ENTOMOTROPICA
Vol. 30(7): 57-68
on line 03-Junio-2015

ISSN 2443-437X (electrónico)
ISSN 1317-5262 (impreso)

Lance fly (Diptera: Lonchaeidae) host plants in the State of São Paulo, Southeast Brazil

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Abstract

Raga A, de Souza-Filho MF, Strikis PC, Marangoni Montes SMN. 2015. Lance fly (Diptera: Lonchaeidae) host plants in the State of São Paulo, Southeast Brazil. Entomotropica 30(7): 57-68.

Many species of Lonchaeidae predominate in the complex of fruit flies (Tephritoidea) infesting more species of host fruits that the species of Tephritidae. In the southern hemisphere, very little is known about the diversity of the species of Lonchaeidae and their host relationship. This paper records the species of Lonchaeidae and their respective host plants as recovered out of a total of 1,522 samples of fruit relating to 113 plant species coming from 94 municipalities of the State of São Paulo, Brazil. A total of 26,906 Lonchaeidae adults were obtained, belonging to 14 species of *Neosilba* McAlpine, *Dasiops inedulis* Steyskal, *Dasiops frieseni* Norrbom & McAlpine and *Lonchaea* sp. Specimens of *Neosilba* represented 99.78 % of the adults recovered: *N. bella* Strikis & Prado, *N. bifida* Strikis & Prado, *N. certa* (Walker), *N. cornuphallus* Strikis, *N. dimidiata* Curran, *N. inesperata* Strikis & Prado, *N. glaberrima* (Wiedemann), *N. laura* Strikis, *N. paramerolatus* Strikis, *N. parva* Hennig, *N. pradoi* Strikis & Lerena, *N. pendula* (Bezzi), *N. perezi* (Romero & Ruppel) and *N. zadolicha* McAlpine & Steyskal. *Neosilba zadolicha* is predominant, abundant and generalist species.

Additional key words: Ecology, *Neosilba,* plant species, Tephritoidea.

Resumen

Raga A, de Souza-Filho MF, Strikis PC, Marangoni Montes SMN. 2015. Plantas hospederas de moscas de la fruta (Diptera: Lonchaeidae) en el Estado de Sao Paulo, Brasil. Entomotropica 30(7): 57-68.

Muchas especies de Lonchaeidae predominan en el complejo de moscas de la fruta (Tephritoidea) infestando más especies de frutas hospedantes que las especies de Tephritidae. En el hemisferio sur, se sabe muy poco acerca de la diversidad de las especies de Lonchaeidae y su relación com las plantas hospederas. Este documento registra las especies de Lonchaeidae y sus respectivas plantas hospederas, de un total de 1 522 muestras de frutas tomadas en 113 especies vegetales, procedentes de 94 municipios del estado de São Paulo, Brasil. Se obtuvieron un total de 26 906 Lonchaeidae adultos, pertenecientes a 14 especies de *Neosilba* McAlpine, *Dasiops inedulis* Steyskal, *Dasiops frieseni* Norrbom y McAlpine y *Lonchaea* sp. Los especímenes de *Neosilba* representaron el 99,78 % de los adultos recuperados: *N. bella* Strikis y Prado, *N. bifida* Strikis y Prado, *N. certa* (Walker), *N. cornuphallus* Strikis, *N. dimidiata* Curran, *N. inesperata* Strikis y Prado, *N. glaberrima* (Wiedemann), *N. laura* Strikis, *N. paramerolatus* Strikis, *N. parva* Hennig, *N. pradoi* Strikis y Lerena, *N. pendula* (Bezzi), *N. perezi* (Romero y Ruppel) y *N. zadolicha* McAlpine y Steyskal. *Neosilba zadolicha* fue la especie predominante, más abundante y generalista.

Palabras clave adicionales: Ecología, especies de plantas, N*eosilba*, Tephritoidea.

Introduction

Flies of the Lonchaeidae family (Tephritoidea) are very peculiar since their body is either bright black or glossy metallic blue and/or green (Korytkowsky and Ojeda 1971). Larvae of Lonchaeidae develop in fruit, flowers, seeds, cacti and seedlings of various species of cultivated and wild plants. Few species are primary invaders of plant tissue, the remainder developing on decaying organic matter (McAlpine 1961, 1987).

