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The multicolored Asian lady beetle, *Harmonia axyridis* (Pallas, 1773) (Coleoptera: Coccinellidae), a not so new invasive insect in Colombia and South America

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The multicolored Asian lady beetle, *Harmonia axyridis* (Pallas, 1773) (Coleoptera: Coccinellidae), a not so new invasive insect in Colombia and South America

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Abstract. The first reports of the multicolored Asian lady beetle *Harmonia axyridis* (Pallas, 1773) (Coleoptera: Coccinellidae) in Colombia appeared in 2011. However, based on museum insect specimens, the introduction of *H. axyridis* in Colombia occurred in 1989 or earlier, making it the second oldest record of the species in South America after the deliberate releases of the species in Argentina in 1986. Currently in Colombia, *H. axyridis* is well established and is here recorded from the States of Antioquia, Caldas, Cauca, Cundinamarca, Nariño, Tolima and Valle del Cauca.

Resumen. Los primeros reportes de la mariquita multicolor asiática *Harmonia axyridis* (Pallas, 1773) (Coleoptera: Coccinellidae) aparecieron en el 2011. Sin embargo, con base en colecciones de insectos en museos, la introducción de *H. axyridis* en Colombia ocurrió en 1989 o antes, haciendo que este sea el segundo registro más antiguo de esta especie en Sur América, después de las liberaciones intencionales de la especie en Argentina en 1986. Actualmente en Colombia, *H. axyridis* está bien establecida y aquí se reporta en los departamentos de Antioquia, Caldas, Cauca, Cundinamarca, Nariño, Tolima y el Valle del Cauca.

Introduction

While studying insects on a citrus orchard in Palmira, in the State of Valle del Cauca, Colombia, the first author photographed a species of coccinellid on the twigs of Tahiti Lime, *Citrus latifolia* Tanaka (Fig. 1). The species was identified as the multicolored Asian lady beetle *Harmonia axyridis* (Pallas, 1773) (Coleoptera: Coccinellidae) by the second author. Specimens of *H. axyridis* collected in Colombia were compared with Chilean, Argentinean, Peruvian and Brazilian specimens.

Harmonia axyridis is a rather characteristic species with white pronotum with black "M" shaped design, frequently separated into four or five spots, and yellow to red elytra, with nine spots (2:3:3:1), and a common scutellar one, although sometimes some or all spots are reduced or absent. It can be distinguished from other similar species of Coccinellidae known from Colombia and more widely in South America by the following combination of features: (i) body glabrous and 6 to 8 mm long; (ii) frequently with wrinkles anterior to elytral apex; (iii) apex of middle and hind tibia without apical spurs; and (iv) postcoxal area of first abdominal ventrite with an oblique dividing line. As the name suggests, the multicolored Asian lady beetle has numerous color morphs, and this may be the reason why the species has eight junior synonyms and numerous subspecies (Koch 2003). Michie et al. (2010) indicated that the plasticity of color pattern observed in *H. axyridis* f. *succinea* is an adaptation to increase the melanic area of the elytra, and hence activity level, when the insect is exposed to cold temperatures, and that its plasticity has helped this particular morph to be so successful and may also have contributed to its invasive success.

The Coccinellidae, whose members are commonly known as ladybirds, ladybugs or lady beetles, is a cosmopolitan family with approximately 6,000 described species to date (Vandenberg 2002), including 1400 South American species (González 2010). The life cycle of Coccinellidae includes a spring or summer larval period of approximately one month, followed by a short period of pupation and an adult life of many months, including a period of hibernation in cold and temperate areas. The majority of the Coccinellidae are diurnal predators and they are associated largely with soft-bodied insects such as

Figure 1. *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae) in copula on a twig of *Citrus latifolia* Tanaka. Palmira, Valle del Cauca, Colombia. Photo by T. Kondo.

