









Scientific Note

New host plants records of *Bactrocera carambolae* Drew & Hancock, 1994 and *Anastrepha* spp. (Diptera: Tephritidae) in Brazil

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Abstract. In this work we report five new host plants of *Bactrocera carambolae* Drew & Hancock, 1994 as well as new records of hosts of *Anastrepha bahiensis* Lima, 1937, *Anastrepha fraterculus* (Wiedemann, 1830), and *Anastrepha striata* Schiner, 1868 from samplings carried out in Mazagão county, Amapá-Brazil.

Keywords: carambola fruit fly, fruit production, quarantine pest, Amazon.

Bactrocera carambolae Drew & Hancock, 1994 (Diptera: Tephritidae), native to Asia, is an invading species in South America, where it was collected for the first time in 1975, in Paramaribo, Suriname (Castilho et al. 2019). Its first detection in Brazil was in 1996, in Oiapoque county, state of Amapá (Silva et al. 2004). Currently, the species occurs in some locations in the states of Amapá, Pará and Roraima and is under official control by the Ministry of Agriculture and Food Supply (Brazil 2018).

The occurrence of *B. carambolae* in Brazil is one of the main phytosanitary barrier for fruit exports, since there are quarantine restrictions imposed by importing countries on the purchase of products from regions where the pest occurs (Silva et al. 2004; Godoy et al. 2011; Lemos et al. 2014; Ferreira & Rangel 2015; Miranda & Adami 2015).

Despite being known as carambola fruit fly, *B. carambolae* is a polyphagous species (Silva et al. 2004; Sauers-Müller 2005; Adaime et al. 2016a). In Southeast Asia, Allwood et al. (1999) reported the occurrence of carambola fruit fly on 75 plant species in 26 families. In South America, hosts were recorded in four countries: 1) French Guiana (France) - 24 hosts in 11 families (Malavasi et al. 2013; Vayssières et al. 2013); 2) Suriname - 23 hosts in 11 families (Sauers-Müller 1991; Sauers-Müller 2005; Malavasi et al. 2013); 3) Brazil - 21 hosts in 9 families, all of them in the state of Amapá (Adaime et al. 2016a); and 4) Guyana - 4 hosts in 4 families (Malavasi et al. 2013).

Taking into account that is necessary to consider a natural host only the plant species whose fruit is found to be unmistakably infested under totally natural field conditions (Aluja & Mangan 2008), this work aimed to report new host plants of *B. carambolae* and species of *Anastrepha* Schiner, 1868 in Brazil.

From April 2018 to March 2020, a sampling of fruits from plants potentially host of fruit flies was carried out in the municipality of Mazagão, state of Amapá, Brazil. The fruits were collected randomly, depending on availability, according to the phenology of each species, being obtained directly from the plants. The collected samples were packed in plastic trays (16 x 30 cm) and transported in stackable plastic boxes to the Entomology Nucleus Laboratory at the Federal University of Amapá, Campus Mazagão. In the laboratory, we followed

the procedures recommended by Silva et al. (2011) for grouped fruit samples. The fruits were counted, weighed and placed in plastic trays on a thin layer of moist sand. The trays were covered with organza attached by elastic alloy. The collected material was examined every three days and the puparia found were removed and transferred to transparent plastic containers containing a thin layer of moistened vermiculite. The plastic containers were covered with organza and a vented lid, being inspected daily. The humidity in the trays and in the containers was maintained by replacing the water. The fruit flies that emerged were stored in glass flasks containing 70% ethanol, for later identification.

The identification of *B. carambolae* was based on Zucchi (2000). Specimens of *Anastrepha* were identified using the illustrated identification key published by Zucchi et al. (2011). Only females were used for identification, which was performed by examination of everted aculei, using a stereomicroscope and optical microscope (40×). Other characteristics were also observed, including wing pattern, mesonotum, mediotergite, and subscutellum.

