

Anastrepha spp. (Diptera: Tephritidae) in *Ximenia
Americana* and Other Tropical Fruits in a Brazilian
Savannah

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Abstract

The aim of this work was to evaluate the infestation of *Anastrepha* species in several fruit tree species and *A. alveata* in wild plum *Ximenia americana* L. (Olacaceae), as well as the fruit fly community in a Savannah area using faunal indexes and population fluctuation. For this, we installed McPhail traps and carried out collections at Palmeiras home garden, municipality of São Pedro of Piauí, state of Piauí, northeastern Brazil. We noted high infestation of *A. alveata* in wild plum, with 144.2 puparia/kg, 216.1 puparia/kg and 321.6 puparia/kg for the years 2014, 2015 and 2016 respectively. The infestation indexes of *A. obliqua* in red mombin (*Spondias purpurea*) were 146.1 puparia/kg in 2016 and 479.2 puparia/kg in 2017, and in umbu-hog plum (*Spondias bahiensis*) 607.3 puparia/kg in 2017, both from the Anacardiaceae family. The species that composed the fruit fly community were *A. alveata*, *A. ethalea* (predominant), *A. obliqua*, *A. zenilidae* (dominant and accessory), *A. sororcula* and *A. fraterculus* (accidental). The population fluctuation of *A. ethalea* occurred from March to October, while *A. alveata* presented population peaks in the fruiting of wild plum, between October and December.

Keywords: *Anastrepha alveata*, *Anastrepha ethalea*, infestation index, faunistic analysis, Population fluctuation

1. Introduction

Brazil, the current third largest fruit producer in the world after China and India, has a highly diversified fruit production sector that occupies approximately two million hectares. However, Brazil is ranked 23rd among fruit-exporting countries in South America. This is because phytosanitary embargoes at destination locations limit Brazil's access to the foreign market. This mainly occurs, particularly when the pest of interest is of quarantine relevance at destination markets, for instance of several species of Tephritidae (PNDP/MAPA, 2020).

Fruit flies are insects that cause considerable damage to fruits. Fruit flies represent one of the main obstacles to international fresh-fruit trade in Brazil. The process of oviposition by the females flies and the opening of galleries inside the fruit by larvae, characteristic damages caused by fruit flies, make them unfit for human consumption.

Approximately 70 species of these tephritids contribute to the phytosanitary problems in the fruit sector; the genera *Anastrepha* Schiner, *Bactrocera* Macquart, *Ceratitis* MacLeay and *Dacus* Fabricus contribute to the majority of these problems (Garcia *et al.*, 2017). Within the genus *Anastrepha*, the species *A. fraterculus* and *A. obliqua* that mainly infest plants of the Anacardiaceae and Myrtaceae families, are species of economic interest throughout Brazil (Leite *et al.*, 2017).

Although the species *A. alveata* Stone is not considered a pest, it is uncommon and so far has only been reported in one host in Mexico, the wild plum *Ximenia americana* L. (Olacaceae) (Piedra *et al.*, 1993; Aluja *et al.*, 2014). Because this species is little-known, in Brazil, it has only been documented from traps in population surveys and recently its biological and behavioral aspects have been studied in conjunction with *X. americana* (Araújo *et al.*, 2019).

The wild plum is a cosmopolitan botanical species that is usually found in Africa, India, New Zealand, Central and South America. In Brazil, it is found mainly in the semi-arid region and coastal plains of the Northeast; widely distributed in several forest ecosystems (Sarmiento *et al.*, 2015).

The fruits are round (both length and diameter = 2 cm), and yellow-skinned when ripe, with a single cream-colored almond seed (Almeida *et al.*, 2016). The pulp that has a firm consistency, is aromatic and has a sweet and sour flavor. The short fruiting is concentrated between October and December, in the first rains.

In all areas of where the plum is found (based on folk medicine), research has been done on the wild plum to identify new drugs or substances that can serve as a model for the synthesis of new drugs due to its therapeutic properties (Sobeh *et al.*, 2017).

