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Sarucallis kahawaluokalani (Kirkaldy) (Hemiptera: Aphididae),
a new invasive aphid on San Andres island and mainland Colombia,
with notes on other adventive species

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Sarucallis kahawaluokalani (Kirkaldy) (Hemiptera: Aphididae), a new invasive aphid on San Andres island and mainland Colombia, with notes on other adventive species

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Abstract. The crape myrtle aphid *Sarucallis kahawaluokalani* (Kirkaldy) (Hemiptera: Aphididae) collected on *Lagerstroemia indica* (Lythraceae) is herein reported as a new invasive species in the city of Palmira, State of Valle del Cauca, and on San Andres island, in the State of San Andres, Old Providence and Santa Catalina, Colombia. The species is illustrated and diagnosed. A brief review of recent invasive species in Colombia, i.e., *Ceroplastes rubens* Maskell (Hemiptera: Coccidae), *Crypticerya multicastrices* Kondo and Unruh (Hemiptera: Monophlebidae) [invasive on the island of San Andres], *Diaphorina citri* Kuwayama (Hemiptera: Liviidae), *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae), *Maconellicoccus hirsutus* (Green) (Hemiptera: Pseudococcidae) and *Singhiella simplex* (Singh) (Hemiptera: Aleyrodidae); and other adventive (but non-invasive) species in Colombia, i.e., *Anagyryus kamali* Moursi (Hymenoptera: Encyrtidae), *Gyranusoidea indica* Shafee, Alam and Agarwal (Hymenoptera: Encyrtidae), and *Tamarixia radiata* (Waterston) (Hymenoptera: Eulophidae) is provided.

Resumen. El pulgón del árbol de Júpiter, *Sarucallis kahawaluokalani* (Kirkaldy) (Hemiptera: Aphididae) colectado sobre *Lagerstroemia indica* (Lythraceae) se reporta como un nuevo insecto invasor en la ciudad de Palmira, departamento del Valle del Cauca y en la isla de San Andrés, departamento de San Andrés, Providencia y Santa Catalina, Colombia. La especie es ilustrada y diagnosticada. Se provee un breve resumen de especies invasoras recientes en Colombia, i.e., *Ceroplastes rubens* Maskell (Hemiptera: Coccidae), *Crypticerya multicastrices* Kondo and Unruh (Hemiptera: Monophlebidae) [invasora en la isla de San Andrés], *Diaphorina citri* Kuwayama (Hemiptera: Liviidae), *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae), *Maconellicoccus hirsutus* (Green) (Hemiptera: Pseudococcidae) y *Singhiella simplex* (Singh) (Hemiptera: Aleyrodidae); y otras especies adventicias (pero no invasoras) en Colombia, i.e., *Anagyryus kamali* Moursi (Hymenoptera: Encyrtidae), *Gyranusoidea indica* Shafee, Alam and Agarwal (Hymenoptera: Encyrtidae) y *Tamarixia radiata* (Waterston) (Hymenoptera: Eulophidae).

Introduction

Crape myrtle, *Lagerstroemia indica* L. (Lythraceae), is native to China, but very common in cultivation and also feral in Bangladesh, Bhutan, Cambodia, India, Indonesia, Japan, Laos, Malaysia, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Thailand and Vietnam (Sánchez de Lorenzo-Cáceres 2000). In the New World, crape myrtle is recorded from Belize, Bolivia, Cameroon, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Puerto Rico, United States, U.S. Virgin Islands, Venezuela (STRI Herbarium 2013); and Brazil (Lorenzi and Souza 2001).



Figure 1. Adult female of *Sarucallis kahawaluokalani* (Kirkaldy). **A.** Alate female in life. Palmira, Colombia. **B.** Slide-mounted alate female. Notice large bifid tubercle (see arrow). Photo A taken by T. Kondo; B by R. Simbaqueba-Cortés.