In the tropics and subtropics, most species of Lonchaeidae are often found in fruit infested by Tephritidae and by other primary pests (Pitkin 1996, Ahlmark and Steck 1997). Some species of Lonchaeidae also lay eggs on fruits not previously infested by species of Tephritidae (Uchôa et al. 2002, Strikis and Prado 2005, Silva et al. 2006, Raga et al. 2011, Garcia and Norrbom 2011).

A total of 536 species of Lonchaeidae has been described. The species are distributed in eight genera, being *Lonchaea* the richest species (213 species), followed by *Dasiops* (128 species), *Silba* (98 species) and *Neosilba* (40 species) (EDIT 2013). Lonchaeids are found in a wide range of habitats from the Arctic Circle to the Equator in all zoogeographical regions (MacGowan and Freidberg 2008). *Neosilba* is limited to the neotropical region, Florida and Southern United States (McAlpine and Steyskal 1982). Species of *Silba* have not been seen in Brazil. Up to date, 25 species of *Neosilba* are known in Brazil.

Some species of Lonchaeidae are geographically widespread in Brazil, particularly *Neosilba bifida* Strikis & Prado, *N. zadolicha* McAlpine & Steyskal, *N. certa* (Walker), *N. pendula* (Bezzi), *N. glaberrima* (Wiedemann), *N. perezi* (Romero & Ruppel) and *Dasiops inedulis* Steyskal (Aguiar-Menezes et al. 2004, 2007; Araújo and Zucchi 2002, Bittencourt et al. 2006, Caires et al. 2009, Lopes et al. 2007, Lourenção et al. 1996, Santos et al. 2004, Silva et al. 2006, Souza et al. 2005, Souza-Filho et al. 2009, Strikis and Prado 2009, Uchôa and Nicácio 2010, Garcia and Norrbom 2011). Raga et al. (2011) recovered Lonchaeids from all Tephritidae host plants (63) collected in the State of São Paulo, 23 of which are introduced hosts. Out of the total of adult Tephritoidea recovered from fruit samples, these authors obtained 20.8 % of specimens of Lonchaeidae.

Although Lonchaeidae are well represented in South America, little is known about the bioecology of the known species (Korytkowsky and Ojeda 1971). Part of the specimens collected come from McPhail traps with baits of hydrolyzed protein or molasses intended to monitor species of Tephritidae (Raga et al. 2006). Knowledge on frugivorous species (Diptera) and their host plants is critical in order to understand the temporal and spatial distribution of this group of insects in the ecosystems (Uchôa and Nicácio 2010) and also to provide input to fruit-growing pest control. With the purpose of contributing to the knowledge on diversity of frugivorous insects, in this work we have recorded the species of Lonchaeidae in the State of São Paulo, Brazil.

Material and methods

The territory of the State of São Paulo is mostly a plateau with the following distribution: 7 % of the surface lies above 900 m, 85 % of the surface lies between 300 m and 900 m, whereas 8 % of the surface lies below 300 m. According to Koeppen climate classification, the State of São Paulo covers three separate climates, most of them corresponding to humid climates. The most important climates are: super-humid, high-altitude tropical, warm and humid tropical, and humid subtropical. The predominant type in the largest area is Cwa, which covers the entire center part of the state and is characterized by high-altitude tropical climate, with rainy summers and dry winters.

Table 1 Species diversity of *Neosilba* (Diptera: Lonchaeidae) and their respective host plant families in the State of São Paulo, Brazil (Mar 1993 to Jun 2013).