The most studied fruit fly species in tropical and subtropical regions are those of economic interest, especially those with a varied number of hosts (polyphagous or oligophagous). However, focus should also be directed to monophagous species rely on a single host as a food resource. For instance, *A. alveata* is only found in *X. americana* (Araújo *et al.*, 2014).

Research on trophic interactions between fruit flies and their hosts is vital to support the development of appropriate management techniques for polyphagous or oligophagous species and to maintain monophagous species in their natural environments (Uchôa, 2012).

The objective of this study conducted in the Brazilian savannah, was to study the infestation and population fluctuation of *Anastrepha* species in different fruits and of *A. alveata* in wild plum, as well as to describe the composition of the fruit fly community by means of fauna analysis.

2. Materials and Methods

2.1 Study area: Location and Characteristics

The research was carried out at Palmeiras home garden (05°53'15,3" S and 42°43'28,3" W), municipality of São Pedro do Piauí, state of Piauí, northeastern Brazil, 106 km from state capital Teresina (05°55'46 "S and 42°43'07" W), with altitude of 264 m (CEPRO, 2011). The climate in the region is of the as type, according to Köppen classification, that is, tropical hot, with a rainy season from January to June and a dry season from July to December. The average rainfall is 1,200 mm and the average temperature is 26°C (Aguar, 2004).

The research was carried out in a demarcated area of 4 ha of typical cerradão vegetation (Brazilian savannah) with areas of babassou forest, (*Orbygnia phalerata* Mart.) Arecaceae, representing the characteristics of a secondary-type vegetation.

2.2 Survey of *Anastrepha* spp. in Traps and Directly in Fruits

We installed 13 McPhail traps in randomly distributed wild plum plants at height of 3/4 of each the plant's height. The plants geographical position were recorded by GPS (Global Position System) Garmin CHX Legender®, where 05°53'15.3"S and 42°43'28.3"W was the georeferenced starting point (Figure 1). We supplied the traps with attractive feed based on hydrolyzed maize protein (Bio *Anastrepha*®), diluted to 5% (400 mL of attractant). We replaced the attractive feed fortnightly.

Samples of ripe wild plum fruits were collected weekly (freshly fallen fruits or on the plant). While fruits of other botanical species were collected fortnightly throughout each year according to the fruiting season, including red mombin *Spondias purpurea* L., umbu-hog plum *Spondias bahiensis* P. Carvalho, Van den Berg & M. Machado (Machado *et al.*, 2015) mango *Mangifera indica* L., bush-passion-fruit *Passiflora laurifolia* L., brave-cotton *Cochlospermum vitifolium* (Willd.) Spreng, coroata *Bromelia pinguin* L., marmelo-do-cerrado *Alibertia edulis* (L. Rich) A. Riche, pau-terra *Quelea parviflora* Mart., guabiraba *Campomanesia xantrocarpa* Berg, lobeira *Solanum lycocarpum* St. Hil., araticum-do-cerrado *Annona crassiflora* Mart, mandacaru *Cereus jamacaru* DC., maniçoba *Manihot pseudoglaziovii* Pax & Hoffman. The sample size varied according to fruit availability.

We placed the fruits in trays and the trap content in plastic bottles and transported them to the Entomology Laboratory, Agricultural Sciences Center (CCA) of the Federal University of Piauí (UFPI), in Teresina. We performed the steps of separating fruits and sorting the content of the traps in the Laboratory.

Samples of wild plum fruits and other botanical species, collected from November / 2014 to September / 2017, were counted, grouped by species (biomass defined in kg) and packed in plastic trays (dimensions 40x25x7 cm) containing autoclaved sand as a substrate for pupation.