Recently, the first author collected specimens of a characteristic aphid with ornate wings on crape myrtle at Corpoica, Palmira Research Center, in the city of Palmira, in the State of Valle del Cauca, Colombia. The same aphid species was later collected on the same host on the island of San Andres, in the State of San Andres, Old Providence and Santa Catalina, of Colombia, located in the Caribbean Sea. The aphid was identified as *Sarucallis kahawaluokalani* (Kirkaldy) (Hemiptera: Aphididae), a new invasive species for Colombia. Here we provide some information that will aid in the identification of this aphid species and a summary of other recent adventive (invasive and non-invasive) species in Colombia. There are many definitions for invasive species, e.g., “invasive species are those that are not native to the ecosystem under consideration and that cause or are likely to cause economic or environmental harm or harm to human, animal, or plant health” (Beck et al. 2008); adventive (= non-native, nonindigenous) species which threaten ecosystems, habitats, or species (Frank and Thomas (2004). Invasive insects (those that are pests) are by definition a subset of adventive species (Frank and Thomas (2004). According to these definitions, we consider *Harmonia axyridis* as an invasive species; because it causes environmental harm by displacing native coccinellids (see section on *H. axyridis* in Results and Discussion). Exotic natural enemies that have newly arrived to Colombia are herein considered as adventive species.

Materials and Methods

The specimens were slide-mounted chiefly following the method of Blackman and Eastop (2000). The insects were immersed in a solution of 10% KOH in a glass tube heated in a hot water bath for 5–10 minutes, then cleaned in 1% acetic acid in a Petri dish. The internal content of each specimen was removed using a fine hair brush. Specimens were dehydrated gradually, soaked in 70%, 80% and 95% EtOH for 5–10 minutes respectively. Cleared specimens were placed into Petri dishes with clove oil to remove remaining residues. Each specimen was then placed onto a slide in a drop of Canada balsam, and sealed with a cover slip. Each slide was labeled with the insect’s collection data and dried on a hot plate for 3 weeks at 45°C. The specimens were identified as *S. kahawaluokalani* first by TK based on external morphology and host plant information, and later RSC verified this identification based on the cuticular morphology of slide-mounted specimens using the “Key to Lagerstroemia aphids” by Blackman and Eastop (1994).

Repositories

MECP	Museo de Entomología, Corporación Colombiana de Investigación Agropecuaria, Centro de Investigación Palmira, Palmira, Valle del Cauca, Colombia.
MEFLG	Museo Entomológico Francisco Luis Gallego, Universidad Nacional de Colombia, Sede Medellín, Medellín, Colombia.
UNAB	Museo Entomológico Facultad de Agronomía, Universidad Nacional de Colombia, Sede Bogotá, Bogotá, Cundinamarca, Colombia.

Material studied. *Sarucallis kahawaluokalani*. **Colombia:** Valle del Cauca, Palmira, Corporación Colombiana de investigación Agropecuaria (CORPOICA), Centro de investigación Palmira, 03°30'52.8"N, 76°18'58.3"W, 1014 m asl, 20.x.2013, coll. T. Kondo, *ex* on leaves of *Lagerstroemia indica* L. (Lythraceae), 5 slides 10 specimens, catalogue number 813 (3 slides UNAB; 2 slides MEFLG). **Colombia:** San Andrés, Barrio Obrero, 12°34'20.6"N, 81°42'19.9"W, 26 m asl, 27.xi.2013, coll. T. Kondo, *ex* on leaves of *Lagerstroemia indica* L. (Lythraceae), 5 slides 10 specimens (3 slides UNAB; 1 slide MEFLG; 1 slide MECP).

Results and Discussion

Sarucallis kahawaluokalani (Kirkaldy) (Hemiptera: Aphididae)

Diagnosis. According to Bodlah et al. (2013), the crape myrtle aphid can be diagnosed as follows: winged females are yellow or pale green in color (Fig. 1A). Colonies are composed of nymphs and winged females. Alate females with dark longitudinal stripes on head, thorax and apex of leg segments (Fig. 1A). Head and thorax devoid of spinal tubercles; antenna 6 segmented, each segment pigmented at its apex, antennal tubercles feebly developed (Fig. 1A). Processus terminalis 1.5 or less than length of base of antennomere VI. Fore wings with black spots on veins (Fig. 1A). Abdominal segment II with one large bifid medial tubercle, markedly pigmented (Figure 1B). Abdominal lateral tubercles well developed (Fig. 1B). Siphunculi short, dark, anal plate bilobed; cauda knobbed, with 8 or 9 hairs. Nymphs pale to bright yellow, with black spike- or hair-like projections on the abdomen, lacking black spots, but with two large black tubercles on dorsum of abdomen.