Coccoidea and Aphidoidea. Other species feed on Acari (e.g., those of the tribe Sthetorini), Psylloidea (e.g., those of the tribes Coccinellini and Ortaliinae), Aleyrodidae (e.g., those of the tribe Serangiini), and some others prey on coccinellid larvae (Vandenberg 2002). Although coccinellids usually are considered beneficial as they control agricultural pests and many species are mass reared and sold for that purpose, members of the subfamily Epilachninae are phytophagous, feeding especially on cucurbits and legumes, and some are considered important agricultural pests, e.g., *Epilachna paenulata* (Germar, 1824) (Diaz et al. 2010) and *E. varivestis* Mulsant, 1850 (Nakamura and Shiratori 2010). Furthermore, species of the tribe Halyziini feed on fungi of the genus *Erysiphales* (Vandenberg 2002).

The multicolored Asian lady beetle as a predator

Harmonia axyridis is a well-known predator of aphids and other soft-bodied arthropods (Koch 2003). In soybean production systems in the USA, *H. axyridis* plays an important role in controlling the soybean aphid *Aphis glycines* Matsumura, 1917 (Hemiptera: Aphididae) (Douglas et al. 2004). Numerous releases of *H. axyridis* as a classical biological control agent were made in the USA dating back to as early as 1916 (Gordon 1985, *apud* Koch 2003). However, the first established population in the USA (in the State of Louisiana) was documented in 1988 (Chapin and Brou 1991, *apud* Koch 2003; Hahn and Kovach, 2004). Thereafter, *H. axyridis* rapidly expanded its range in North America, and now is found in much of the continental USA and southern Canada (Koch 2003).

The multicolored Asian lady beetle as a pest

Harmonia axyridis may cause negative impacts that can be classified into three general categories: 1) impacts on non-target arthropods; 2) impacts on fruit production; and 3) impacts as a household invader (Koch and Galvan 2008). *Harmonia axyridis* has received particular attention because it is often used as

a biological control agent and because it is thought to displace native coccinellids through resource competition wherever it is introduced (Koch et al. 2006). However the multicolored Asian lady beetle is a generalist predator that preys on a wide variety of non-target insects, including the monarch butterfly *Danaus plexippus* (L., 1758) (Lepidoptera: Nymphalidae), and is known as an intraguild predator, that may feed on other coccinellids and on *Chrysoperla carnea* (Stephens, 1836) (Neuroptera: Chrysopidae) (Koch et al. 2004; Koch and Galvan 2008). The insect is also known as a pest. In the State of Ohio, USA, *H. axyridis* has been reported to attack fruits such as apples, grapes and peaches, and to bite people (Kovach 2004). Their bite often causes allergic reactions in humans (Huelsman and Kovach 2004). On the other hand, *H. axyridis* is considered an urban pest in temperate climates, where large numbers of beetles invade homes in search of places for overwintering. In Ohio (USA), *H. axyridis* is considered as a serious nuisance pest to homeowners during fall, winter, and early spring (Huelsman and Kovach 2004).

Introduction and distribution in South America

Harmonia axyridis was intentionally introduced to the province of Mendoza in Argentina in the late 1990s, and it was later found in Buenos Aires (Argentina) and in Curitiba (Brazil) (Grez et al. 2010). Hitherto, in South America, *H. axyridis* has been reported from **Argentina** (Buenos Aires) (Grez et al. 2010; Saini 2004), (Mendoza) (Grez et al. 2010), **Brazil** (Curitiba) (Grez et al. 2010), (Parana) (Almeida and Silva 2002), (Minas Gerais) (Queiroz-Rezende 2010), **Chile** (Santiago and Valparaiso) (Grez et al. 2010), **Paraguay** (Caaguazú, Itapúa and Cordillera) (Silvie et al. 2007), **Peru** (Tumbes and Lima) (G. González personal observation, *apud* Grez et al. 2010; Iannacone and Perla 2011), **Ecuador** (Gonzalez and Kondo 2012) and **Uruguay** (Nedv d and Krej ík 2010). Based on studies of climatic similarities between South America and locations in Asia which were analyzed using the climate matching software, CLIMEX, and a biome matching method, Koch et al. (2006) predicted that most of South America is suitable for establishment of *H. axyridis*. Furthermore, Grez et al. (2010) suggested that *H. axyridis* would soon colonize other areas of South America. As predicted by various authors (Koch et al. 2006; Grez et al. 2010, Poutsma et al. 2008, *apud* Martins et al. 2009), *H. axyridis* was reported recently from **Colombia** in the State of Valle del Cauca by Brown et al. (2011) based on a personal communication, and by Amat-Garcia et al. (2011) based on specimens collected in Bogota in the State of Cundinamarca on *Croton bogotanus* Cuatrec., 1935 (misspelled as *Croton bogotensis*) (Euphorbiaceae). Here we reconfirm the presence of *H. axyridis* in Colombia based on newly collected material and museum specimens, and try to estimate a time of its introduction into Colombia.