The puparia were extracted by sieving, counted and kept in plastic containers (250 mL) with moist sand, covered with voile fabric and kept in the breeding room under controlled climatic conditions (temperature 27 ± 2 °C, air RH of $70 \pm 5\%$) until emergence of adults. In 2015 and

2016, 40 wild plum fruits were sampled per collection (four in total). The fruits were individually weighed and placed in plastic containers (50 mL) with autoclaved and moist sand, wrapped in voile and kept in the breeding room under the same climatic conditions and above mentioned procedures.

Emerged adult fruit flies were inactivated in a freezer (10 min permanence), then fixed in 70% ethanol as well as the specimens collected in traps. Specimens were sexed and identified based on female characteristics, since the vast majority of *Anastrepha* species are female.

2.3 Infestation Index of *Anastrepha* spp. in Sampling with Grouped Fruits

We computed the above Index with the formula:

$I = \text{number of pupils obtained} / \text{kg of fruits and number of pupils} / \text{fruits.}$

2.4 Infestation Index and Infestation Intensity of *A. alveata* on Individualized Wild Plum Fruits

It was computed based on Corsato (2004): where

fly infestation index (%) = (infested fruits/total fruits) x 100;

infestation intensity (I.I.) = (number of puparia/mass),

where mass is the total weight of infested fruits (kg).

2.5 Pest Species Identification

We identified the species based on identification keys provided by Zucchi (2000) and Zucchi *et al.* (2011). The identified specimens were stored in 70% ethanol and deposited at the Entomology Laboratory of UFPI (campus of Teresina) and at the Iraci Paiva Coelho Entomological Collection (CIPC) in the Maranhão State University, in São Luís, state of Maranhão.

2.6 Botanical Species

Information on fruiting season and fruit collection of botanical species were based on *in loco* observations throughout each year.

2.7 Faunistic Analysis

We carried out the *Anastrepha* species diversity analysis based on Silveira Neto *et al.* (1976). The estimated parameters were frequency, dominance, constancy, Shannon Diversity Index and Equitability. The ANAFAU software (Moraes *et al.*, 2003) was used for computations.

2.8 Population Fluctuation

The population fluctuation analysis was based on the total number of *Anastrepha* adults caught in the traps. The population seasonal variations were based on the monthly catch of the number of specimens per species (females) and of adults (females and males) (from November/2014 to December/2017). Population fluctuation was analyzed in relation to climatic variables of total rainfall (mm), average temperature (°C) and average relative

humidity (%). Meteorological data were obtained from the National Institute of Meteorology (INMET), from the Ministry of Agriculture, Livestock and Supply, through the Automatic Stations.

2.9 Statistical Analyses

The correlation of climatic variables on the number of adults and *Anastrepha* species was assessed by computing the Pearson correlation coefficient (SAS Institute, 2001).

3. Results and Discussion

We documented 3,215 *Anastrepha* specimens, 669 in traps and 2,546 in fruits. Seven species were captured from the traps (Table 1) and two from the fruits (Table 2).

Table 1. Species and number of *Anastrepha* adults collected through McPhail traps installed in *Ximenia americana* plants at Palmeiras home garden, municipality of São Pedro of Piauí, northeastern Brazil (from Nov./2014 to Dec./2017)

Years	<i>Anastrepha</i> spp.		
	Females	Males	Total
2014	14 09 <i>A. alveata</i> 03 <i>A. obliqua</i> 02 <i>A. fraterculus</i>	3	17
2015	81 65 <i>A. alveata</i> 11 <i>A. ethalea</i> 04 <i>A. obliqua</i> 01 <i>A. zenildae</i>	49	130
2016	104 62 <i>A. alveata</i> 29 <i>A. ethalea</i> 09 <i>A. obliqua</i> 02 <i>A. sororcula</i> 02 <i>A. zenildae</i>	60	164
2017	169 64 <i>A. alveata</i> 86 <i>A. ethalea</i> 14 <i>A. obliqua</i> 03 <i>A. zenildae</i> 02 <i>Anastrepha</i> sp.	189	358
Total	368	301	669
percentage	55%	45%	100%