Neosilba species	% of adults	Botanical family (number of botanical species)
N. bella Strikis & Prado	0.46	Myrtaceae (2), Rosaceae (1), Rubiaceae (1), Sapotaceae (1), Verbenaceae (1)
N. bifida Strikis & Prado	0.25	Fabaceae (1), Moraceae (1), Myrtaceae (3), Rosaceae (2), Rubiaceae (1), Rutaceae (1), Verbenaceae (1)
N. certa (Walker)	9.65	Annonaceae (2), Combretaceae (1), Fabaceae (3), Malpighiaceae (1), Moraceae (2), Myrtaceae (7), Oxalidaceae (1), Passifloraceae (2), Rosaceae (7), Rubiaceae (1), Rutaceae (5), Sapotaceae (2), Solanaceae (4)
N. cornuphallus Strikis	0.10	Fabaceae (1), Malpighiaceae (1), Moraceae (1), Myrtaceae (1), Rosaceae (1), Verbenaceae (1)
N. dimidiata Curran	0.27	Annonaceae (1), Myrtaceae (2), Sapotaceae (1)
N. inesperata Strikis & Prado	1.82	Fabaceae (1), Malpighiaceae (1), Myrtaceae (5), Oxalidaceae (1), Passifloraceae (1), Rosaceae (3), Rubiaceae (1), Rutaceae (3), Solanaceae (3)
N. glaberrima (Wiedemann)	5.73	Anacardiaceae (1), Annonaceae (1), Fabaceae (2), Lauraceae (1), Malpighiaceae (1), Moraceae (1), Myrtaceae (2), Oxalidaceae (1), Passifloraceae (1), Rosaceae (2), Rutaceae (5), Sapotaceae (3), Solanaceae (4)
N. laura Strikis	0.44	Fabaceae (1), Myrtaceae (2), Rubiaceae (1), Rutaceae (1), Solanaceae (1)
N. paramerolatus Strikis	0.01	Sapotaceae (1)
N. parva Hennig	9.97	Lauraceae (1), Rutaceae (1), Solanacae (4)
N. pradoi Strikis & Lerena	0.21	Myrtaceae (1), Rutaceae (1), Solanaceae (1)
N. pendula (Bezzi)	16.34	Anacardiaceae (3), Annonaceae (1), Fabaceae (2), Malpighiaceae (2), Moraceae (1), Myrtaceae (9), Oxalidaceae (1), Rhamnaceae (1), Rosaceae (5), Rubiaceae (1), Rutaceae (5), Sapotaceae (2)
N. perezi (Romero & Ruppel)	0.03	Euphorbiaceae (1), Malpighiaceae (1)
N. zadolicha McAlpine & Steyskal	54.72	Anacardiaceae (2), Annonaceae (6), Combretaceae (1), Cucurbitaceae (3), Ebenaceae (1), Fabaceae (2), Lauraceae (1), Malpighiaceae (1), Moraceae (3), Musaceae (1), Myrtaceae (5), Passifloraceae (2), Rosaceae (4), Rubiaeae (1), Rutaceae (8), Sapotaceae (5), Solanaceae (6)

The average temperature in the hottest month is above 22 ˚C. In some isolated spots, type-Am climate is found, which characterizes rainy tropical climate, with dry winters, where the rainfall in the driest month is lower than 60 mm (Estado de São Paulo 2007).

From March 1993 to June 2013, a total of 1,522 fruit samples of 113 botanical species related to 31 plant families were collected from 94 municipalities of all regions of São Paulo State, Brazil. A total of 322,664 fruits (5,424.78 kg) were collected randomly from the top and from the ground under the trees (Table 1). Samples were obtained from unsprayed trees and brought to the Laboratory of Economic Entomology, Instituto Biológico. The fruits were placed in fruit-holding boxes containing sterilized sand at the bottom and a piece of cotton cloth at the top. About 15-20 days later, the sand in the boxes was sieved to remove Lonchaeidae puparia, which were transferred to a glass cage (6,000 cc) with dry sand at the bottom and kept

at 25 ± 2 ºC and 70 ± 10 % relative humidity for 25 days for adult emergence. Adults were killed in a freezer and placed in labeled vials with 70 % ethanol for identification.

The identification of the species of Lonchaeidae involves examining the male's genitals or the female's structure and chaetotaxy (McGowan and Okamoto 2013). Specimens of Lonchaeidae were classified according to McAlpine and Steyskal (1982), Strikis and Prado (2006, 2009), Strikis and Lerena (2009).

Results

In the present study, 26,906 adult Lonchaeidae were recovered, belonging to 14 species of *Neosilba, Dasiops inedulis, Dasiops frieseni* Norrbom & McAlpine and *Lonchaea* sp. (Tables 1 and 2). The specimens of *Neosilba* totaled 99.78 % of the adults recovered and showed a sexual ratio of 0.50. Species of Lonchaeidae were found in 77 vegetal species/hybrids (Table 2), corresponding to 68.1 % of the plant species collected.

