Field Survey of Asian Citrus Psyllid (Hemiptera: Liviidae) Infestations Associated with Six Cultivars of Poncirus trifoliata (Rutaceae)

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Field survey of Asian citrus psyllid (Hemiptera: Liviidae) infestations associated with six cultivars of *Poncirus trifoliata* (Rutaceae)

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The Asian citrus psyllid, *Diaphorina citri* Kuwayama (Hemiptera: Liviidae), is an important pest because it transmits a bacterium 'Candidatus Liberibacter asiaticus' putatively responsible for a serious citrus disease known as Asian huanglongbing or citrus greening disease (Bové 2006; Gottwald 2010). Classic recommendations to growers confronted with the disease are to plant disease-free nursery stock, routinely identify and remove infected trees to reduce inoculum loads, and aggressively manage populations of the psyllid (Hall et al. 2013). Insecticidal control is the key tactic used to manage the psyllid, but host plant resistance may hold some promise in the search for alternative tactics. Whereas no resistance to the psyllid has been observed within the *Citrus* genus (Rutaceae), relatively strong levels of antixenotic resistance to the psyllid have been reported in *Poncirus trifoliata* (L. Raf. (Rutaceae), a species in the same Rutaceae subfamily as *Citrus*. Aubert (1987) noted reduced infestations of the psyllid on *P. trifoliata*. Westbrook et al. (2011) conducted a field survey of 87 genotypes in the plant family Rutaceae and concluded *P. trifoliata* was one of the most resistant to psyllid colonization. Recent laboratory and greenhouse investigations confirmed that *P. trifoliata* cultivars usually are colonized less by the psyllid than are *Citrus* cultivars (Richardson & Hall 2013; Hall et al. 2015).

The purpose of the research presented here was to assess infestations of the psyllid associated with 5-yr-old *P. trifoliata* trees under field conditions. Infestation densities of eggs and nymphs on flush shoots were monitored over the summer of 2016 on 6 pure *P. trifoliata* cultivars, 4 citrange cultivars, and 2 conventional *Citrus* cultivars—a sweet orange (*Citrus sinensis* [L.] Osbeck) cultivar (Hamlin) and a sweet orange hybrid (Temple) (Table 1). Citranges are hybrids between *P. trifoliata* and sweet orange. Six to 8 trees of each of the 12 cultivars were available for monitoring in a large planting of many experimental citranges (0.8 ha area, 8 rows with about 100 trees per row, 1.5 m spacing between trees, 1 cultivar per row). The trees were subjected to regular irrigation, fertilization, and weed control but without any insecticides or horticultural oils. On each sample date, 2 flush shoots (each with at least some leaves appropriate for oviposition) were randomly collected from each tree, transported to a laboratory, and examined under a microscope to count numbers of eggs and nymphs of *D. citri*. Additionally on each sample date, each tree was examined to estimate the percentage of branches with flush shoots appropriate for oviposition. Data on log-transformed numbers of psyllids per flush shoot and on arcsine-transformed percentages of flush shoots with 5th instar nymphs were subjected to analyses of variance (PROC GLM; SAS Institute 2010), mean comparisons among cultivars were investigated with the Ryan-Einot-Gabriel-Welsch multiple range test, and results were reported with untransformed means.

*Poncirus trifoliata* is a deciduous genotype, and trees in the field are thus usually completely void of foliage throughout the winter.

Table 1. Mean number of immature Asian citrus psyllids per flush shoot in a 5-yr-old field planting of *Citrus*, citrange, and *Poncirus trifoliata* trees sampled during Mar to Sep 2016.

| Genotype group | Cultivar       | Mean number per flush shoot¹ | Mean percentage of infested samples with fifth instar nymphs³ |
|----------------|----------------|------------------------------|------------------------------------------------------------|
|                | Eggs           | Nymphs                       |                                                            |
| Citrus         | Hamlin         | 16.0ab                      | 21.6a                                                     | 37.2ab                             |
| Citrus         | Temple         | 10.6b                       | 22.5a                                                     | 47.7ab                             |
| Citrange       | C-35           | 25.0a                       | 20.4a                                                     | 18.5ab                             |
| Citrange       | Carrizo        | 18.6ab                      | 16.1a                                                     | 23.3ab                             |
| Citrange       | Norton         | 21.4ab                      | 20.2a                                                     | 34.0ab                             |
| Citrange       | Uvalde         | 28.7ab                      | 24.4a                                                     | 35.3ab                             |
| Poncirus       | Argentina      | 0.8c                        | 1.5b                                                      | 13.3b                              |
| Poncirus       | Flying Dragon  | 2.0c                        | 1.1b                                                      | 7.7b                               |
| Poncirus       | Large Flower   | 0.8c                        | 0.8b                                                      | 57.1a                              |
| Poncirus       | Pomeroy        | 0.8c                        | 1.6b                                                      | 27.3ab                             |
| Poncirus       | Rich 16-6      | 0.9c                        | 0.4b                                                      | 20.0ab                             |
| Poncirus       | Rubidoux       | 1.7c                        | 1.0b                                                      | 9.1b                               |

¹Means in the same column followed by the same letter are not significantly different (P > 0.05), Ryan-Einot-Gabriel-Welsch multiple range test.