Table 2. Infestation rates of *Anastrepha* spp. obtained in *Ximenia americana* fruits, *Spondias purpurea* and *Spondias bahiensis*, collected at Palmeiras home garden, municipality of São Pedro of Piauí, northeastern Brazil (from Nov./2014 to Dec./2017)

Years	Fruits		Puparia N	Infestation rate* (fruits/kg)	<i>Anastrepha</i> spp.		
	Species	N/kg			♀	♂	Total
2014	<i>X. americana</i>	639/2.754	397	0.62/144.2	140 A. <i>alveata</i>	165	305
2015	<i>X. americana</i>	897/3.419	739	0.82/216.1	255 A. <i>alveata</i>	265	520
2016	<i>X. americana</i>	1,423/5.293	1,702	1.2/321.6	385 A. <i>alveata</i>	379	764
	<i>S. purpurea</i>	83/0.739	108	1.3/146.1	35 A. <i>obliqua</i>	38	73
2017	<i>S. purpurea</i>	105/1.010	484	4.6/479.2	116 A. <i>obliqua</i>	119	235
	<i>S. bahiensis</i>	148/1.062	645	4.4/607.3	135 A. <i>obliqua</i>	175	310
Total		3,295/14.277	4,075	-	1,066	1,141	2,207

* 1st value: puparia/fruit; 2nd value: puparia/kg.

In the state of Piauí, with the exception of *A. ethalea* and *A. zenilda*, the species *A. obliqua* and *A. fraterculus* were recorded in yellow mombin (Sousa *et al.*, 2017) and *A. alveata* in wild plum (Araújo *et al.*, 2014).

Twenty-six plant species belonging to 21 botanical families were collected; only three species of two families had fruit fly infestations: red mombin *S. purpurea*, umbu-hog plum *S. bahiensis* (Anacardiaceae) and wild plum *X. americana* (Olacaceae).

We observed only two records associated *A. alveata* within the wild plum as host. Similar results were reported in Veracruz, Mexico and in the state of Piauí, northeastern Brazil (Piedra *et al.*, 1993; Araújo *et al.*, 2014). Injuries observed in fruits resulted in considerable infestation indexes, with 144.2 puparia/kg (0.62 puparia/fruits), 216.1 puparia/kg (0.82 puparia/fruits) and 321.6 puparia/kg (1.2 puparia/fruits) for the years 2014, 2015 and 2016 respectively (Table 2). Araújo *et al.* (2014) also observed high infestation index of *A. alveata* in wild plum (158.9 puparia/kg), in a fruit survey previously carried out in the same area.

Based on the results obtained from this study, it could be inferred that *A. alveata* is strictly a monophagous wild plum pest, with no succession in other hosts, in a three-year period of wild plum tree fruiting.

No other fruit fly species collected in the area was noted infesting the wild plum. This is despite the abundance of fruits and the characteristic exhaled aroma, factors considered attractive to fruit flies of polyphagous habit. However, there are documented records of *A.*

fraterculus associated with the wild plum (Piedra *et al.*, 1993; Araújo *et al.*, 2014).

Anastrepha obliqua was found infesting red mombin and umbu-hog plum with considerable infestation indexes (Table 2).

Infestation indexes in red mombin showed increasing values, with 146.1 puparia/kg (1.3 puparia/fruits) in 2016 and 479.2 puparia/kg (4.6 puparia/fruits) in 2017. In umbu-hog plum, *A. obliqua* infestation was observed only in 2017, whose index of 607.3 puparia/kg (4.4 puparia/fruits) was as high as in red mombin in the same year. This can be attributed to the fact that both species are primary hosts and the fruiting of the umbu-hog plum succeeds that of the fruiting of red mombin.

Anastrepha obliqua is a polyphagous species, with high rates of infestation, mainly in hosts of the genus *Spondias*. This was recorded in the states of Piauí in *S. mombin* (Araújo *et al.*, 2014; Gomes Neto *et al.*, 2016; Sousa *et al.*, 2017), Bahia, in *S. purpurea* (Leite *et al.*, 2017) and Amapá, in *S. dulcis*, *S. mombin* and *S. purpurea* (Lemos *et al.*, 2017).