Neosilba zadolicha was predominant and abundant, representing 54.72 % of male adults of the genus recovered during the study, followed by *N. pendula* (16.34 %) and *N. parva* (9.97 %). Except for *Neosilba paramerolatus* Strikis, which was recovered only from *Pouteria torta* (Martens) Radlkofer (Sapotaceae), the remainder species of *Neosilba* occurred from 2 to 19 hosts.

In general, the species of *Neosilba* recovered in the present study had high plasticity in terms of colonizing host plant families, particularly *N. zadolicha, N. certa, N. glaberrima* and *N. pendula,* obtained from 17, 13, 13 and 12 botanic families, respectively. These species were found in 51, 40, 33 and 25 hosts respectively (Table 2). Myrtaceae, Rosaceae, Rutaceae and Solanaceae displayed 11, 10, 9 and 8 species of Lonchaeidae, respectively.

The species richness of Lonchaeidae was greater in *Eriobotrya japonica* (Thumb.) Lindl. (10), followed by *Psidium guajava* L. (9), *Inga* spp. (8), *Coffea* spp. (8), *Prunus persica* (L.) Batsch. (7), *Malpighia emarginata* Sessé & Moc ex DC. (7) and *Solanum gilo* Raddi (7).

Neosilba certa, N. glaberrima, N. parva, N. perezi and *N. zadolicha* were obtained in hosts collected in any month of the year. *Neosilba dimidiata* Curran was obtained only during the first quarter of year, *N. pradoi* was obtained in May and December, and *N. paramerolatus* was obtained only in January (Table 3).

Discussion

The diversity obtained in the present study demonstrates the importance of Lonchaeidae in the context of the Superfamily Tephritoidea and their capacity to explore different plant species and families under tropical conditions. The characteristic of polyphagia was evidenced in most species recorded in the State of São Paulo. Twenty-six species are concomitant hosts of *N. zadolicha* and *N. pendula,* whereas 15 species are concomitant hosts of *N. glaberrima* and *N. pendula.*

Most species of Myrtaceae collected in the present study are native and commonly found in rural and urban areas of the State of São Paulo. The fruit of these plants displayed the greatest diversity of *Neosilba* (11 species), nine species of *Neosilba* were recovered from *Psidium guajava* fruits. Some species of Myrtaceae have several fruiting seasons along the year or else they have a single, long period of fruiting, which possibly facilitates exploration by Lonchaeidae. This aspect is also characteristic of *E. japonica*, but it is not observed in other species of Rosaceae, which produce fruit only once a year. Solely in *E. japonica* we have obtained the entire diversity observed in Rosaceae (10 species). The diversity was greater than the one obtained by Strikis and Prado (2009) for *E. japonica* in the State of São Paulo, where the first report of infestation by *N.*

Table 2. Host plants of Lonchaeidae species (Diptera: Tephritoidea) in the State of São Paulo, Brazil (Mar 1993 to Jun 2013).