Materials and Methods

Collection data on *H. axyridis* was gathered from nine insect collections (8 in Colombia and 1 in Chile; see depositories below). Species identification was carried out by the authors based on direct observation, or based on photographs of coccinellids sent by collaborators (see Acknowledgment section). Specimens deposited at the Museo Entomológico Francisco Luis Gallego were kindly identified by Mr. John A. Quiroz. This study was carried out at insect collections or museums located in Cali, Palmira (State of Valle del Cauca), Bogota (State of Cundinamarca), Medellin (State of Antioquia), Pasto (State of Nariño), and Santa Marta (State of Magdalena), and only covers a small area of the Colombian territory.

Depositories

CEUNP: Colección Entomológica de la Universidad Nacional, sede Palmira, Palmira, Valle del Cauca, Colombia.

CIAT: Insect Collection, International Center for Tropical Agriculture, Palmira, Valle del Cauca, Colombia.

GGPC: Guillermo González Personal Collection, Santiago, Chile.

ICN: Instituto de Ciencias Naturales, Universidad, Nacional de Colombia, Bogotá, Colombia.

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.

UDENAR: Colección de insectos, Universidad de Nariño, Facultad de Ciencias Agrícolas, Pasto, Nariño, Colombia.

UNAB: Museo Entomológico Facultad de Agronomía, Universidad Nacional de Colombia, Sede Bogotá, Bogotá, Cundinamarca, Colombia.

UVCO: Museo de Entomología, Universidad del Valle, Cali, Valle del Cauca, Colombia.

