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Occurrence of fruit flies (Diptera: Tephritidae) in the municipality of Alvorada do Gurguéia in South Central Piauí, Brazil

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ABSTRACT

The state of Piauí is in a Cerrado/Caatinga transition area, which is known the richness of its fauna and flora. Therefore, this work aims to know the diversity of fruit fly species in cashew orchards and native forest fragments in the south-central region of Piauí. Fruit flies were collected in McPhail traps and by sampling fruits. The material collected from the traps and the fruits in the two areas were taken to the Laboratory of Phytotechnics from Campus Prof. Cinobelina Elvas at the Universidade Federal do Piauí (UFPI/CPCE), municipality of Bom Jesus, Piauí, Brazil. In McPhail traps, six species of the genus *Anastrepha*: *A. alveata*, *A. dissimilis, A. fraterculus, A. manihoti, A. obliqua*, and *A. zenildae* were captured, of which *A. fraterculus, A. obliqua,* and *A. zenildae* were present in both areas. *Anastrepha alveata*, *A. dissimilis* and *A. manihoti* occurred only in the cashew orchard. In fruit sampling, *A. fraterculus, A. obliqua*, and *A. zenildae* infested wild-guava fruits, *Myrcia tomentosa* (Myrtaceae), in native forest. *Anastrepha fraterculus, A. obliqua* and *A. zenildae* were obtained directly from *M. tomentosa* fruits and from traps. The availability of host fruits is the factor that most influences the population fluctuation of fruit flies, mainly in the native forest area. *Anastrepha manihoti* is reported for the first time in the state of Piauí. This is the first record of *A. fraterculus*, *A. obliqua* and *A. zenildae,* infesting wild-guava fruits, *M. tomentosa*.

Keywords: *Anastrepha*; host fruit; diversity; ecotone; McPhail traps.

INTRODUCTION

Fruit flies (Diptera: Tephritidae) are among the main agricultural pests in the world and have an economic impact on the production and marketing of fruits and vegetables. Fruit flies are among the main reasons for concern in tropical developing countries, where fruit production is an important source of income. Fruits resulting from female oviposition and larvae feeding inside make them unfit for consumption (ALUJA; MANGAN, 2008; BATISTA et al., 2019).

Brazil has a great diversity of fruit plants and potential hosts for several species of fruit flies, mainly species of the genus *Anastrepha* Schiner, 1868, *Bactrocera* Macquart, 1835, and *Ceratitis* MacLeay, 1829 (Tephritidae). *Bactrocera* carambolae Drew & Hancock is a quarantine pest present in Brazil, being restricted to the states of Amapá, Pará and Roraima. From the genus *Ceratitis*, the only species introduced in Brazil is *Ceratitis capitata* (Wiedmann), which infests

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exotic and native fruits. Of the 128 species of *Anastrepha* that occur in Brazil, seven are particularly economically important (ZUCCHI, 2000; CASTILHO et al., 2019; ZUCCHI; MORAES, 2022). Research on associations with host plants and their natural enemies in native forest areas is still incipient, this lack is greater in the phytophysiognomies of the Cerrado and Caatinga biomes in the Northeast region of Brazil.

The Northeast Brazilian provides a relatively rich flora that makes up different phytophysiognomies and biomes, with many fruit species that host fruit flies and that are also natural repositories of parasites of these tephritid species (ARAÚJO et al., 2014). Ecotone regions (or transition zones) have characteristics that are both unique and derived from adjacent domains, in which little is known about their flora and may have a high number of species in different types of habitats. Ecosystems in transition areas generally have a high diversity index, in which endemic species can occur due to the peculiar characteristics of the interface between confluent biomes (ALVES et al., 2013; BOTREL et al., 2015). In Northeast Brazil, although these are semiarid regions, there are great variations in the physiognomies and diversity of flora (ALVES et al., 2013).

The south central region of Piauí is in a Cerrado-Caatinga transition area. There are a lack of studies concerning fruit flies (Tephritidae) and their parasitoids, being 23 species of fruit flies having previously been reported in this state (ZUCCHI; MORAES, 2021). Fruit cropping in the state of Piauí has been strengthened as an economic activity with the implementation of irrigated fruit growing projects (e.g., *Guadalupe Plateaus* and the *Tabuleiros Coastal Irrigation District of Piauí-DITALPI*, and *Gurguéia Valley*), benefiting small farmers growing tropical fruits in the region (ARAÚJO et al., 2014, GOMES NETO et al., 2017). Despite the impetus of northeastern fruit cropping in Brazil, there are few publications on fruit flies from Piauí, especially regarding natural environments.