Family/ Botanical name	Native (N) or Introduced (I)	Total number of lonchaeids	Total number of males	(comparative % of *Neosilba* males)
Anacardiaceae				
Lithraea molleoides (Vell.) Engl.	N	35	15	*N. glaberrima* (86.67), *N. pendula* (13.33)
Mangifera indica L.	I	21	8	*N. zadolicha*
Spondias dulcis Parkinson	I	7	3	*N. pendula*
Spondias purpurea L.	I	7	3	*N. pendula* (66.67), *N. zadolicha* (33.33)
Annonaceae				
Annona coriacea Mart.	N	47	18	*N. zadolicha* (94.44), *N. certa* (5.56)
Annona emarginata (Schltdl.) H. Rainer	N	1	1	*N. certa*
Annona mucosa Jacq.	N	10	5	*N. zadolicha* (60.00), *N. certa* (40.00)
Annona reticulata L.	I	4	3	*N. zadolicha*
Annona sericia Dunal	N	67	22	*N. dimidiata* (54.55), *N. zadolicha* (27.27), *N. glaberrima* (18.18)
Annona squamosa L. x A. cherimola Mill.	I	9	6	*N. zadolicha* (83.33), *N. pendula* (16.67)
Annona sylvatica St. Hil.	N	29	9	*N. zadolicha*
Caricaceae				
Carica papaya L.	I	2	2	*Lonchaea* sp.
Combretaceae				
Terminalia catappa L.	I	173	97	*N. zadolicha* (47.42), *N. inesperata* (39.18), *N. certa* (13.40)
Cucurbitaceae				
Cucurbita maxima Duchesne	N	410	220	*N. zadolicha*
Cucurbita moschata Duchesne	I	19	9	*N. zadolicha*
Cucurbita moschata x C. maxima	I	22	12	*N. zadolicha*
Ebenaceae				
Diospyros kaki L.f.	I	2	1	*N. zadolicha*
Euphorbiaceae				
Manihot esculenta Crantz	N	3	3	*N. perezi*
Fabaceae				
Inga spp.	N	1,859	875	*N. zadolicha* (64.80), *N. certa* (14.97), *N. glaberrima* (7.66), *N. pendula* (6.63), *N. laura* (4.91), *N. bifida* (0.46), *N. inesperata* (0.34), *N. cornuphallus* (0.23)
Leucaena leucocephala (Lam.) de Wit.	I	2	2	*N. certa* (50.0), *N. pendula* (50.0)
Swartzia langsdorffii Raddi	N	26	14	*N. zadolicha* (64.28), *N. glaberrima* (21.44), *N. certa* (14.28)

Continue.....

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Family/ Botanical name	Native (N) or Introduced (I)	Total number of lonchaeids	Total number of males	(comparative % of *Neosilba* males)
Lauraceae				
Persea americana Mill.	I	3,100	1,546	*N. zadolicha* (76.78), *N. certa* (8.02), *N. glaberrima* (7.89), *N. pendula* (7.12), *N. parva* (0.19)
Malpighiaceae				
Bunchosia armeniaca (Cav.) Juss.	I	3	1	*N. pendula*
Malpighia emarginata Sessé & Moc ex DC.	I	566	309	*N. pendula* (53.07), *N. inesperata* (40.14), *N. zadolicha* (4.86), *N. certa* (0.97), *N. cornuphallus* (0.32), *N. glaberrima* (0.32), *N. perezi* (0.32)
Malvaceae				
Gossypium hirsutum L.	I	251	130	*N. zadolicha*
Moraceae				
Ficus carica L.	I	120	50	*N. certa* (50.00), *N. zadolicha* (24.00), *N. glaberrima* (18.00), *N. bifida* (6.00), *N. cornuphallus* (2.00)
Ficus sp.	N	3	3	*N. certa* (33.33), *N. pendula* (33.33), *N. zadolicha* (33.33)
Morus nigra L.	I	4	2	*N. zadolicha*
Musaceae				
Musa X *paradisiaca* L. (cv. Nanica)	I	2	1	*N. zadolicha*
Myrtaceae				
Eugenia brasiliensis Lam.	N	1	0	*Neosilba* sp.
Eugenia involucrata DC.	N	31	13	*N. certa* (30.76), *N. pradoi* (23.08), *N. laura* (23.08), *N. pendula* (23.08)
Eugenia leitonii D. Legrand	N	17	5	*N. glaberrima* (60.00), *N. zadolicha* (40.00)
Eugenia pyriformis Cambess.	N	88	48	*N. zadolicha* (50.00), *N. certa* (39.58), *N. pendula* (6.26), *N. inesperata* (2.08), *N. laura* (2.08)
Eugenia schomburgkii Benth.	N	46	28	*N. pendula* (85.71), *N. inesperata* (7.15), *N. zadolicha* (3.57), *N. bella* (3.57)
Eugenia uniflora L.	N	120	70	*N. pendula* (95.71), *N. inesperata* (4.29)
Myrciaria jaboticaba (Vell.) O. Berg	N	10	2	*N. certa*
Myrciaria glazioviana (Kiaersk) G. M. Barroso & Sobral	N	19	10	*N. inesperata* (40.00), *N. pendula* (40.00), *N. certa* (20.00)
Plinia edulis (O. Berg) Sobral	N	5	4	N. bifida
Psidium cattleianum Sabine	N	40	24	*N. certa* (62.50), *N. pendula* (29.17), *N. bifida* (4.16), *N. dimidiata* (4.17)

Continue.....