The infestation indices and infestation intensity of *A. alveata* were analyzed with data from fruit collections in 2015 and 2016. *A. alveata* in wild plum fruits showed a considerable infestation intensity when compared with the infestation index (Table 3).

Table 3. Infestation index (%) and infestation intensity (II) of *Anastrepha alveata* in *Ximenia americana* fruits collected at Palmeiras home garden, municipality of São Pedro of Piauí, northeastern Brazil (from Nov./2014 to Dec./2017)

Years	Fruits (N)		Puparia Mass (kg)	Puparia	Infestation		Adults (N°)
	Collected	Infested			%	I.I.	
2015	200	79	0.377	159	39.5	421.75	144
2016	200	173	0.714	442	86.5	619.04	195

According to Corsato (2004), the relationship between infestation index and infestation intensity is not always constant. This is because the percentage of infested fruits does not directly measure the infestation intensity; an infested fruit even with only one larva, is a lost fruit. Therefore, the infestation intensity does not quantify production loss.

However, with a higher the number of larvae in fruits, a larger number of the adult population that will emerge in the next generation. The infestation intensity serves as a prognosis for the infestation index of future fruiting periods, which may affect production at some level.

In this study, this is clearly observed when comparing the yearly infestation intensity of *A. alveata* in 2015 (421.75) and 2016 (619.04), which represented a 46.78% increase from one year to the other and, consequently, an increase in the number of adults in 35.42%, which could probably infest more fruits.

An intrinsic behavior of *A. alveata*, distinct from polyphagous/multivoltine species, is the gradual increase of infestation during the host fruiting, as new populations are generated. This increases the level of damage if timely control measures are not adopted. In the case of

A. alveata, we noted an intense fruit attack at the beginning of the fruiting period, but the intensity regressed as fruits reached the end of the fruiting period, when they were free of attack.

Therefore, since *A. alveata* is a monophagous species of a host with annual and concentrated fruiting and it is also univoltine, as some *Anastrepha* species, such as *A. crebra* Stone and *A. bezzii* Lima. These species are monophagous and apparently univoltine, whose adults must survive for long periods and deal with high environmental variability, which, according to Aluja *et al.* (1999), determines the timing of fruit production of their host plants. This explains the initial high infestation of *A. alveata* in order to guarantee a new population that will wait until the next year's fruiting period.

We inspected the traps 78 times during the sampling period and 368 *Anastrepha* females were captured, represented by seven species (Table 4).

Table 4. Frequency, dominance and constancy of *Anastrepha species* caught in McPhail-type traps installed in *Ximenia americana* plants in a Savannah area, at Palmeiras home garden, municipality of São Pedro of Piauí, state of Piauí, northeastern Brazil (from Nov./2014 to Dec./2017)

Species	Cap.	N	Freq. (%)	Dom.*	Cons.**
<i>A. alveata</i>	58	200	54.35	d	w
<i>A. ethalea</i>	76	126	34.25	d	w
<i>A. oblique</i>	18	30	8.15	d	y
<i>A. zenildae</i>	6	6	1.63	d	y
<i>A. sororcula</i>	2	2	0.54	n	y
<i>A. fraterculus</i>	2	2	0.54	n	y
<i>Anastrepha sp.</i>	2	2	0.54	n	y

Diversity Index (Shannon-Weaner) => H = 1.0549

IC (P = 0.05) => [1.050281; 1.059469]

Uniformity Index or Equity => E = 0.5421

N: total females caught; *d: dominant, n: non-dominant; **w: constant, y: accessory

The analysis of *Anastrepha* catches on traps pointed to a sharp aggregate distribution of females, with four traps (30.77%), capturing 61.41% of females. We installed the traps near

the cultivated fruit trees, in an area more shaded by plant density, which probably influenced the increase of catches.

