* L.) but also occurred on *Lawsonia inermis* L., *Heimia salicifolia* Link, *Punica granatum* L., *Lythrum alatum* Pursh, and *Callicarpa americana* L. 12 weeks after CMBS inoculation. Our previous observations on CMBS infestation test in a greenhouse also indicated that *Ficus carica* L., *Malus pumila* and *Glycine max* could support growth and development of CMBS. However, no systematic study was found investigating CMBS's acceptance of diverse *Lagerstroemia* species, assorted *Callicarpa* species and several *Ficus* species simultaneously.

MATERIALS AND METHODS

Host Plants

Six *Lagerstroemia* species (*L. caudata*, *L. fauriei* 'Kiowa', *L. indica* 'Dynamite', *L. limii*, *L. speciosa*, *L. subcostata*), nine *Callicarpa* species (*C. acuminata*, *C. americana* 'Bok Tower', *C. bodinieri* 'Profusion', *C. dichotoma* 'Issai', *C. japonica* var. *luxurians*, *C. longissima* 'Alba', *C. pilosissima*, *C. randaiensis*, *C. salicifolia*), three *Ficus* species (*F. pumila*, *F. roxburghii*, *F. tikoua*) and *Lythrum californicum*, as shown in Table 1, were tested and compared in the study. All plants were potted up in one-gal pots containing Jolly Gardener Pro-Line C/25 growing mixture (Oldcastle Lawn & Garden Inc, Poland Spring, ME)

Insects

CMBS-infected branches were collected from the nursery pad in the Department of Horticultural Sciences, Texas A&M University in May 2019. White ovisacs in good condition were selected to infest the 19 plant species.

Table 1. A multiple-choice test was used to evaluate 19 plant species as CMBS host candidates.

Species	Series	Section	Family	Native origin
Callicarpa pilosissima	*Callicarpae*	*Callicarpa*	Verbenaceae	China
Callicarpa acuminata	*Callicarpae*	*Callicarpa*	Verbenaceae	Mexico, USA
Callicarpa americana 'Bok Tower'	*Callicarpae*	*Callicarpa*	Verbenaceae	USA
Callicarpa bodinieri 'Profusion'	*Callicarpae*	*Callicarpa*	Verbenaceae	China, Vietnam
Callicarpa dichotoma 'Issai'	*Callicarpae*	*Callicarpa*	Verbenaceae	China, Japan, Korea
Callicarpa japonica var. *Luxurians*	*Verticirimae*	*Callicarpa*	Verbenaceae	China, Japan, Korea
Callicarpa longissima 'Alba'	*Callicarpae*	*Callicarpa*	Verbenaceae	China, Japan, Vietnam
Callicarpa randaiensis	*Verticirimae*	*Callicarpa*	Verbenaceae	China
Callicarpa salicifolia	*Callicarpae*	*Callicarpa*	Verbenaceae	China
Ficus pumila	--	*Sect. Rhizocladus*	Moraceae	East Asia
Ficus roxburghii (auriculata)	--	*Sect. Neomorphe*	Moraceae	Asia
Ficus tikoua	--	*Sect. Ficus*	Moraceae	Asia
Lagerstroemia caudata	--	--	Lythraceae	China
Lagerstroemia fauriei 'Kiowa'	--	--	Lythraceae	Japan
Lagerstroemia indica 'Dynamite'	--	--	Lythraceae	--
Lagerstroemia limii	--	--	Lythraceae	China
Lagerstroemia speciosa	--	--	Lythraceae	China
Lagerstroemia subcostata	--	--	Lythraceae	Japan, China, Philippines
Lythrum californicum	--	--	Lythraceae	Mexico, USA

Greenhouse Experiment

The multiple-choice experiment was conducted in Texas A&M University (TAMU) Department of Horticultural Sciences Greenhouse. Each plant was tied with CMBS-infested branches containing five fresh white ovisacs, and then one set of the 19 species was arranged in a cage with no canopy overlap. The cage (75cm × 50cm × 40cm) was made of PVC pipe frames, covered and enclosed with handmade mesh netting, and a 30cm-long zipper was added to the front mesh panel to water and observe plants easily. There were a total three sets of 19 species in three cages (three replicates) and the cages were placed separately on different benches in the greenhouse at 25 ± 5°C and 50 ± 10%RH.

Statistical Analysis

The plants in cages were examined bi-weekly starting three weeks after the CMBS inoculation. To confirm host range and eval-uate CMBS acceptance among these plant species, the number of CMBS pupae (recognized by white narrowly spindle-shaped cocoons) and gravid females (recognized by white oval ovisacs) on each species as key parameters were counted and compared for 3 months. Plant species that supported several generations of CMBS were defined as host plants (Sands and Van Driesche, 1999), and variation in average amount of pupae and gravid females on each species under the same family was relevant to the insect's different feeding and oviposition acceptance. Data on average amount of pupae as well as gravid females were analyzed separately by One-way ANOVA using JMP Pro 14 (SAS Institute, Cary, NC).