Continue. Table 2. Host plants of Lonchaeidae species (Diptera: Tephritoidea) in the State of São Paulo, Brazil (Mar 1993 to Jun 2013).

Family/ Botanical name	Native (N) or Introduced (I)	Total number of lonchaeids	Total number of males	(comparative % of *Neosilba* males)
Myrtaceae				
Psidium guajava L.	N	507	271	*N. zadolicha* (47.23), *N. pendula* (24.72), *N. certa* (11.07), *N. glaberrima* (7.75), *N. bifida* (4.42), *N. cornuphallus* (1.85), *N. inesperata* (1.48), *N. bella* (0.74), *N. dimidiata* (0.74)
Syzygium jambos (L.) Alston	I	15	11	*N. pendula* (81.82), *N. zadolicha* (18.18)
Syzygium samarangense (Blume) Alston	I	23	14	*N. pendula* (92.86), *N. certa* (7.14)
Oxalidaceae				
Averrhoa carambola L.	I	89	47	*N. certa* (82.98), *N. inesperata* (8.51), *N. pendula* (6.38), *N. glaberrima* (2.13)
Passifloraceae				
Passiflora alata Curtis	N	964	489	*N. zadolicha* (96.72), *N. glaberrima* (2.26), *N. certa* (1.02), *Lonchaea* sp.
Passiflora edulis Sims	N	1,294	373	*N. zadolicha* (98.66), *N. certa* (1.07), *N. inesperata* (0.27), *Lonchaea* sp., *Dasiops inedulis* Steyskal, *Dasiops frieseni* Norrbom & McAlpine
Rhamnaceae				
Zizyphus joazeiro Mart.	N	1	1	*N. pendula*
Rosaceae				
Eriobotrya japonica (Thunb.) Lindl.	I	1,177	588	*N. pendula* (52.87), *N. certa* (24.16), *N. zadolicha* (16.05), *N. glaberrima* (3.54), *N. inesperata* (1.35), *N. bella* (1.18), *N. bifida* (0.34), *N. pradoi* (0.34), *N. cornuphallus* (0.17), *Lonchaea* sp.
Malus X *domestica* Borkh.	I	83	41	*N. zadolicha* (87.80), *N. certa* (7.32), *N. pendula* (4.88)
Prunus mume Sielbold & Zucc.	I	21	8	*N. certa*
Prunus persica (L.) Batsch.	I	774	378	*N. zadolicha* (82.01), *N. certa* (11.91), *N. pendula* (4.77), *N. inesperata* (0.79), *N. glaberrima* (0.26), *N. bifida* (0.26), *Lonchaea* sp.
Prunus salicina Lindl.	I	4	3	*N. certa*, *N. pendula*, *N. inesperata*
Pyrus communis L.	I	1	1	*N. certa*
Rubus sp.	N	7	3	*N. zadolicha*, *N. pendula*, *N. certa*
Rubiaceae				
Coffea spp.	I	1,752	890	*N. pendula* (94.38), *N. zadolicha* (2.26), *N. inesperata* (2.04), *N. bella* (0.52), *N. certa* (0.20), *N. bifida* (0.10), *N. laura* (0.10), *Lonchaea* sp.
Rutaceae				
Citrus aurantium L.	I	19	12	*N. zadolicha* (91.67), *N. glaberrima* (8.33)

Continue.....

Continue. Table 2. Host plants of Lonchaeidae species (Diptera: Tephritoidea) in the State of São Paulo, Brazil (Mar 1993 to Jun 2013).