Population dynamics of fruit flies are subject to the influence of factors such as temperature, humidity, light, diversity and abundance of hosts (SANTOS et al., 2011; ALUJA et al., 2012). Investigations on faunal patterns and the seasonality of the occurrence of fruit fly species are fundamental for decision-making and the establishment of integrated management strategies against pest species (SANTOS et al., 2011).

It is known that fragmentation of forests leads to a great loss of biodiversity, affecting the discovery of useful information on the biology, ecology and evolution of species of fruit flies (QUERINO et al., 2014) and other phytophagous, decomposing, entomophagous insects. Thus, this paper aims to know the diversity of fruit fly species in cashew orchard and in a native forest fragment in the south central region of the state of Piauí, Brazil.

MATERIAL AND METHODS

Study area

The research was performed in two areas (native forest and cashew orchard) between February 2016 and April 2018. The native forest (approximately 30.3 ha) belongs to the University Experimental Farm (161.3 ha) from the Universidade Federal do Piauí (CPCE/UFPI) (8°22'08.90"S, 43°51'52.08"W, 224 m), which constitutes a legal reserve characterized by the presence of the Cerrado-Caatinga biomes.

The cashew production area (8.6 ha) is in Chácara Anda Sol (8°27'55.41"S, 43°53'46.22"W, 232 m), where the cashew species *Anacardium occidentale* L. 'CP76' of early ripening (April to October) is cultivated.

Both areas are in the municipality of Alvorada do Gurguéia, in the south central part of the state of Piauí, approximately 10 km from each other. The region is characterized by a hot and humid climate classified by Köppen as Awa (ALVARES, et al., 2013), with average rainfall between 900- and 1,200-mm year 1, distributed from December to April, with an average annual temperature of 26.6 °C.

Collections with McPhail traps and fruit sampling

To obtain fruit flies, two sampling methods were used: McPhail traps with food bait and fruit sampling, in the two study areas.

Five McPhail traps were installed in each location (total 10 traps) and baited with a 10% hydrolyzed corn protein solution (BioAnastrepha). These were attached to branches within the treetops approximately 1.5 m high from ground level. The attractant was replaced weekly, when the captured insects were also transferred to properly identified and preserved plastic bottles and preserved at 70% ethanol.

Fruits were collected weekly both from the ground and from the treetops, when possible, within a radius of 25 meters from the traps, was this distance established. The fruit flies from the traps and the native fruits collected weekly were transported to the Phytotechnics laboratory of Campus Prof. Cinobelina Elvas from the Universidade Federal do Piauí (UFPI/CPCE), municipality of Bom Jesus, Piauí. In the laboratory, the fruits were quantified, weighed individually, identified and placed in transparent plastic cups containing autoclaved sand and closed with voile tissue. The samples were kept under room conditions (26 ± 2 °C, 50 ± 10% RH). The sorting of fruits and sand was carried out for a period between 10 and 15 days after collection, and the pupae were transferred to other cups with autoclaved sand until the emergence of the adult fruit flies. Adults were quantified, properly labeled and kept in 70% ethanol for later identification.

The identification of fruit fly species was based on examining the genitalia of females of *Anastrepha* species, using taxonomic keys (STONE, 1942; ZUCCHI, 2000), and only the females were considered in the analyses.

Data analysis

For the analyses, were considered only the females of the species of *Anastrepha*. The faunistic analysis was based on the frequency, constancy, abundance and dominance indices, according to SILVEIRA-NETO et al. (1976), considering only the number of females for the species of *Anastrepha*. To better understand the discussion, the research was subdivided into two seasons: February 2016 to January 2017 (scarce rains) and February 2017 to April 2018 (rainiest period), according to the (ALVARES, et a., 2013).

