N O T E

Japanese Beetle (Coleoptera: Scarabaeidae) Response to Field-Grown Crape Myrtles[1]

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The Japanese beetle, *Popillia japonica* Newman, is recognized as the most widespread and destructive pest of turf, landscape and nursery crops in the eastern United States (Fleming 1972, U.S.D.A. Tech. Bull. 1449; Potter and Held 2002, Annu. Rev. Entomol. 47: 175 - 205). The adults feed on more than 300 plant species including crape myrtle which is one of the most popular deciduous flowering trees grown in the United States (Pettis et al. 2004, J. Econ. Ent. 97: 981 - 992). Crape myrtles (*Lagerstroemia* spp.) owe their popularity to their striking appearance and easy cultivation and maintenance requirements, which are associated with low insect and disease problems. Some of the common problems encountered are the crape myrtle aphid, *Tinocallis kahawaluokalani* (Kirkaldy), granulate ambrosia beetle, *Xylosandrus crassiusculus* (Mot.), powdery mildew, *Erysiphe* sp., and *Cercospora* leaf spot. However, in recent years, crape myrtle cultivation has been challenged by arthropod pests like flea beetles (*Altica* spp., Coleoptera: Chrysomelidae) and the Japanese beetle. Whereas flea beetles are primarily a problem on crape myrtles in the nursery rather than on established landscape plantings, Japanese beetles attack both nursery and field- grown plants. Insecticidal control remains the only option to manage or prevent Japanese beetle damage to susceptible nursery stock. Short- term residual insecticides have been used effectively against adults (Pettis et al. 2005, J. Environ. Hort. 43: 145 - 148), although they may flare secondary pests (Potter and Held 2002). Plants vary in their susceptibility to this pest (Held 2004, J. Arboric. 30: 328 - 335) providing a means to manage Japanese beetle while minimizing insecticide use. Previous work has identified resistance to insects and disease-causing organisms among crape myrtle species and cultivars (e.g., Mizell and Knox 1993, J. Entomol. Sci. 28: 1 - 7; Hagan et al. 1998, J. Environ. Hort. 16: 143 - 147; Pettis et al. 2004).

Excised whole leaves or leaf discs are the most common substrates for testing the feeding or ovipositional preferences of phytophagous insects because it is often not

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feasible to use whole plants (Lewis 1984, T. A. Miller (ed.), Techniques in plant-insect interactions. Springer-Verlag, NY). However, it is widely understood that physical damage can cause significant changes in the plant's chemistry which may in turn influence the behavior of herbivores feeding on it (Rhoades 1983, R. Denno and M. McClure (eds.), Impact of variable host quality on herbivorous insects. Academic Press). Our prior projects evaluating crape myrtles for potential resistance to Japanese beetles were restricted to the use of detached leaves and container plants (Pettis et al. 2004). Here we report the relative resistance among field-grown crape myrtles to natural infestations of Japanese beetle in north Georgia.

Four, 3.7 l replicates of 41 crape myrtle cultivars (Figs. 1, 2), representing a range of flower color and heights were planted on 5 m centers at the University of Georgia Mountain Station in Blairsville in May 2004. Plants were mulched with pine bark mulch and irrigated as necessary to establishment.

Plants were subsequently monitored for insect infestation and data collected (insect counts and damage estimates) when pest populations were high enough to discern differences among entries (2005, 2006 and 2008). Insects of interest included Japanese beetle and crape myrtle aphid. Only the Japanese beetle was present in high enough numbers to evaluate from 2004 - 2008. Number of beetles visible on a plant was recorded on 3 sample dates during 2005 and 2006. Visual estimates of percent damage on whole plants was recorded by a minimum of 2 observers and averaged during 2005, 2006, and 2008. Data were transformed using an arcsin, square root transformation before being subjected to an analysis of variance using the GLM procedure of SAS 9.1 (SAS Institute 2003). Mean separation was by Tukey's HSD test.

Pest populations did not reach high levels until 2005 and were limited to Japanese beetles which were abundant during 2005, 2006 and 2008. Number of beetles per plant was highly variable within a season and often depended on differences in timing of bloom. Number of beetles at any particular time did not always reflect overall plant damage. Percent plant (foliar) damage was viewed as a better estimate of potential Japanese beetle resistance.