Sarucallis kahawaluokalani belongs to the tribe Panaphidini in the subfamily Calaphidinae (Favret 2013). It is native to Southeast Asia, but was first described from specimens collected in Hawaii, by Kirkaldy (Herbert and Mizell 2006). The crape myrtle aphid is the most important insect pest of crape myrtle *Lagerstroemia* spp. in the United States and heavy infestations may cause cosmetic damage, although feeding appears to have no long-term effects on plant health or vigor (Herbert and Mizell 2006). *Sarucallis kahawaluokalani* also is commonly known in the scientific literature as *Tinocallis kahawaluokalani* (Kirkaldy, 1907). Until recently, the genus *Sarucallis* Shinji, 1922, was placed as a synonym of *Tinocallis* Matsumura, 1919, by Remaudière and Remaudière (1997), but it was later revived as a separate genus by Quednau (2003). Some junior synonyms of *S. kahawaluokalani* include: *Monellia lagerstroemiae* Takahashi, 1920; *Sarucallis lythrae* Shinji, 1920; and *Tinocallis kahawaluokalani* (Kirkaldy, 1907) (Yovkova and Petrovic-Obradovic 2011).

Sarucallis kahawaluokalani is widely distributed and has been reported from Argentina, Brazil, China, Cuba, France, Germany, Greece, Hawaii, Honduras, India, Italy, Japan, Korea, Panama, Spain, United States, and Venezuela (Blackman and Eastop 1994; Carrera and Cermeli 2003; Evans and Halbert 2007; Grillo 2008; Higuchi 1972; Leclant and Renoust 1986; Mier Durante et al. 1995; Peronti and Sousa-Silva 2002; Quiros and Emmen 2006; Szpeiner 2008; Tsitsipis et al. 2007). It is the most important insect pest on *Lagerstroemia* spp. (Herbert and Mizell 2006; Mizell and Schiffhauer 1987). Additionally, *S. kahawaluokalani* is mostly monophagous, monoecious and holocyclic (Lazzari and Zonta-de-Carvalho 2006), feeding mainly on *Lagerstroemia indica* L., but occasionally found on *Eugenia uniflora* L. (Myrtaceae) (Zemora 2009) and *Punica granatum* L. (Lythraceae) (Mizell and Knox 1993). In the USA, *S. kahawaluokalani* is monophagous, feeding exclusively on crape myrtle (Herbert and Mizell 2006). All samples of *S. kahawaluokalani* in Colombia were collected on leaves of *L. indica*.

This is the first report of *S. kahawaluokalani* from continental Colombia and from San Andres Island. San Andres is the main island of the Archipelago of San Andres, Old Providence and Santa Catalina, a southwestern Caribbean State of Colombia, composed of an extensive area of islands, banks and cays in the western Caribbean, located about 700 km northwest of mainland Colombia, and 250 km east of Nicaragua (Geister and Diaz 1997, Hartnoll et al. 2006).

Other Recent Adventive (Invasive and Non-Invasive) Species in Colombia

In the last decade, there has been an increase in the number of adventive (invasive and non-invasive) species reported from Colombia. Some of the recent invasions besides *S. kahawaluokalani* are discussed below.