Material studied. *Harmonia axyridis* (Pallas). **Colombia: Antioquia:** Amalfi, Bosque, 26.x.2000, coll. O. Ruíz, det. John A. Quiroz, 1 specimen (No. 7465: 10); Cañón del río Porce, 18.iii.1998, coll. J. G. Hurtado, det. John A. Quiroz, ex. insect net, 1 specimen (No. 7465: 29); Copacabana, Relleno Sanitario, Curva de Rodas, 24.x.2000, coll. D. Acevedo, det. John A. Quiroz, 4 specimens (No. 7465: 11-14); La Unión, 01.iii.1998, coll. J. Jaramillo, det. John A. Quiroz, ex. insect net, 1 specimen (No. 7465: 30); Medellín, 03.xi.1998, coll. R. Vélez, det. John A. Quiroz, ex. Preying upon aphids on *Jacaranda caucana*, 6 specimens (No. 7465: 1-6), Medellín, Univ. Nacional de Colombia, 28.ii.1998, coll. A. Rodríguez, det. John A. Quiroz, ex. plant locally called Morera, 1 specimen (No. 7465-20); Medellín, Univ. Nacional de Colombia, 04.iv.1998, coll. A. Rodríguez, det. John A. Quiroz, ex. plant locally called Nacedero, 1 specimen (No. 7465: 21); Medellín, Univ. Nacional de Colombia, 25.iv.1998, coll. A. Rodríguez, det. John A. Quiroz ex. plant locally called Nacedero, 1 specimen (No. 7465: 22); Medellín, Univ. Nacional de Colombia, 13.v.1998, coll. A. Rodríguez, det. John A. Quiroz, ex. *Amaranthus* sp., 1 specimen (no. 7465: 23); Medellín, Univ. Nacional de Colombia, 01.iii.1998, coll. A. Rodríguez, det. John A. Quiroz, ex. grass, 1 specimen (No. 7465: 24); Medellín, Universidad Nacional de Colombia, 26.ii.1998, coll. A. Rodríguez, det. John A. Quiroz, ex. grass, 1 specimen (No. 7465: 25); Medellín, Univ. Nacional de Colombia, 9.iv.1998, coll. A. Rodríguez, det. John A. Quiroz, ex. *Cajanus cajan*, 3 specimens (No. 7465: 26-28); Medellín, Univ. Nacional de Colombia, 12.iv.1998, coll. D. Terrazas, det. John A. Quiroz, ex. *Symphytum officinale*, 1 specimen (No. 7465: 31); Rionegro, 24.ii.1998, coll. A. Rodríguez, det. John A. Quiroz, ex. corn, 5 specimens (No. 7465: 15-19); Santa Fé de Antioquia, 30.ix.2000, coll. R. Gaviria, det. John A. Quiroz, ex. caugth on flight, 1 specimen (No. 7465: 9) **(MEFLG)**; **Caldas:** Manizales, 05°04'N, 75°, 31'W, 2216 m a.s.l., 27.iv.2005, colls. Luque N. & Jamaica D., ex. Sweeping net, 2 specimens **(UNAB)**; **Cauca:** Bolivar, 03.vi.1994, coll. Deisy Martínez, ex. Pastos, 1 specimen **(UDENAR)**; **Cundinamarca:** Bogotá, Universidad Nacional de Colombia, 04°38'07"N, 74°04'57"W, 2600 m a.s.l., 03.viii.2011, coll. D. Suarez, ex. *Croton bogotanus* (Euphorbiaceae), 1 specimen; Silvania, Finca el Altillo, 04°24'N, 74°23'W, 1470 m a.s.l., 20.v.2001, colls. C. Forero & E. Rodríguez, 1 specimen; Caquezá, Girón de Blancos, 04°24'30"N, 73°63'50"W, 1740 m a.s.l., 16.xi.2003, coll. A. Forero **(UNAB)**; Bogotá, Universidad Nacional de Colombia, Bofota Campus, 24.vi.2011, coll. Edwin Ariza, 4 specimens (No. 054076, 054077, 054078, 054079) **(ICN)**; **Nariño:** San José, 18.i.1990, coll. L. Miranda, ex. Foliage, 2 specimens; La Union, 08.xii.1994, coll. Carlos Solarte, ex. Light trap, 1 specimen; Yaquanquer, 27.iii.2002, coll. Oswal Estrada, ex. Potato, 1 specimen; Chachagüi, coll. Adriana Ch., 01.x.1989, ex. Foliage, 1 specimen **(UDENAR)**; **Tolima:** Espinal, 04°09'10"N, 74°12'19"W, 322 m a.s.l., 26.iv.2005, coll. L. Camilo, 1 specimen; Espinal, 04°09'10"N, 74°12'19"W, 322 m a.s.l., 26.iii.2005, coll. M. Velandia, ex. Captured in flight, 1 specimen **(UNAB)**; **Valle del Cauca:** Cali, Dapa, 1700 m a.s.l., 14.vii.2002, coll. Ana María Correa, 1 specimen **(UVCO)**; La Unión, 04°32'N, 73°03'W, 975 m a.s.l., 27.iv.2005, coll. A. Sánchez, ex. Meadow, 1 specimen **(UNAB)**; Palmira, Corporación Colombiana de Investigación Agropecuaria (CORPOICA), Centro de Investigación Palmira, 29.xii.2011, coll. H. Rodriguez, ex. *Citrus* sp., 1 specimen; Valle del Cauca, Caicedonia, finca Jamaica, 29.xii.2011, coll. H. Rodriguez, ex. *Citrus* sp., 1 specimen **(GGPC)**; Palmira, 27.xi.2001, coll. Ángela Rojas, 1 specimen; Palmira, 5.xi.2002, coll. O. Londoño, 1 specimen; Palmira, 1001 m a.s.l., 05.ix.2007, coll. O. Cárdenas, No. 12, 1 specimen; Palmira, 15.ix.2007, 1000 m a.s.l., coll. G. Arroyo, No. 19, 1 specimen; Palmira, 06.ix.2007, 1200 m a.s.l., coll. N. Melo, No. 18, ex. Grass, 1 specimen; Palmira, 1000 m a.s.l., 22.x.2006, coll. F. Campuzano, No. 16, ex. Leaf litter, 1 specimen; Palmira, 1000 m a.s.l., 8.xii.2007, coll. A. Duran, No. 8, ex. On ground, 1 specimen; Palmira, 1000 m a.s.l., 20.ix.2006, coll. A. Vega, 1 specimen; Palmira, 1000 m a.s.l., 03.x.2006, coll. R. Bolarta, No. 45, ex. Corn, 1 specimen; Palmira, 100 m a.s.l., 12.xi.2007, coll. E. Arbeláez, #18, ex. Leaf litter, 1 specimen; Palmira, 1000 m a.s.l., 27.iv.2005, coll. J. Gutiérrez, 1 specimen; Palmira, ICA, 12.viii.2000, coll. Grupo CBA, ex. Cotton, 1 specimen; Palmira, 10.xi.2006, coll. S. Gómez, ex. Ground, 1 specimen; Palmira, 21.ix.2004, coll. L. López, ex. Shrub, 1 specimen; Buitrera, 26.v.2000, coll. Franco, 1