On the first sample date (6 August, 2005) the average numbers of beetles observed on the different cultivars ranged from 0 - 51.8 ($F = 6.44$, df = 40, $P < 0.0001$). 'Muskogee' had the highest average number of beetles (51.8), which was significantly higher than all the other cultivars except 'Sioux' and 'Comanche' (50.8 and 36.8, respectively). Several cultivars were observed with 10 or fewer beetles. Among these, 'Chickasaw' had no beetles, whereas average number of beetles on 'Lipan', 'Tonto', 'Hardy Lavender', 'Pink Velour', 'Pokomoke' and 'Tuscarora' was less than one. Cultivars that had between 10 and 25 beetles were 'Acoma', 'Byer's Wonderful White', 'Carolina Beauty', 'Catawba', 'Zuni', 'Biloxi', 'Yuma', 'Natchez', 'Hopi' and 'Miami' (Fig. 1A).

The second sample date (23 August 2005) revealed very low numbers of beetles in general ranging from 0 - 4, and so there were no significant differences among the cultivars ($F = 1.46$, df = 40, $P = 0.635$).

On the third sample date (10 July 2006) the average numbers of beetles ranged from 0 - 61 ($F = 2.64$, df = 40, $P < 0.0001$). No beetles were found on the cultivars 'Biloxi', 'Chickasaw', 'Pocomoke' and 'Wichita'. Several cultivars had fewer than 10 beetles on average: 'Hardy Lavender', 'Potomac', 'Raspberry Sundae', 'Tonto', 'Tuscarora', 'Apalachee', 'Lipan', 'Tuskegee', 'Acoma', 'Muskogee', 'Centennial', 'Victor', 'Miami', 'Pecos', 'Hope', 'Centennial Spirit', 'Dynamite' and 'Powhatan'. Nineteen cultivars had an average of 10 or more beetles and among these the highest numbers were

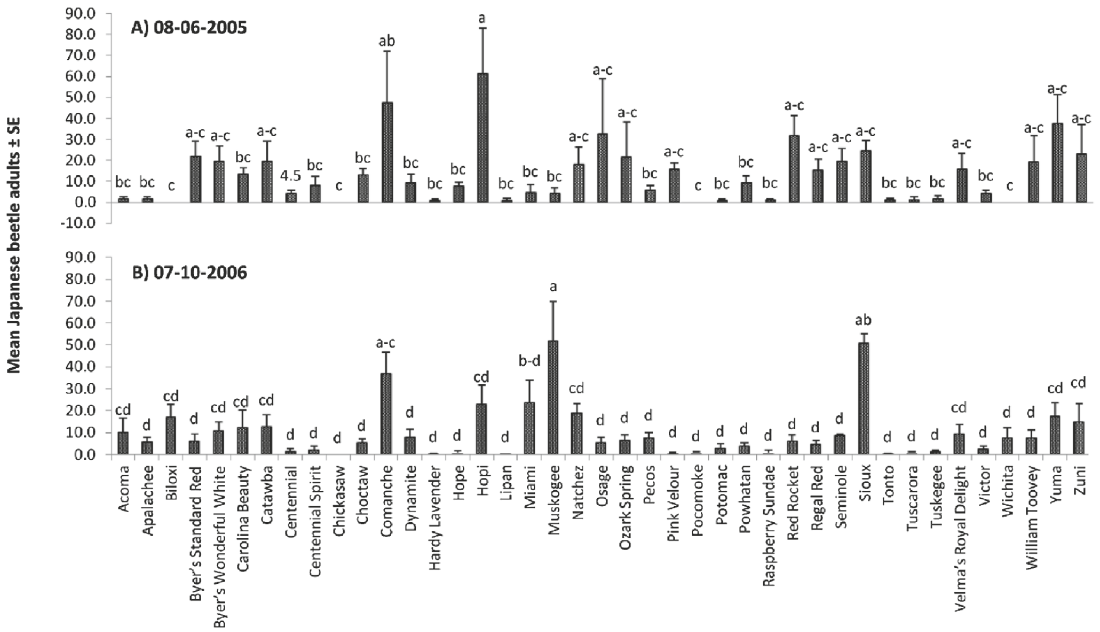

Fig. 1. Mean number of Japanese beetle adults present on field grown crape myrtle cultivars on sample dates during 2005 - 2006 (A) 08 - 06 - 2005, (B) 07 - 10 - 2006.

seen on 'Hopi', 'Comanche' and 'Yuma' (61.3, 47.5 and 37.5 respectively). 'Hopi' beetle counts were significantly higher than those on several other cultivars, but were not significantly higher than those on 'Regal Red', 'Velma's Royal Delight', 'Pink Velour', 'Natchez', 'William Toovey', 'Catawba', 'Byer's Wonderful White', 'Seminole', 'Ozark Spring', 'Byer's Standard Red', 'Zuni', 'Sioux', 'Red Rocket', 'Osage', 'Yuma' and 'Comanche' (Fig. 1B).