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whereas citranges may be semi-deciduous. During early Mar of this survey, ample quantities of flush shoots were present in trees of the Citrus and citrange cultivars, and psyllid eggs and nymphs were present on this flush. However, none of the P. trifoliata trees at this time had yet broken winter dormancy and thus all of them were barren of foliage. The P. trifoliata cultivars began to flush toward the end of Mar. Thereafter during the summer, at least some flush was consistently available on the P. trifoliata cultivars, and flushing patterns were similar in Citrus, citranges, and P. trifoliata (Fig. 1a). Among 9 sample dates during late Mar to Sep, relatively large infestation densities of eggs and nymphs were observed on the Citrus and citrange cultivars whereas significantly fewer were consistently observed on the pure P. trifoliata cultivars (Table 1; Fig. 1b). Over all sample dates, means ± SE of 13.3 ± 1.9, 23.7 ± 2.4, and 1.1 ± 0.2 eggs per flush shoot were observed on the Citrus, citrange, and P. trifoliata cultivars, respectively. Although fewer eggs were deposited on P. trifoliata, at least some of these hatched: means of 2.0 ± 2.3, 20.8 ± 1.9, and 1.0 ± 0.2 nymphs per flush shoot were observed on the Citrus, citrange, and P. trifoliata cultivars, respectively. Few nymphs were observed on the pure P. trifoliata shoots but at least some developed to the 5th instar (Table 1), and general observations indicated these older nymphs were healthy enough that they would have successfully molted to the adult stage.

Reduced colonization by Asian citrus psyllid on P. trifoliata was largely a result of reduced rates of oviposition. Because P. trifoliata readily hybridizes with Citrus species, if the specific traits responsible for reduced oviposition can be identified, then it might be possible to transfer these traits to conventional Citrus cultivars. However, we found no reduced oviposition on the 4 citrange cultivars tested in this study. The resistance in P. trifoliata to psyllid oviposition may be either a recessive or a multi-genic trait, or there may be genetically controlled traits in Citrus that promote oviposition.

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**Summary**

The Asian citrus psyllid (Hemiptera: Liviidae) transmits a bacterium responsible for huanglongbing, a serious citrus disease. Insecticidal control of the psyllid is a key tactic used to manage the disease, but host plant resistance may hold some promise and clues in the search for alternative tactics. Results of a field survey revealed that relatively large infestation densities of the psyllid developed on conventional Citrus ( Rutaceae) and citrange ( Rutaceae) cultivars but not on any of 6 Poncirus trifoliata (L.) Raf. ( Rutaceae) cultivars. Poncirus trifoliata is a species closely related to Citrus, and citranges are hybrids of sweet orange and P. trifoliata. Reduced colonization by the psyllid on P. trifoliata was largely a result of reduced rates of oviposition. Poncirus trifoliata resistance to oviposition was not observed in 4 citrange cultivars.

Key Words: citrus greening; huanglongbing; Diaphorina citri; Liberibacter

**Sumario**

El psílido asiático de los cítricos (Hemiptera: Liviidae) transmite la bacteria responsable del huanglongbing, una enfermedad seria de los cítricos. El control químico del psílido es una táctica clave utilizada para manejar la enfermedad, pero la resistencia de la planta hospedadora puede ser prometedora y dar una pista en la búsqueda de tácticas alternativas. Los resultados de un sondeo del campo revelaron densidades de infestación relativamente grandes del psílido desarrollándose en cultivares convencionales de Citrus ( Rutaceae) y citrange ( Rutaceae), pero no sobre ninguno de los 6 cultivares de Poncirus trifoliata (L.) Raf. ( Rutaceae). Poncirus trifoliata es una especie estrechamente relacionada con Citrus y las citranges son híbridos de naranja dulce y P. trifoliata. La reducción de la colonización por el psílido sobre P. trifoliata fue en gran parte resultado de una tasa de oviposición reducida. No se observó resistencia a la oviposición en Poncirus trifoliata en los 4 cultivares de citrange.

Palabras Clave: enverdecimiento de los cítricos; huanglongbing; Diaphorina citri; Liberibacter

**References Cited**

Aubert B. 1987. Trioza erytreae Del Guercio and Diaphorina citri Kuwayama (Homoptera: Psylloidea), the two vectors of citrus greening disease: biological aspects and possible control strategies. Fruits 42: 149–162.

Bové JM. 2006. Huanglongbing: a destructive, newly-emerging, century-old disease of citrus. Journal of Plant Pathology 88: 7–37.

Gottwald TR. 2010. Current epidemiological understanding of citrus huanglongbing. Annual Review of Phytopathology 48: 119–139.

Hall DG, Richardson ML, Ammar ED, Halbert SE. 2013. Asian citrus psyllid, Diaphorina citri (Hemiptera: Psyllidae), vector of citrus huanglongbing disease. Entomologia Experimentalis et Applicata 146: 207–223.

Hall DG, George J, Lapointe SL. 2015. Further investigations on colonization of Poncirus trifoliata by the Asian citrus psyllid. Crop Protection 72: 112–118.

Richardson ML, Hall DG. 2013. Resistance of Poncirus and Citrus × Poncirus germplasm to the Asian citrus psyllid. Crop Science 53: 183–188.

SAS Institute, Inc. 2010. SAS® Procedures Guide Version 9.3. SAS Institute, Cary, North Carolina.

Westbrook CJ, Hall DG, Stover EW, Duan YP, Lee RF. 2011. Colonization of Citrus and Citrus-related germplasm by Diaphorina citri (Hemiptera: Psyllidae). HortScience 46: 997–1005.