We collected 17 samples (683 fruits, 10.61 kg) in urban and rural communities in the municipality of Mazagão, in 11 of them (64.7%) there was infestation by fruit fly (Tab. 1). In total, 1,268 puparia were obtained, from which emerged specimens of *B. carambolae* (340♀ + 351♂) and *Anastrepha* spp. (20♀ + 18♂). The species obtained were *B. carambolae*, *Anastrepha bahiensis* Lima, 1937 *Anastrepha fraterculus* (Wiedemann, 1830), *Anastrepha obliqua* (Macquart, 1835) and *Anastrepha striata* Schiner, 1868 (Diptera: Tephritidae) (Tab. 2).

Bactrocera carambolae infested fruits of *Averrhoa bilimbi* L. (Oxalidaceae), *Calycolpus goetheanus* (Mart. ex DC.) O.Berg (Myrtaceae), *Spondias purpurea* L. (Anacardiaceae), *Syzygium jambos* (L.) Alston and *Syzygium samarangense* (Blume) Merr. & L. M. Perry (Myrtaceae) (Tab. 2). This is the first record of these plant species as hosts of *B. carambolae* in Brazil. After these records, the pest has 26 confirmed host plant species (in 9 families) in the country, five more than in the list presented by Adaime et al. (2016a). Myrtaceae is the family with more host species reported (9).

Spondias purpurea had previously been reported as host of *B. carambolae* in French Guiana and Suriname; *S. jambos* in Suriname;

and *S. samarangense* in Guyana, Suriname and French Guiana (Sauers-Müller 1991; Sauers-Müller 2005; Vayssières et al. 2013). The species *A. bilimbi*, *S. jambos* and *S. samarangense* are part of the host range of *B. carambolae* in Southeast Asia (Allwood et al. 1999). In turn, *C. goetheanus* was never reported as a host of *B. carambolae*. Interestingly, this plant is native of Neotropical region and occurs naturally in peri-urban forests, revealing the adaptative capacity of *B. carambolae* to native plant species, as had been demonstrated by Lemos et al. (2014).

Among our results, the high infestation rates in *S. jambos* (765.3 puparia/kg in Mazagão Novo and 1,111.1 puparia/kg in Mazagão Velho) exclusively by *B. carambolae* are noteworthy (Tab. 2). Until then, the greatest infestations by *B. carambolae* in samples collected in Amapá were 559.4 puparia/kg in *Chrysobalanus icaco* L. (Chrysobalanaceae) and 620.7 puparia/kg in *Malpighia emarginata* DC. (Malpighiaceae), recorded by Lemos et al. (2014). *Averrhoa bilimbi* presented only two

infested samples among the eight collected, with low rate of infestation (9.2 puparia/kg).

In addition to the results for *B. carambolae*, this work presents other findings: 1) *C. goetheanus* constitutes a new host record of *A. fraterculus* and *A. striata* in Brazil; 2) *S. purpurea* constitutes a new host record of *A. bahiensis* in Brazil. After these records, *A. fraterculus*, *A. striata* and *A. bahiensis* have 117, 29 and 16 hosts reported in Brazil, respectively (Zucchi & Moraes 2008; Adaime et al. 2016b).

Considering the socioeconomic expression of *B. carambolae* for Brazilian fruit production (Silva et al. 2004; Godoy et al. 2011; Lemos et al. 2014; Ferreira & Rangel 2015; Miranda & Adami 2015), it is imperative that studies aimed at registering new host plants for this pest continue to be carried out and the results generated can be used to adopt more targeted and effective control measures.

Table 1. Plant species sampled in Mazagão county, State of Amapá, Brazil (from April 2018 to March 2020).