Percent damage on leaves was recorded on 4 sample dates. Five cultivars showed greater than 20% leaf damage on the first sample date (6 August 2005). These ranged from 22.1 ('Byer's Wonderful White'), 23.8 ('Biloxi'), 29.8 ('Sioux'), 30.4 ('Hopi') to 30.5 ('Comanche') ($F = 3.89$, df = 40, $P < 0.0001$). These damage ratings were statistically similar to those on some cultivars with damage ratings ranging from 18.3 ('Miami') to 8.8 ('William Toovey'), but significantly different from some of the other cultivars which had leaf damage ranging from 8.4 ('Pocomoke') to 1.0 ('Chickasaw') (Fig. 2A).

On the second sample date (23 August 2005), leaf damage rating percentages ranged from 1.4 - 48.5 ($F = 7.57$, df = 40, $P < 0.0001$). Nine cultivars had leaf damage between 25 - 50% and these were 'Osage' (25.9), 'Regal Red' (26.0), 'Miami' (26.6), 'Natchez' (27.8), 'Comanche' (36.1), 'Byer's Wonderful White' (41.1), 'Hopi' (43.5), 'Biloxi' (47.0) and 'Sioux' (48.5). These ratings were significantly higher than those on the other cultivars that showed lower than 25% percent leaf damage. Among these the lowest damage was on 'Chickasaw' (1.4%) (Fig. 2B).

'Hopi' had the highest leaf damage of 30.3% on the third sample date (10 July 2006), and this was significantly higher than the damage on all the other cultivars except 'Pink Velour' (15.1), 'Zuni' (15.3), 'Seminole' (15.4), 'Sioux' (16.5), 'Regal Red' (20.0), 'Comanche' (23.8), 'Byer's Wonderful White' (25.3) and 'Biloxi' (28.0) ($F = 6.02$, df = 40, $P < 0.0001$). The other cultivars were not significantly different from each other in leaf damage, and 'Chickasaw' was the lowest among these (0.13) (Fig. 2C).