Family/ Botanical name	Native (N) or Introduced (I)	Total number of lonchaeids	Total number of males	(comparative % of *Neosilba* males)
Citrus limonia Osbeck	I	471	222	*N. zadolicha* (95.94), *N. glaberrima* (3.16), *N. pendula* (0.45), *N. certa* (0.45)
Citrus mitis Blanco	I	701	372	*N. pendula* (44.89), *N. glaberrima* (19.09), *N. zadolicha* (18.28), *N. certa* (15.85), *N. laura* (1.62), *N. inesperata* (0.27)
Citrus reticulata Blanco cv. Ponkan	I	22	12	*N. zadolicha* (58.33), *N. pendula* (25.00), *N. inesperata* (16.67)
Citrus reticulata Blanco cv. Cravo	I	160	87	*N. zadolicha* (93.10), *N. glaberrrima* (4.60), *N. pradoi* (1.15), *N. parva* (1.15)
Citrus reticulata Blanco X *C. sinensis* (L.) Osbeck	I	55	33	*N. zadolicha* (93.94), *N. certa* (6.06)
Citrus sinensis (L.) Osbeck	I	518	359	*N. zadolicha* (65.91), *N. glaberrima* (25.00), *N. certa* (5.92), *N. pendula* (2.27), *N. inesperata* (0.45), *N. bifida* (0.45)
Fortunella sp.	I	60	40	*N. zadolicha* (75.00), *N. certa* (15.00), *N. pendula* (10.00)
Sapotaceae				
Chrysophyllum cainito L.	I	7	2	*N. zadolicha*, *N. pendula*
Chrysophyllum mexicanum Brandegee	I	6	3	*N. zadolicha*
Manilkara zapota (L.) P. Royen	I	12	9	*N. zadolicha*
Mimusops commersonii (G. Don) Engl.	I	13	5	*N. glaberrima* (60.00), *N. certa* (40.00)
Pouteria caimito (Ruiz & Pav.) Radlk.	N	78	36	*N. zadolicha* (61.11), *N. glaberrima* (19.44), *N. pendula* (11.11), *N. bella* (5.56), *N. certa* (2.78)
Pouteria torta (Mart.) Radlk.	N	59	26	*N. dimidiata* (84.62), *N. zadolicha* (7.68), *N. glaberrima* (3.85), *N. paramerolatus* (3.85)
Solanaceae				
Capsicum sp.	I	371	181	*N. glaberrima* (27.08), *N. certa* (26.52), *N. zadolicha* (20.44), *N. pendula* (17.68), *N. inesperata* (5.52), *N. laura* (2.76)
Capsicum annum L.	I	2,271	1,156	*N. parva* (36.76), *N. zadolicha* (30.10), *N. certa* (17.65), *N. glaberrima* (10.12), *N. pendula* (0.78)
Mandragora officinarum L.	I	1	0	*Neosilba* sp.
Solanum gilo Raddi	I	3,556	1,878	*N. zadolicha* (65.02), *N. parva* (18.64), *N. certa* (8.73), *N. pendula* (3.66), *N. glaberrima* (3.09), *N. pradoi* (0.59), *N. inesperata* (0.27)
Solanum lycopersicon L..	I	2	2	*N. zadolicha*
Solanum mammosum L.	N	15	8	*N. zadolicha* (62.50), *N. certa* (25.00), *N. parva* (12.50)
Solanum melongena L	N	1,034	502	*N. zadolicha* (47.01), *N. parva* (43.03), *N. glaberrima* (9.96)
Solanum variabile Mart.	N	2	1	*N. inesperata*
Verbenaceae				
Citharexylum myrianthum Cham.	N	181	92	*N. pendula* (94.56), *N. cornuphalus* (3.26), *N. bifida* (1.09), *N. bella* (1.09)

Table 3. Seasonal occurrence of *Neosilba* species (Diptera: Tephritoidea) in the State of São Paulo, Brazil (Mar 1993 to Jun 2013).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
N. bella	x	x	x	x	x	x	x					x
N. bifida	x	x	x	x	x	x	x					x
N. certa	x	x	x	x	x	x	x	x	x	x	x	x
N. cornuphallus	x	x			x		x	x				
N. dimidiata	x	x	x									
N. inesperata	x	x	x	x	x	x	x	x	x	x	x	x
N. glaberrima	x	x	x	x	x	x	x	x	x	x	x	x
N. laura	x			x		x	x	x	x	x		x
N. paramerolatus	x											
N. parva	x	x	x	x	x	x	x	x	x	x	x	x
N. pradoi		x		x	x	x		x				x
N. pendula	x	x	x	x	x	x	x	x	x	x	x	x
N. perezi	x	x	x	x	x	x	x	x	x	x	x	x
N. zadolicha	x	x	x	x	x	x	x	x	x	x	x	x

bella, N. pradoi and *N. cornuphallus* happened in loquats.