Four species were dominant in the fruit fly community, *A. alveata*, *A. ethalea*, *A. obliqua* and *A. zenildae* (Table 4). This implies that they are adapted to the environmental conditions of the area and therefore they may influence appearance of other tephritid species. In this case, the dominance of more than one species in the community can explain the existence of only seven species in the area. Among these species, *A. alveata* and *A. ethalea* were predominant, as they presented the highest faunal indexes in the classes of each analyzed category.

Anastrepha alveata was the most frequent of captured female, followed by *A. ethalea*. The highest constancy values demonstrated by the catches, were also observed for these two species, with values above 50%. These were also present in the area for the longest (months) throughout the year.

The presence of *A. alveata* was conditional on the fruiting of the wild plum, occurring between September and December, while *A. ethalea*, with unknown host, was present in almost every month of each year, except in December. The highest constancy values were also observed for these two species, with values above 50%.

Anastrepha obliqua and *A. zenildae* had a frequency of below 10% and the remaining had a frequency of below 1.0%. Additionally, all were considered accessory as regards constancy as they appeared in those collected in short periods of the year (from one to three months) (Table 4).

The Shannon Diversity Index value of 1.05449 is a consequence of the high frequency of *A. alveata*, as evidenced by the higher number of specimens collected. However, this dominant effect was minimized by the high constancy of the presence of *A. ethalea*, as reflected in Equitability index of 0.5421 (Table 4). If *A. ethalea* was excluded from the community, the Equitability index would be lower.

In this study, *A. alveata* was considered predominant, revealing a new profile in relation to the records previously made in Brazil. According to Araújo et al. (2014) the number of specimens collected in surveys with traps, did not reach 1%, compared to other species of *Anastrepha*. In Mexico, during a 12-year period, only 11 *A. alveata* specimens were collected in Veracruz (Ordano et al., 2013) in a fruit fly survey in *Citrus maxima* L. orchards.

Anastrepha ethalea, also considered predominant by faunal indexes, was not seen in association with any fruit of the sampled plant species. In Brazil, there is no host record for *A. ethalea* (Zucchi, 2008) however but it is considered a fruit pest of *Passiflora* species (Subhagan et al., 2020).

We noted the occurrence of some *P. laurifolia* plants in the area but no *A. ethalea* infestation was detected in the fruits collected. The records of *A. ethalea* in the state of Piauí were no more than two specimens under monitoring in commercial mango and citrus orchards (Menezes et al., 2000; Santos & Pádua, 2004; Feitosa et al., 2008). On the other hand, in the state of Maranhão, two specimens were recorded (Holanda, 2012) and the state of Roraima, *A.*

ethalea was represented by a specimen in a guava orchard (Trassato *et al.*, 2016).

Anastrepha obliqua was also a dominant species in surveys carried out through traps in Brazil (Santos & Pádua, 2004; Feitosa *et al.*, 2008; Azevedo *et al.*, 2010; Santos *et al.*, 2011; Holanda, 2012; Marsaro Junior. *et al.*, 2013).

Anastrepha zenilidae, analyzed as a dominant species, has its largest area of occurrence in the semiarid region, as recorded in surveys conducted in the states of Ceará and Minas Gerais (Azevedo *et al.*, 2010; Alvarenga *et al.*, 2010). The species *A. sororcula*, *A. fraterculus* classified as non-dominant and accidental, were dominant and constant in other surveys.

A. sororcula stands out in guava orchards in the Brazilian northeastern region, (Sousa *et al.*, 2017), and *A. fraterculus* in citrus orchards and temperate climate fruits in the southern and southeastern regions (Oliveira *et al.*, 2017). Therefore, the geographic distribution of *Anastrepha* spp. is not uniform, but conditioned to adaptation patterns according to the abiotic conditions of each region.