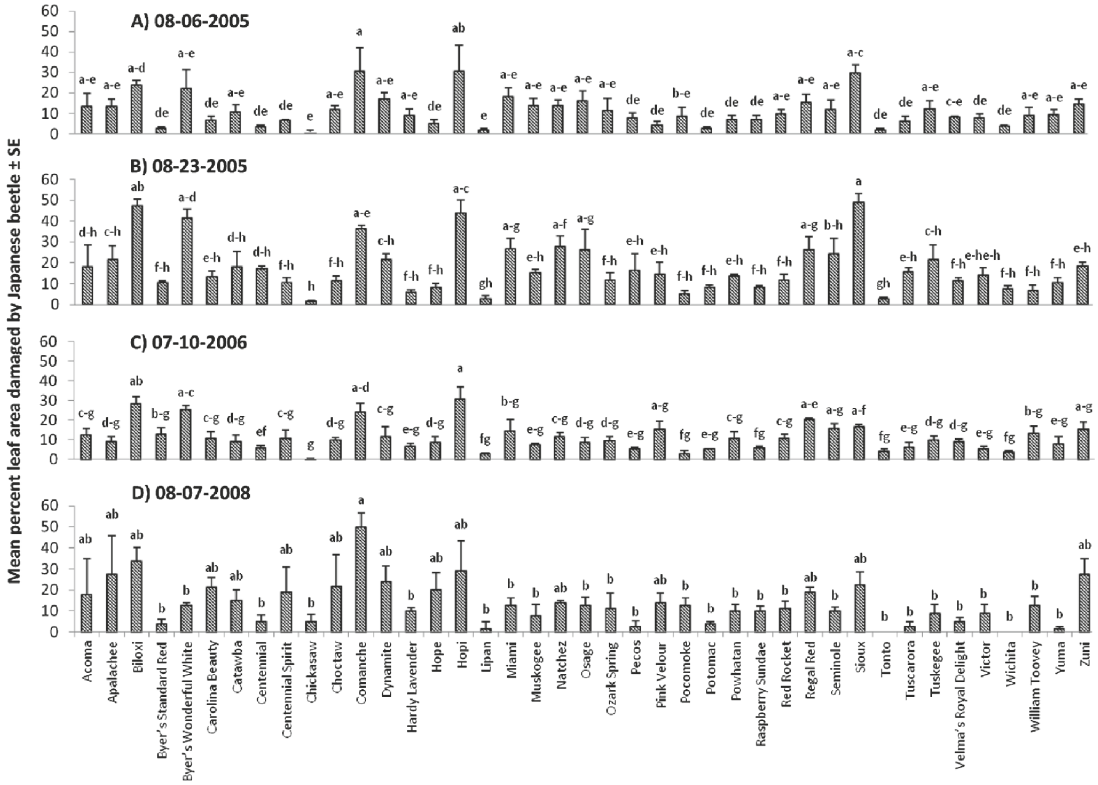

Fig. 2. Mean percentage leaf damage by Japanese beetle adults present on field grown crape myrtle cultivars over four sample dates during 2005 - 2008. (A) 08 - 06 - 2005, (B) 08 - 23 - 2005, (C) 07 - 10 - 2006, (D) 08 - 07 - 2008.

'Chickasaw' was again among the cultivars with lowest leaf damage on the fourth sample date (7 August 2008) on which the damage ratings ranged from 0 - 5.0 ($F = 2.45$, df = 40, $P < 0.0001$). Some varieties showed no feeding damage (0), like 'Lipan', 'Tonto' and 'Wichita'. However, these 4 varieties were not significantly different from all the other varieties except 'Comanche', which had the highest rating of 5% (Fig. 2D).

Field trials showed differential susceptibility among crape myrtle cultivars to Japanese beetles. Some cultivars consistently showed a lower preference by the beetles, indicated by lower leaf damage and fewer numbers of beetles on the plants. The cultivars that showed significantly lower percent leaf damage on 3 or more sample dates were 'Centennial', 'Chickasaw', 'Choctaw', 'Lipan', 'Pecos', 'Potomac', 'Raspberry Sundae', 'Tonto', 'Wichita' and 'Tuscarora'. The cultivars that consistently had significantly fewer or no beetles on 3 or more sample dates were 'Apalachee', 'Chickasaw', 'Hardy Lavender', 'Lipan' 'Pocomoke', 'Potomac', 'Raspberry Sundae', 'Tonto', 'Tuscarora', and 'Wichita'. The cultivars that were among the most damaged on 3 or more sample dates were 'Biloxi', 'Byer's Wonderful White', 'Comanche', 'Dynamite', 'Hopi', 'Miami, 'Natchez', 'Regal Red', 'Sioux' and 'Zuni'; and the cultivars that consistently had significantly higher numbers of beetles on two or more sample dates were 'Byer's Wonderful White', 'Catawba', 'Comanche', 'Hopi', 'Miami', 'Natchez', 'Osage', 'Regal Red', 'Sioux', and 'Zuni'.

From the above results it was possible to identify clear differences among the cultivars in susceptibility to Japanese beetles. Some of these results are in agreement with the results obtained with screening containerized crape myrtle plants. Pettis et al. (2004) evaluated crape myrtle cultivars to identify potential resistance to Japanese beetle and flea beetles, *Altica* spp. In that study, the cultivars 'Regal Red', 'Tuscarora', 'Zuni', 'Miami', and 'Carolina Beauty' were highly damaged by Japanese beetles, whereas 'Cordon Blue', 'Tonto', 'Lipan', 'New Orleans', and 'Acoma' were among the least damaged in choice trials. In no-choice trials, 'Wichita', 'Potomac', 'Lipan', 'Comanche', 'Choctaw', 'Biloxi', 'Tuscarora', 'Catawba', 'Yuma', 'Chickasaw', 'Centennial Spirit', 'Sioux', and 'Pokomoke' had significantly lesser damage, whereas the most damaged cultivars were 'Red Rocket', 'Victor', 'Byers Standard Red', 'Byers Wonderful White', 'Raspberry Sundae', 'Zuni', and 'Seminole'. Cultivars with *Lagerstroemia fauriei* Koehne in their parentage generally exhibited less damage by Japanese beetles and *Altica* sp. flea beetles with few exceptions (Pettis et al. 2004). Resistance identified in prior studies was largely confirmed in the present report with the following exceptions; 'Acoma' determined to be resistant in Pettis et al. (2004) was moderately resistant in the present study, whereas 'Chickasaw', found moderately resistant in the prior study proved to be resistant under field conditions.

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