Communities	Families	Sampled species	CS/IS*	Fruits (n)	Mass (kg)	Puparia (n)	Emergence		Infestation puparia/kg
							n	%	
Mazagão Novo	Anacardiaceae	<i>Spondias purpurea</i> L.	1/1	46	0.50	37	18	48.6	74.0
	Myrtaceae	<i>Calycolpus goetheanus</i> (Mart. ex DC.) O. Berg.	1/1	59	0.26	45	20	44.4	173.1
		<i>Syzygium jambos</i> (L.) Alston	2/2	66	1.18	903	547	60.6	765.3
		<i>Syzygium samarangense</i> (Blume) Merr. & L. M. Perry	1/1	97	2.39	5	3	60.0	2.1
	Oxalidaceae	<i>Averrhoa bilimbi</i> L.	4/2	106	2.61	24	24	100	9.2
Mazagão Velho	Myrtaceae	<i>Syzygium jambos</i> (L.) Alston	1/1	8	0.18	200	86	43.0	1,111.1
	Oxalidaceae	<i>Averrhoa bilimbi</i> L.	2/0	53	1.04	0	0	-	-
Carvão	Anacardiaceae	<i>Spondias purpurea</i> L.	1/1	44	0.63	31	18	58.1	49.2
	Myrtaceae	<i>Calycolpus goetheanus</i> (Mart. ex DC.) O. Berg.	1/1	81	0.55	15	6	40.0	27.3
	Oxalidaceae	<i>Averrhoa bilimbi</i> L.	2/0	105	1.07	0	0	-	-
Camaipi	Anacardiaceae	<i>Spondias purpurea</i> L.	1/1	18	0.20	8	7	87.5	40.0
Total	-	-	17/11	683	10.61	1,268	729	-	-

*CS = Collected Samples, IS = Infested Samples.

Table 2. Hosts of fruit flies species in Mazagão county, State of Amapá, Brazil (from April 2018 to March 2020).

Communities	Hosts species*	Fruit flies species
Mazagão Novo	<i>Averrhoa bilimbi</i> L. ^a	<i>Bactrocera carambolae</i> (7♀ + 17♂)
	<i>Calycolpus goetheanus</i> (Mart. ex DC.) O. Berg. ^b	<i>Bactrocera carambolae</i> (6♀ + 7♂)
		<i>Anastrepha fraterculus</i> (3♀ + 4♂)
		<i>Anastrepha fraterculus</i> (8♀)
<i>Spondias purpurea</i> L. ^c	<i>Anastrepha bahiensis</i> (2♀)	
	<i>Anastrepha obliqua</i> (1♀)	
	<i>Anastrepha</i> spp. (7♂)	
	<i>Bactrocera carambolae</i> (266♀ + 281♂)	
Mazagão Velho	<i>Syzygium jambos</i> (L.) Alston ^d	<i>Bactrocera carambolae</i> (1♀ + 2♂)
	<i>Syzygium samarangense</i> (Blume) Merr. & L. M. Perry ^e	<i>Bactrocera carambolae</i> (51♀ + 35♂)
	<i>Syzygium jambos</i> (L.) Alston ^f	<i>Anastrepha fraterculus</i> (1♀)
Carvão	<i>Calycolpus goetheanus</i> (Mart. ex DC.) O. Berg. ^g	<i>Anastrepha striata</i> (2♀)
		<i>Anastrepha</i> spp. (3♂)
		<i>Bactrocera carambolae</i> (9♀ + 9♂)
Camaipi	<i>Spondias purpurea</i> L. ^h	<i>Anastrepha fraterculus</i> (3♀ + 4♂)

*Sampling dates and geographical coordinates: ^aJuly 18, 2018 (00°06'14.9"S, 51°17'10.6"W and 00°06'19.9"S, 51°17'9.1"W), ^bApril 14, 2018 (00°06'23.6"S, 51°17'15.9"W), ^cJanuary 31, 2019 (00°06'18.8"S, 51°16'41.8"W), ^dApril 14, 2018 (00°06'58.7"S, 51°17'46.3"W and 00°06'23.0"S, 51°17'15.8"W), ^eFebruary 20, 2020 (00°05'28.4"S, 51°16'34.2"W), ^fMay 2, 2018 (00°13'10.8"S, 51°26'00.2"W), ^gMarch 10, 2020 (00°11'48.3"S, 51°21'59.6"W), ^hMay 3, 2018 (00°10'57.5"S, 51°21'17.5"W), ⁱMay 16, 2018 (00°08'15.5"S, 51°21'0.8"W).

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Authors' Contributions

APDB, LMSR and JMGC contributed to the field and laboratory work, taxonomic identification of fruit flies, critical reviews, and

adding intellectual content to the manuscript. MSMS contributed to the taxonomic identification of fruit flies, critical reviews and adding intellectual content to the manuscript. RA, LNL and RMAF contributed to the concept and design of the study, data analysis and interpretation and manuscript preparation. SVCN contributed to the identification of botanical material, critical reviews and adding intellectual content to the manuscript.

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