We assessed the *Anastrepha* adult population fluctuation collected in traps in relation to climatic variables and species with the largest number of specimens in order to know the dynamics of adults in a three-year period (Figure 2). The fluctuation of adults (females and males) was continuous, except in September and October of 2015, when no specimens were captured. The highest peaks of each year occurred in December 2015, October 2016 and August and December 2017. There were two considerable peaks in 2017, one in August, caused by the most expressive increase in male population, and in December, with the increase in female population (Figure 1A).

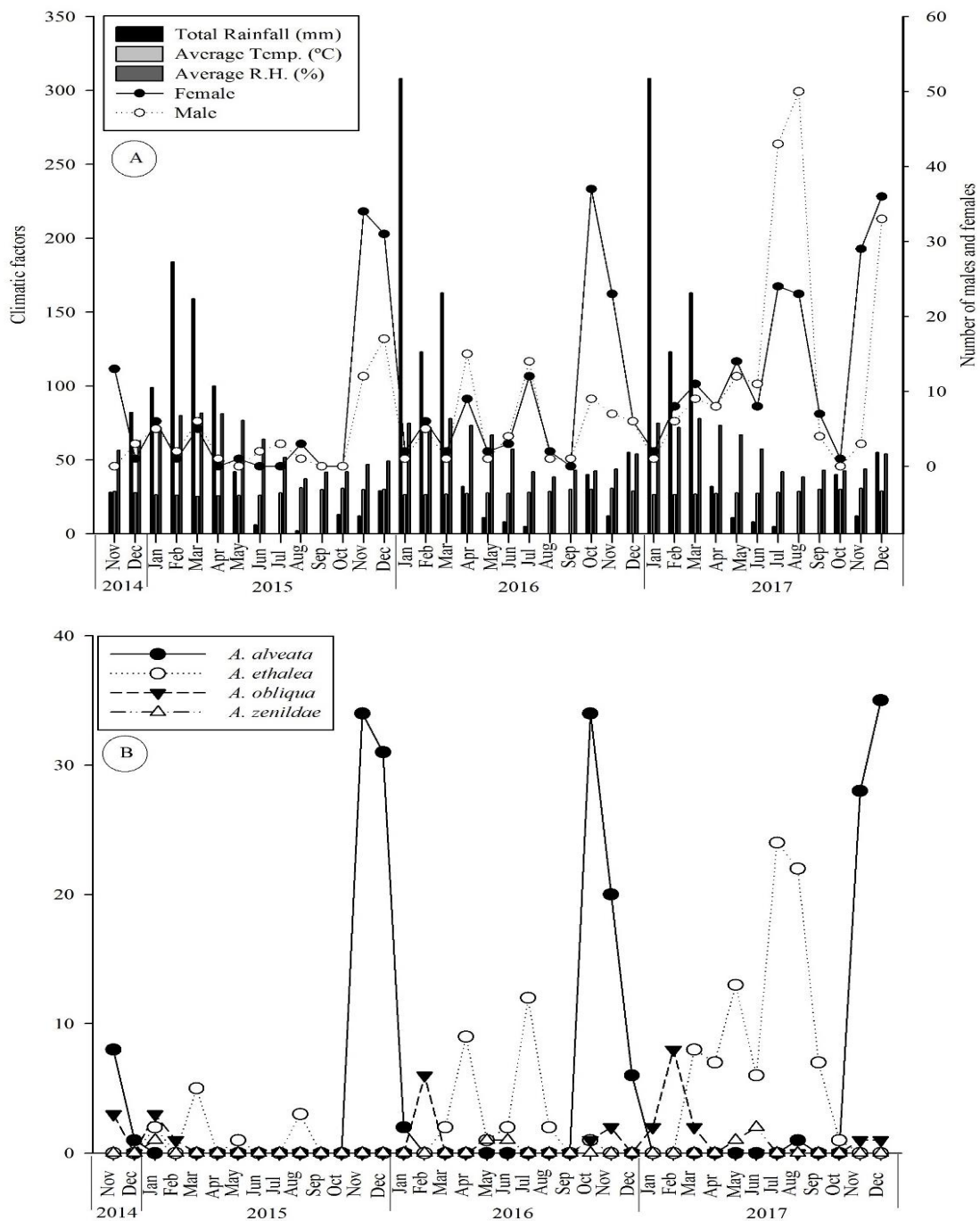


Figure 1. Population fluctuation of *Anastrepha* females and males under climatic conditions of total rainfall (mm), average temperature (°C) and average relative humidity (%) (A) of species *A. alveata*, *A. ethalea*, *A. obliqua* and *A. zenilda* (B), collected in McPhail traps installed in *Ximenia americana* plants, in a Savannah area at Palmeiras home garden, municipality of São Pedro of Piauí, state of Piauí, northeastern Brazil (from Nov./2014 to Dec./2017)

With the exception of *A. alveata*, whose capture showed a positive correlation only with temperature ($r = 0.66241$ and $P = 0.0001$), the other captures of adults and the most frequent

Anastrepha species did not correlate with climatic analyzed parameters (Figures 1A and 1B). For both fruit fly species, catches occurred due to the availability of fruits, wild plum for *A. alveata*, and red mombin and umbu-hog plum for *A. obliqua*. The same cannot be said for the other two species, *A. zenildae* and *A. ethalea*, which had no association with any collected fruit of the botanical species.

According to Santos *et al.* (2011), fruit availability and climatic conditions (rainfall, temperature and air humidity) are determining factors for the occurrence of fruit flies. It was observed in this study, that as regards the population dynamics of fruit flies, particularly for *A. alveata* and *A. ethalea*, the availability of host fruits is a crucial survival factor for *A. alveata*, while for *A. ethalea* no host was identified. However, as these two species were adapted to the Savannah environment, we assume that the climatic conditions of the area are favorable factors for the life dynamics of these species.