Diaphorina citri Kuwayama, 1908 (Hemiptera: Liviidae)

Of all recent invasive species, *Diaphorina citri* (Fig. 2A) has received particular attention because it is a confirmed vector of the phloem limited gram-negative bacterium *Candidatus Liberibacter asiaticus*, one of the pathogens that cause the devastating citrus disease “Huanglongbing” (HLB) or citrus greening disease (Halbert and Manjunath 2004, Grafton-Cardwell et al. 2013). Besides being a vector of HLB, the Asian citrus psyllid, *D. citri*, can cause direct damage to its host plant by sucking large amounts of sap, injecting toxins that cause malformation of leaves and shoots and by inducing sooty molds that grow on the honeydew they produce (Michaud 2004). *Diaphorina citri* has a worldwide distribution; in South America it is known from Argentina, Brazil, Colombia, Paraguay, Uruguay and Venezuela (Augier et al. 2006, Cermeli et al. 2007, EPPO 2005, ICA 2010a). In Colombia, *D. citri* was reported in Colombia for the first time in 2007 and has been recorded since from the States of Antioquia, Atlántico, Bolívar, Caldas, Cauca, Cesar, Córdoba, Cundinamarca, Magdalena, Meta, Norte de Santander, Quindío, Risaralda, Santander, Sucre, Tolima, and Valle del Cauca (ICA 2010a).

Scale Insects (Hemiptera: Coccoidea)

A few scale insects also have been reported as invasive in Colombia in recent years. The pink wax scale, *Ceroplastes rubens* Maskell, 1893 (Hemiptera: Coccidae) (Fig. 2B), was reported in 2008 from the State of Valle del Cauca on *Philodendron* sp. and *Aglaonema* sp. (Kondo 2008) and since then it has also been collected on avocado leaves of various cultivars in the coffee growing region of Colombia, which includes the States of Antioquia, Caldas, Risaralda and Valle del Cauca (Kondo et al. 2011). In the Neotropical region, *C. rubens* has been reported from Colombia (Kondo 2008), Guadeloupe (Matile-Ferrero and Étienne 2006), Haiti (Perez-Gelabert 2008), Martinique (Matile-Ferrero and Étienne 2006) and Puerto Rico (Nakahara and Miller 1981). In Colombia, *C. rubens* is commonly found in low numbers and it is not considered a pest (T.K. personal observation).

The Colombian fluted scale, *Crypticeria multicitricas* Kondo and Unruh, 2009 (Hemiptera: Monophlebidae) (Fig. 2C), was reported as an invasive pest on the islands of San Andres and Old Providence in 2010 (ICA 2010b). It likely arrived on the islands of San Andres and Old Providence on infested ornamental plants brought from continental Colombia (Kondo et al. 2012a). *Crypticeria multicitricas* is endemic to mainland Colombia and has only been reported as an invasive species on San Andres and Old Providence islands (ICA 2010b; Kondo et al. 2012a).

The pink hibiscus mealybug (PHM), *Maconellicoccus hirsutus* (Green 1908) (Hemiptera: Pseudococcidae) (Fig. 2D), was originally reported from the States of Atlántico, Cesar, Guajira and Magdalena, on mainland Colombia (Kondo et al. 2008). The oldest known museum specimens of the PHM from mainland Colombia are dated 2006 (Kondo et al. 2008), but the insect was introduced to Colombia in 2003 (M.A. Alterio, pers. comm. *apud* Kondo et al. 2012a). The PHM was reported as an invasive pest on Old Providence Island in 2010 (ICA 2010b) and later from the island of San Andres in 2012 (Kondo et al. 2012a). In the New World, the PHM was first recorded from Grenada in 1993 (Persad 1995), and later spread to many other Caribbean islands, Colombia, USA (California and Florida), and Venezuela