RESULTS

McPhail trap collections

In the 10 traps a total of 954 individuals of different species of the genus *Anastrepha* were captured (386 females and 568 males). Of these total, 841 specimens (329 females and 512 males) were captured in the native forest area: *Anastrepha zenildae* (Zucchi, 1979), (n = 185), *Anastrepha obliqua* (Macquart, 1835), (n = 100) and *Anastrepha fraterculus* (Wiedemann, 1830), (n = 44) (Table 1). Only 113 specimens (57 females and 56 males) were captured in the cashew orchard, represented by *Anastrepha alveata* (Stone, 1942), (n = 16), *A. zenildae* (n = 14), *Anastrepha dissimilis* (Stone, 1942), (n = 10), *A. fraterculus* (n = 7), *Anastrepha manihoti* (Lima, 1934) (n = 6) and *A. obliqua* (n = 4) (Table 1).

Table 1. Analysis of fruit fly (Diptera: Tephritidae) fauna collected in a McPhail trap in an area of native forest and cashew orchard, Alvorada do Gurguéia, Piauí, Brazil (March 2016 to April 2018).

Species	Native forest											
	March 2016 to April 2017						May 2017 to April 2018					
	n	%	D	A	F	C	N	%	D	A	F	C
A. zenildae	2	33.33	nd	C	F	z z	183	56.66	d d	c	f	y
A. obliqua	4	66.67	nd	C	F	z z	96	29.72	d d	c	f	y
A. fraterculus	-	-	-	-	-	-	44	13.62	d d	c	f	y
Species	**Cashew orchard**											
	March 2016 to April 2017						May 2017 to April 2018					
	n	%	D	A	F	C	N	%	D	A	F	C
A. alveata	6	60	d	C	F	y	10	21.28	D	a	vf	w
A. zenildae	4	40	nd	C	F	y	10	21.28	D	a	vf	w
A. obliqua	-	-	-	-	-	-	4	8.51	Nd	r	in	z
A. fraterculus	-	-	-	-	-	-	7	14.89	D	c	f	Y
A. dissimilis	-	-	-	-	-	-	10	21.28	D	a	vf	w
A. manihoti	-	-	-	-	-	-	6	12.77	D	c	f	y

D = Dominance - d: dominant; nd: not dominant. A = Abundance - a: abundant; c: common; r: rare. F = frequency - vf: very frequent; f: frequent; in infrequent. C = Constancy - w: constant; y: accessory; z: accidental; n = number of specimens.

Population fluctuation

In the first period of the survey (February 2016 to March 2017, scarce rain), *A. zenildae* showed a population peak in March 2017 and another in May 2016 in the areas of native forest and cashew orchard, respectively (Fig 1a,c). *Anastrepha alveata* showed three population peaks (May 2016, October 2016 and February 2017) and occurred only in the cashew orchard (Fig. 1c). In the second survey period (February 2017 to April 2018, rainiest period), *A. zenildae, A. fraterculus,* and *A. obliqua* showed a population peak in January 2018 in the native forest area (Fig. 1b). In the cashew orchard, the six species showed peaks between May and July 2017. In addition, *A. alveata* showed two other population peaks in September and November 2017 (Fig. 1d).