Anastrepha alveata showed the highest population fluctuation peaks of (Figure 1B), (Nov/2015, Oct./2016 and Dec./2017), which coincided with the wild plum fruiting, marked by great fruit availability. After fruiting in the subsequent months, *A. alveata* was no longer captured, revealing that its presence is synchronized with its host phenology.

The temporal distribution of *A. ethalea* occurred between March to October, with an almost total absence in the subsequent months, registering a population peak in July / 2017 (Figure 1B).

It was not possible to relate the population fluctuation of *A. ethalea* to fruits of any of the botanical species sampled, even those that showed occurrence of fruits in population peaks, such as brave-cotton *C. vitifolium*, coroata *B. pinguin* L, marmelo-do-cerrado *A. edulis* and pau-terra *Q. parviflora*.

Anastrepha obliqua showed peaks, but not with an annual continuity, only with the Anacardiaceae family fruiting season, which, despite the existence of mangoes, was infestation observed only in *Spondias* species, red mombin and umbu-hog plum. The occurrence of *A. zenildae* was sporadic, probably associated with the family Myrtaceae fruits in the area, although no infestations were found.

This study was conducted in an area botanically dominated by Savannah species. We found population peaks of *A. alveata* and *A. ethalea* in fruit fly populations. Both species are little known, due to the scarcity of studies in native vegetation given the strong reduction of native savannah vegetation, notably in the state of Piauí. Therefore, it is necessary to urgently study such endemic species under high extinction-threat and avoid the extinction of knowledge of the ecological interactions associated with these species.

4. Conclusions

A. alveata is a univoltine, monophagous pest of the wild plum species due to its high infestation rate and intensity. In a savannah area in the state of Piauí, northeastern Brazil, there are seven predominant species in the fruit fly community: *A. alveata*, *A. ethalea*, *A. obliqua*, *A. zenildae*, *A. sororcula*, *A. fraterculus* and *Anastrepha* sp.

A. alveata has population peaks in the fruiting of wild plum and *A. obliqua* in the fruiting of

red mombin *Spondias purpurea* and umbu-hog plum *Spondias bahiensis*.

The population fluctuation of *A. ethalea* ranges from February to November.

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