RESULTS

Host Range Confirmation

Based on the current observation record (Figure 1), an increasing number of white pupae and white ovisacs were largely seen on all of the six *Lagerstroemia* species (*L. caudata*, *L. fauriei* 'Kiowa', *L. indica* 'Dynamite', *L. limii*, *L. speciosa*, and *L. subcostata*) as well as seven of the nine *Callicarpa* species (*C. americana* 'Bok Tower', *C. dichotoma* 'Issai', *C. japonica* var. *luxurians*, *C. longissima* 'Alba', *C. pilosissima*, *C. randaiensis*, and *C. salicifolia*). The average amount of pupae in *C. dichotoma* 'Issai', for instance, increased to 217 on August 22nd, while average gravid females increased to 124.

There was a remarkable increase in *L. limii* with 756 pupae and 377 gravid females. In marked contrast, only 9 pupae and 4 gravid females emerged on *C. acuminata*; 5 pupae and 2 gravid females were observed on *C. bodinieri* 'Profusion'. Just one pupa formed on each *F. tikoua* plant 3 months after CMBS inoculation. The result indicated that the six *Lagerstroemia* species as well as the nine *Callicarpa* species mentioned above were CMBS host plants.

CMBS Feeding and Oviposition Acceptance among 19 Plant Species

Variation in average number of pupae and gravid females on each species was relevant to the insect's different acceptance - including feeding and oviposition. On 22 August 2019, the data was taken and analyzed with a one-way ANOVA running JMP Pro 14 - to determine the plant species effect on number of pupae and gravid females. The One-way analysis result demonstrated significant difference in the average amount of pupae (F=2.9606, DF=18, 37; $P < 0.01$) and gravid females (F=6.1820, DF=18, 37; $P < 0.001$) among the 19 species. Thus, CMBS was accepted differently among the 19 plant species. The largest number of pupae was observed on *L. subcostata* (826), followed by *L. limii* (735), *C. dichotoma* 'Issai' (217) and *L. fauriei* 'Kiowa' (184) (Fig. 1). The largest number of gravid females occurred on *L. limii* (377), followed by *L. subcostata* (302), *L. fauriei* 'Kiowa' (200) and *C. dichotoma* 'Issai' (124).