According to Strikis and Prado (2009), the adult of *N. inesperata* is very similar to *N. glaberrima* and it was described from specimens recovered from *E. japonica*. In the present study, the incidence of *N. inesperata* was very low in loquats (1.35 %), but it was meaningful in acerola *M. emarginata* (Malpighiaceae) and *Myrciaria glazioviana* (Kiaersk) G. M. Barroso & Sobral (Myrtaceae).

Except for *Citrus mitis* Blanco, in the other species of Rutaceae collected in the present study, *N. zadolicha* prevailed. This species was also predominant in species of *Solanum* (Solanaceae), in most fruit species of *Annona* (Annonaceae), and in passion fruit (*P. alata* and *P. edulis*). In flower buds of *P. alata* collected in the State of Rio de Janeiro (Brazil), Aguiar-Menezes et al. (2004) obtained *N. zadolicha, Neosilba* sp. and *Dasiops longulus* Norrbom & McAlpine. Those authors recovered only *D. inedulis* from flower buds of *P. edulis* f. *flavicarpa*, similar to those that Chacon and Rojas (1984) obtained in Colombia.

The citric fruits were infested by six species of *Neosilba*, predominantly *N. zadolicha*. The State of São Paulo has approximately 600,000 hectares of sweet oranges [*Citrus sinensis* (L.) Osbeck], with different varieties fruiting all year long. This fact may contribute to the dominance and constancy of *N. zadolicha*.

Species of *Coffea* showed seven species of *Neosilba* and *Lonchaea* sp., with dominance of *N. pendula*, which was also commonly found in samples of Myrtaceae (9 species), Rosaceae (5) and Rutaceae (5). According to Raga et al. (2002), Lonchaeidae corresponded to 10.8 % of the specimens of adult Tephritoidea recovered from fruits of *Coffea* spp. in the State of São Paulo. In the State of Rio de Janeiro, Souza et al. (2005) observed six species of *Neosilba* in coffee fruit, with greater incidence in systems of cultivation in the shade and dominance by *Neosilba turgidiphallus* Strikis and *N. certa*. From coffee berries collected from Minas Gerais state (Brazil), Camargos et al. (2011) recovered *N. pendula, N. zadolicha* and *N. inesperata,* with predominance of the first species.

Neosilba certa was recovered in seven species of Myrtaceae, particularly *Psidium cattleianum* Sabine and *Myrciaria jaboticaba* (Vell.) O. Berg., but it adapted to exotic species of Rosaceae and Rutaceae.

Considered related only to cassava shoots *Manihot esculenta* Crantz (Gisloti and Prado 2011), *N. perezi* is recorded for the first time in acerola fruits. Commercial cultivations of both species are widely distributed in the State of São Paulo. Three annual harvests are obtained in irrigated cultivations of acerola.

In this study, fruits of avocado were attacked by five species of *Neosilba*, with dominance of *N. zadolicha*. Although avocados are not infested by Tephritidae in the State of São Paulo (Raga et al. 2011), *Neosilba batesi* (Curran) infests this Lauraceae in Florida and Mexico (McAlpine and Steyskal 1982, Ahlmark and Steck 1997).

Neosilba parva was strongly associated to Solanaceae, particularly *Capsicum annum* L. According to McAlpine and Steyskal (1982), *N. parva* has grown in *Solanum* spp., but there is little knowledge about other hosts. This species has recently been recorded in avocados and citrus. In *Solanum hirtum* Vahl. collected from Venezuela, Valles et al. (2003) registered infestations by *Lonchaea* sp. and *N. pendula.*

The diversity of Lonchaeidae species and its relationship with host plants in the state of São Paulo show the importance of this group in the mosaic of frugivorous species in tropical and subtropical environments.

An effort is required to conduct taxonomic and bio-ecological studies on Lonchaeidae to determine the importance of this group in the total diversity of Tephritoidea, and its possible economic losses in horticulture.

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Recibido: 19-05-2014.
Aceptado: 04-11-2014.