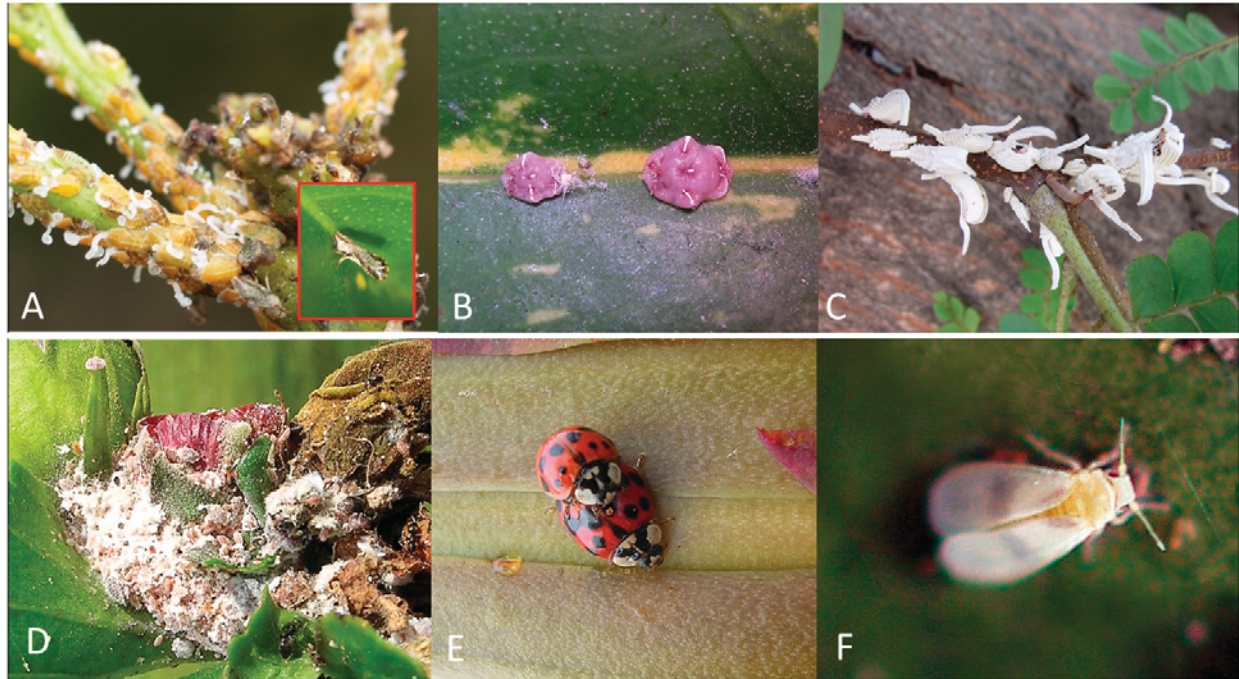


Figure 2. Recent invasive species in Colombia. **A.** *Diaphorina citri* Kuwayama. **B.** *Ceroplastes rubens* Maskell. **C.** *Crypticerya multicatrices* Kondo and Unruh. **D.** *Maconellicoccus hirsutus* (Green). **E.** *Harmonia axyridis* (Pallas). **F.** *Singhiella simplex* (Singh). Photos taken by T. Kondo.

(Kondo et al. 2012a). The PHM has continued to spread in South America, being recently reported as an invasive species in neighboring Brazil (Culik et al. 2013; Marsaro-Júnior 2013). Like *C. multicatrices*, *M. hirsutus* probably arrived on the islands of San Andres and Old Providence on infested ornamental plants brought from continental Colombia (Kondo et al. 2012a).

The multicolored Asian lady beetle, *Harmonia axyridis* (Pallas, 1773) (Coleoptera: Coccinellidae)

Harmonia axyridis (Pallas, 1773) (Coleoptera: Coccinellidae) (Fig. 2E) was reported first from Colombia in 2011 (Brown et al. 2011; Amat-Garcia et al. 2011). However, Kondo and González (2013), based on data of museum insect specimens, indicated that the arrival of *H. axyridis* in Colombia occurred in 1989 or earlier, at least 22 years before the first published reports in 2011, and has expanded its distribution to the States of Antioquia, Caldas, Cauca, Cundinamarca, Nariño, Tolima and Valle del Cauca. In South America, *H. axyridis* is known from Argentina, Brazil, Chile, Colombia, Paraguay, Peru, Ecuador, and Uruguay (González and Kondo 2012; Kondo and González 2013). *Harmonia axyridis* may cause negative impacts by affecting non-target arthropods; fruit production; and as a household invader (Koch and Galvan 2008). Besides being often used as a biological control agent, *H. axyridis* is thought to displace native coccinellids through resource competition wherever it is introduced (Koch et al. 2006). In Colombia, based on observations, it appears that *H. axyridis* has displaced *Hippodamia convergens* Guérin-Ménéville, 1842 and *Coleomegilla maculata* (De Geer, 1775) from a cassava orchard at the International Center for Tropical Agriculture located in the municipality of Palmira (Kondo & Gonzalez 2012).