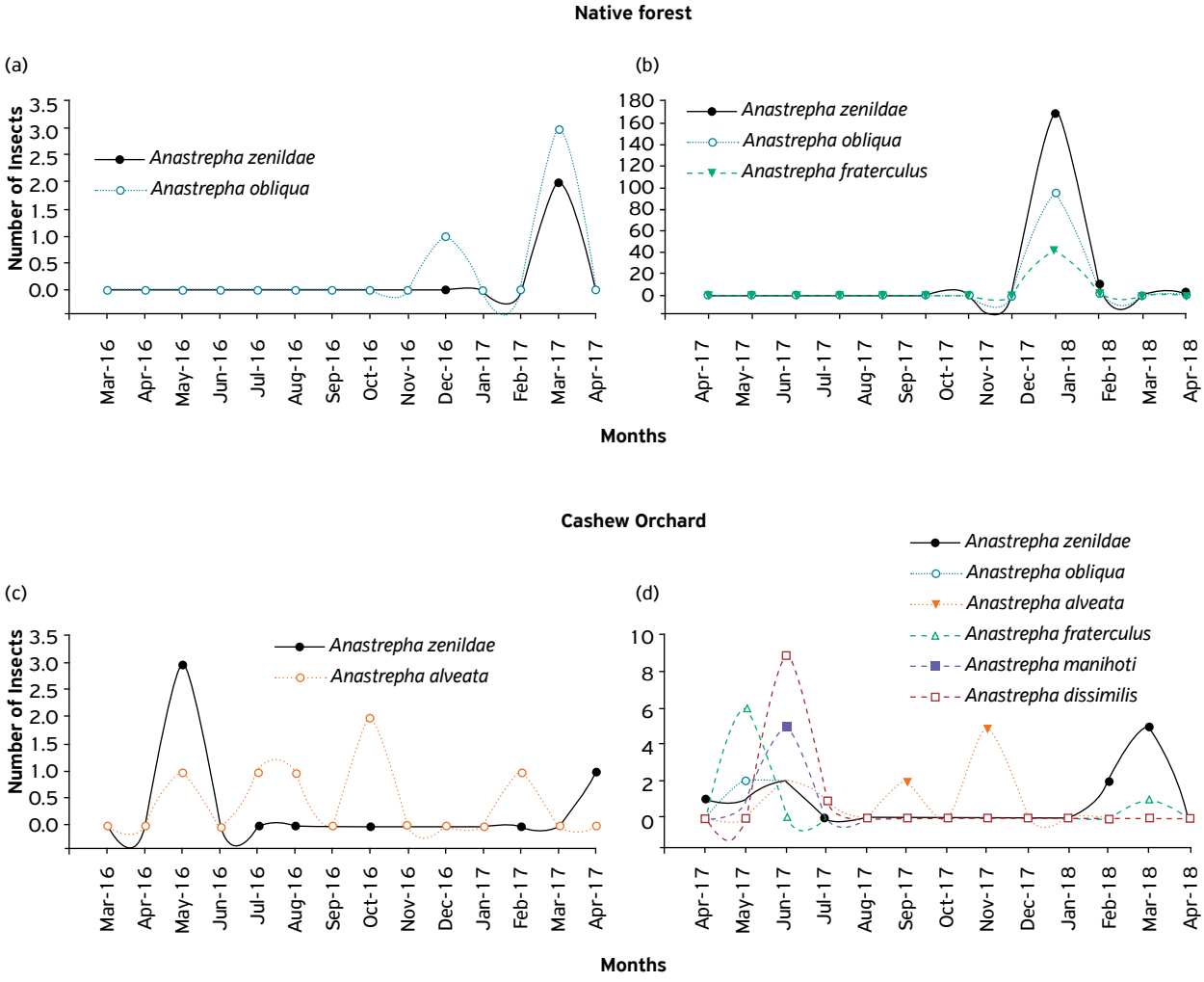

Figure 1. Population fluctuation of fruit flies (Diptera: Tephritidae) captured in McPhail traps in the areas of native forest (a and c) and cashew orchard (b and d) in the municipality of Alvorada do Gurguéia, Piauí, Brazil (March 2017 to April 2018).

Faunistic analysis

Whiting the fruit flies, *A. fraterculus* had the highest frequency (0.118%), followed by *A. zenildae* (0.093%) and *A. obliqua* (0.059%) (Table 2). Six species of Anastrepha were captured in a McPhail trap during the sampling period (Table 1). No species was considered predominant, nor was it classified as superdominant, superabundant, superfrequent or superconstant in quantitative parameters (Table 3). Regarding the characteristics of the community, there was a significant difference in the diversity index (H) in the two years of study. The species richness index was higher in the area of cashews in both years of study. Due to the equitability index, the species distribution occurred more uniformly in the cashew orchard than in the native forest area (Table 3).

Table 2. Host of fruit flies (Diptera, Tephritidae) collected in an area of native forest and cashew orchard in the municipality of Alvorada do Gurguéia, Piauí, Brazil (February 2016 to April 2018).