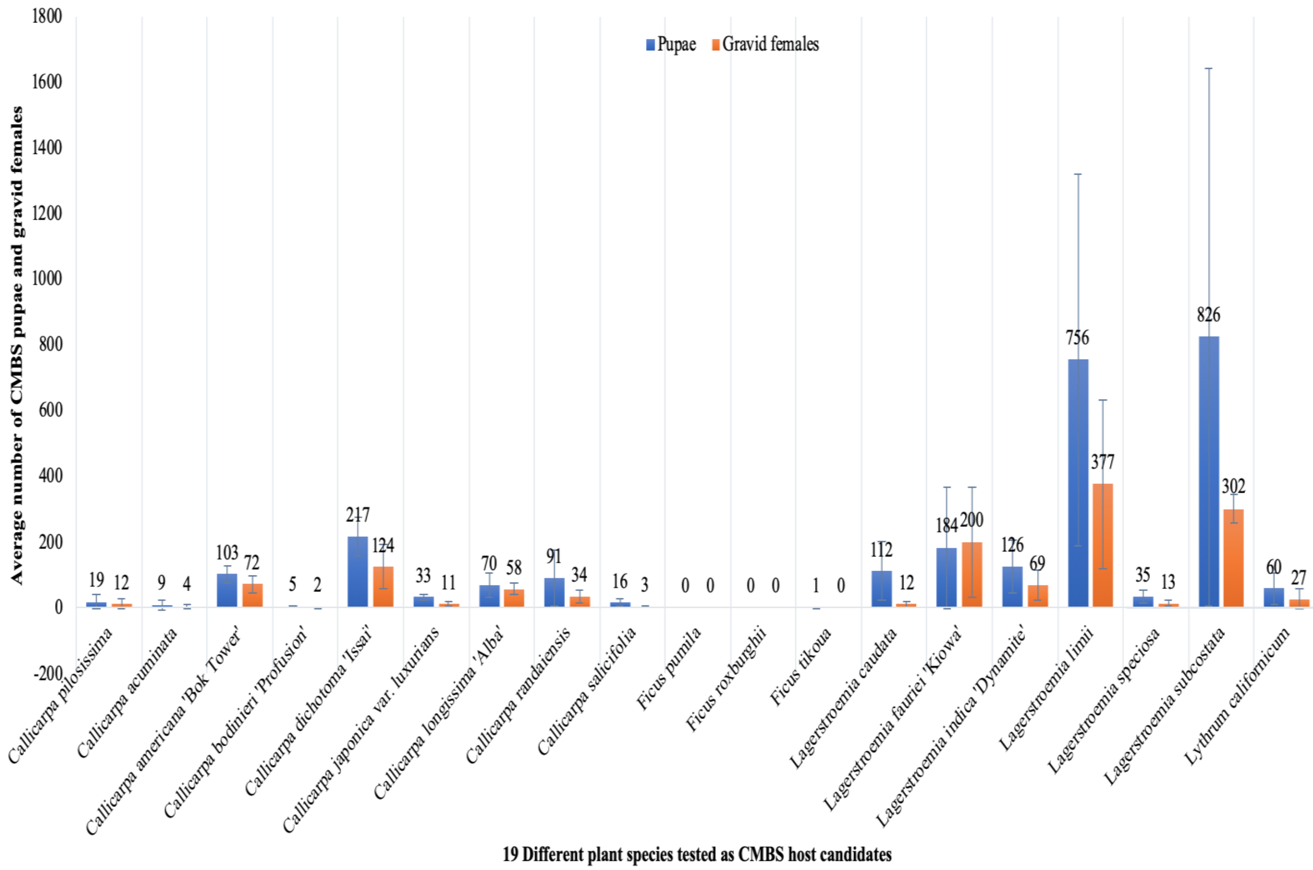

Figure 1. Average amount of pupae and gravid females on *Callicarpa*, *Ficus* and *Lagerstroemia* and *Lythrum* plant species (22 August 2019).

DISCUSSION

Our study shows that CMBS was able to complete its life cycle and largely proliferate on all of the six *Lagerstroemia* species and the nine *Callicarpa* species. There were noted differences in CMBS accepting the evaluated 19 plant species. The underlying cause of CMBS's differential acceptance of these plant species is worthy of further study. Varying acceptance could be caused by differences in physical features (trichomes, tissue thickness and wax microstructure) and/or chemical compounds (volatiles, carbohydrates, amino acids and some plant secondary metabolites) among the different species and cultivars (Schoonhoven et al., 2005). For example, CMBS fed and laid eggs on *F. carica* but cocoons or white ovisacs were hardly seen on *F. pumila* and *F. roxburghii*. The reason why *F. roxburghii* did not support growth and development of CMBS was probably because its surface texture was too thick for CMBS to probe. Future research will evaluate and compare differences in surface morphology and select primary plant metabolites among these three species. Determining parameters affecting plant acceptance can provide insight for improved pest management.

Literature Cited

EDDMapS. (2019). Early detection and distribution mapping system. The University of Georgia - Center for Invasive Species and Ecosystem Health. http://www.eddmaps.org last accessed August 31, 2019.

Gu, M., Merchant, M., Robbins, J., and Hopkins, J. (2014). Crape myrtle bark scale: A new exotic pest. Texas A&M AgriLife Ext. Service. EHT 49.

Merchant, M.E., Gu, M., Robbins, J., Vafaie, E., Barr, N., Tripodi, A.D., and Szalanski, A.L. (2014). Discovery and spread of *Eriococcus lagerstroemiae* Kuwana (Hemiptera: Eriococcidae), a new invasive pest of crape myrtle, *Lagerstroemia* spp. *https://bugwoodcloud.org › pdf › ESAPosterDiscovAndSpread2014*

Sands, D., and Van Driesche, R. (1999). Evaluating the host range of agents for biological control of arthropods: rationale, methodology and interpretation, Host Specificity Testing of Exotic Arthropod Biological Control Agents: The Biological Basis for Improvement in Safety. Proceedings of the Xth International Symposium on Biological Control of Weeds. pp. 69-83.

Schoonhoven L.M., Van Loon, B., van Loon, J.J., and Dicke, M. (2006). Insect-Plant Biology. Oxford University Press. 2nd Ed. ISBN: 9780198525950

Venette, R.C., Kriticos, D.J., Magarey, R.D., Koch, F.H., Baker, R.H., Worner, S.P., Gómez Raboteaux, N.N., McKenney, D.W., Dobesberger, E.J., and Yemshanov D. (2010). Pest risk maps for invasive alien species: a roadmap for improvement. BioScience *60*:349-362.

Wang, Z., Chen, Y., Gu, M., Vafaie, E., Merchant, M., and Diaz, R. (2016). Crapemyrtle Bark scale: a new threat for crapemyrtles, a popular landscape plant in the U.S. Insects *7*: 78.

Wang, Z., Chen, Y., and Diaz, R. (2019). Temperature-dependent development and host range of crapemyrtle bark scale, *Acanthococcus lagerstroemiae* (Kuwana) (Hemiptera: Eriococcidae). Florida Entomologist *102*:181-186.