The fig whitefly, *Singhiella simplex* (Singh, 1931) (Hemiptera: Aleyrodidae)

One of the most recent invasive species in Colombia is the fig whitefly, *Singhiella simplex* (Fig. 2F), reported from Colombia on leaves of Cuban laurel *Ficus microcarpa* L. f. in the city of Palmira and on

the weeping fig *F. benjamina* L. (Moraceae), a common tree along the streets of Cali and Palmira, in the State of Valle del Cauca (Kondo and Evans 2012). *Singhiella simplex* is native to the Oriental region (Burma, China and India) and has been introduced to Puerto Rico and the USA (Florida) (Hodges 2007; Evans 2008; Mannion et al. 2008). It has been recorded also from Brazil, Cayman Islands, Jamaica (Jesus et al. 2010; Velasco et al. 2011), and was observed in Israel in 2011 and first recorded in Colombia in 2012 (Kondo and Evans 2012).

Adventive parasitoids (Hymenoptera: Chalcidoidea)

(Not illustrated)

Invasive species may arrive together with their natural enemies or the natural enemies arrive soon after. The latter has been the case with the natural enemies of the Asian citrus psyllid, *D. citri*, and the PHM, *M. hirsutus*, in Colombia. *Diaphorina citri* was reported in Colombia for the first time in 2007 and its principal parasitoid, the ectoparasitoid *Tamarixia radiata* (Waterston) (Hymenoptera: Eulophidae), was first reported in Colombia in 2011 in the States of Cundinamarca (Ebratt et al. 2011a, b) and Norte de Santander (Ebratt et al. 2011a). Later, in 2012, *T. radiata* was reported for the first time in the State of Valle del Cauca, Colombia, in the municipalities of Palmira, Sevilla and Zarzal (Kondo et al. 2012b). Because of the importance of *D. citri* as a vector of HLB, the control of *D. citri* is a critical component of disease prevention, containment and management. In Reunion Island, where *D. citri* has been introduced, it has been successfully controlled with *T. radiata* introduced from Pakistan (Étienne and Aubert 1980). In Colombia, Ebratt et al. (2011b) reported *T. radiata* parasitizing *D. citri* on orange, tangerine, Tahiti lime and swinglea. Further, Kondo et al. (2012b) collected *T. radiata* from *D. citri* collected on leaves of three species of *Citrus* (Rutaceae): *Citrus reticulata* Blanco, *C. sinensis* (L.) Osbeck cv. Salustiana and *C. latifolia* Tanaka.

The PHM was detected in mainland Colombia in 2003, Old Providence Island in 2010, and San Andres Island in 2012 (see Scale insects' section above). The PHM caused great damage to many plants when it first arrived in Colombia (M. A. Alterio, pers. comm.), but it was later controlled by natural enemies. The parasitoids *Anagyrus kamali* Moursi, 1948, and *Gyranusoidea indica* Shafee, Alam and Agarwal, 1975 (Hymenoptera: Encyrtidae), were first reported from the municipalities of Cúcuta and Los Patios, in the State of Norte de Santander in mainland Colombia in 2012 (Montes-Rodríguez 2012). About the same time, these same species of parasitoids were reported from the island of San Andres (Evans et al. 2012).

Conclusions

The crape myrtle aphid, *S. kahawaluokalani* is recorded in Colombia for the first time. Other invasive insect species recorded in the last decade in Colombia include: *Ceroplastes rubens*, *Crypticerya multicitricipes*, *Diaphorina citri*, *Maconellicoccus hirsutus* and *Singhiella simplex*. Most studies in Colombia, as well as in many other developing countries are focused on agricultural pests, thus many invasive species which attack other plants usually remain unnoticed, e.g., *S. kahawaluokalani* and *S. simplex*. Some recent adventive species in Colombia include natural enemies such as *Anagyrus kamali*, *Harmonia axyridis*, *Gyranusoidea indica* and *Tamarixia radiata*. It is important to continue studies on invasive and adventive species in order to document their global expansion.

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