specimen; ICA, 23.v.2000, coll. Rodríguez; Palmira, km 30, 16.v.2000, coll. Pastrana, 1 specimen; Palmira, 12.iv.2000, coll. Martínez, 1 specimen; Ingenio Providencia, 5.v.2000, coll. Rodríguez, 1 specimen **(CEUNP)**; Palmira, 13.xii.2000, coll. A. Trochez, ex. *Citrus*, 3 specimens; Palmira, viii.1999, coll. J. Barrera, ex. Cotton, 1 specimen (**MECP)**; Palmira, 19.iv.2003, coll. Fulvia Garcia, ex. *Zea mays*, 1 specimen; Yumbo, 06.v.2003, coll. Fulvia Garcia, ex. *Gossypium hirsutum*, 1 specimen **(CIAT)**; Tuluá, 2.vii.2000, coll. A. Madrigal, det. John A. Quiroz, ex. *Gossypium hirsutum*, 2 specimens (No. 7465: 7 & 8) **(MEFLG)**.

Results and Discussion

The earliest collection date of *H. axyridis* in Colombia is from 1989, from a specimen collected in the municipality of San José, in the State of Nariño, with several specimens collected in the 1990s in Bolivar (Cauca), Chachagüi, La Unión, San José (Nariño), and Palmira (Valle del Cauca). There is a clear increase in number of specimens in the 2000s, and a wider distribution in additional departments, namely, Antioquia, Caldas, Cundinamarca and Tolima. This suggests that *H. axyridis* was introduced into Colombia in the late 1980s, at least 22 years earlier than the first published reports of *H. axyridis* in Colombia (Amat-Garcia et al. 2011; Brown et al. 2011) and since then it has expanded its distribution. The earliest recorded introduction of *H. axyridis* in South America was in 1986 in Mendoza, Argentina (García et al. 1999, *apud* Poutsma et al. 2008). This means that the introduction of *H. axyridis* into Colombia was also one of the earliest introductions of the species into South America.

Harmonia axyridis is very common in the State of Valle del Cauca (T.K., personal observation). It has displaced other coccinellids, such as *Hippodamia convergens* Guérin-Méneville, 1842 and *Coleomegilla maculata* (De Geer, 1775) from a cassava orchard at the International Center for Tropical Agriculture located in Palmira (M. P. Hernandez, personal communication). In Colombia, *H. axyridis* has not been found yet in Santa Marta (Magdalena) (A. Arcila, personal communication) nor on San Andres island (M. F. Maya, personal communication). The species appear to be closely associated with human activity, e.g., farming and urban areas. *Harmonia axyridis* was likely introduced either accidentally on plant material, or intentionally for biological control purposes, and not through natural expansion. Either way, the coccinellid now appears to be widespread in many parts of Colombia. Further studies should be carried out in other Colombian museums and in other States in order to get more accurate information on the time and path of introduction of *H. axyridis* in Colombia.

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