Collection number	Hosts	Family	N./ Fruit	Mass (g)	N./ Pupae	Family	Species of flies	♂	♀	Total	Frequency %
1	*M. tomentosa*	Myrtaceae	35	0.477							
2	*M. tomentosa*	Myrtaceae	34	0.581							
3	*M. tomentosa*	Myrtaceae	9	0.822							
4	Cashew 'CP76'	Anacardiaceae	3	0.136							
5	Cashew 'CP76'	Anacardiaceae	16	0.769							
6	Cashew 'CP76'	Anacardiaceae	18	0.467							
7	Cashew 'CP76'	Anacardiaceae	10	0.606							
8	Cashew 'CP76'	Anacardiaceae	15	0.685							
9	Cashew 'CP76'	Anacardiaceae	4	0.147							
10	Cashew 'CP76'	Anacardiaceae	4	0.154							
11	Cashew 'CP76'	Anacardiaceae	12	0.677							
12	Cashew 'CP76'	Anacardiaceae	26	1.191							
13	Cashew 'CP76'	Anacardiaceae	8	0.415							
14	*M. tomentosa*	Myrtaceae	8	0.112	77	Tephritidae	*A. fraterculus*	29	19	48	0.081
						Tephritidae	*A. zenildae*	3	12	15	0.025
						Tephritidae	*A. obliqua*		7	7	0.012
15	*M. tomentosa*	Myrtaceae	11	0.132	56	Tephritidae	*A. fraterculus*	11	6	17	0.029
						Tephritidae	*A. zenildae*	1	12	13	0.022
						Tephritidae	*A. obliqua*	12	6	18	0.030
16	*M. tomentosa*	Myrtaceae	14	0.177	96	Tephritidae	*A. fraterculus*	9	13	22	0.037
						Tephritidae	*A. zenildae*	7	29	36	0.061
						Tephritidae	*A. obliqua*	28	7	35	0.059
17	*M. tomentosa*	Myrtaceae	15	0.445	81	Tephritidae	*A. fraterculus*	14	20	34	0.057
						Tephritidae	*A. zenildae*		28	28	0.047
						Tephritidae	*A. obliqua*	10	3	13	0.022
18	*M. tomentosa*	Myrtaceae	13	0.367	174	Tephritidae	*A. fraterculus*	57	13	70	0.118
						Tephritidae	*A. zenildae*	13	42	55	0.093
						Tephritidae	*A. obliqua*	16	10	26	0.044
19	*M. tomentosa*	Myrtaceae	12	0.154	68	Tephritidae	*A. fraterculus*	8	7	15	0.025
						Tephritidae	*A. zenildae*	4	20	24	0.040
						Tephritidae	*A. obliqua*	6	7	13	0.022
20	*M. tomentosa*	Myrtaceae	9	0.110	40	Tephritidae	*A. fraterculus*	9	1	10	0.017
						Tephritidae	*A. zenildae*	1	17	18	0.030
						Tephritidae	*A. obliqua*	1	6	7	0.012
Total			276	8.615	592			272	311	583	100%

Table 3. Faunistic indices of fruit flies (Diptera: Tephritidae) captured in McPhail traps in an area of native forest and in a cashew orchard, Alvorada do Gurguéia, Piauí, Brazil (March 2016 to April 2018).

	March 2016 to April 2017		May 2017 to April 2018	
	Forest	Orchard	Forest	Orchard
Total number of individuals	6	10	323	47
Number of species	2	2	3	6
Community feature				
Diversity index (H)	0.6365	0.6730	0.9541	1.7439
Confidence interval H (p = 0.05)	[0.527596. 0.745431]	[0.633284. 0.712738]	[0.950962. 0.957173]	[1.731459. 1.756297]
Richness index (Margalef)	0.5581	0.4343	0.3462	1.2987
Uniformity Index (E)	0.9183	0.9710	0.8684	0.9733

Fruit sampling

A total of 276 fruits were sampled, within 25 m of the traps, which were collected according to their availability trees bearing fruit, being 160 of wild guava (*Myrcia tomentosa* Aubl. DC.) (3,368 g) in the native forest area and 116 fruits of *A. occidentale* L. 'CP76' (5,247 g) in the area of cashew orchard. The total mass of all fruits was 8,615 g. From the wild-guava fruits (native forest), 592 pupae were obtained from which 583 adults of fruit flies emerged (285 females and 239 males), being obtained the species: *A. zenildae* (160), *A. fraterculus* (79) and *A. obliqua* (46) (Table 2).

Climatic data

The temperature varied by only 11 °C during the research period, ranging from 28 to 39 °C, and rainfall was concentrated from October to March, with a maximum of 300 mm in March and a minimum of 7.8 mm in June and November 2016. The relative humidity of the air varied according to rain precipitation, with the highest rainfall observed during February and March (60%) and the lowest rainfall in August (approximately 29%) (Fig. 2).

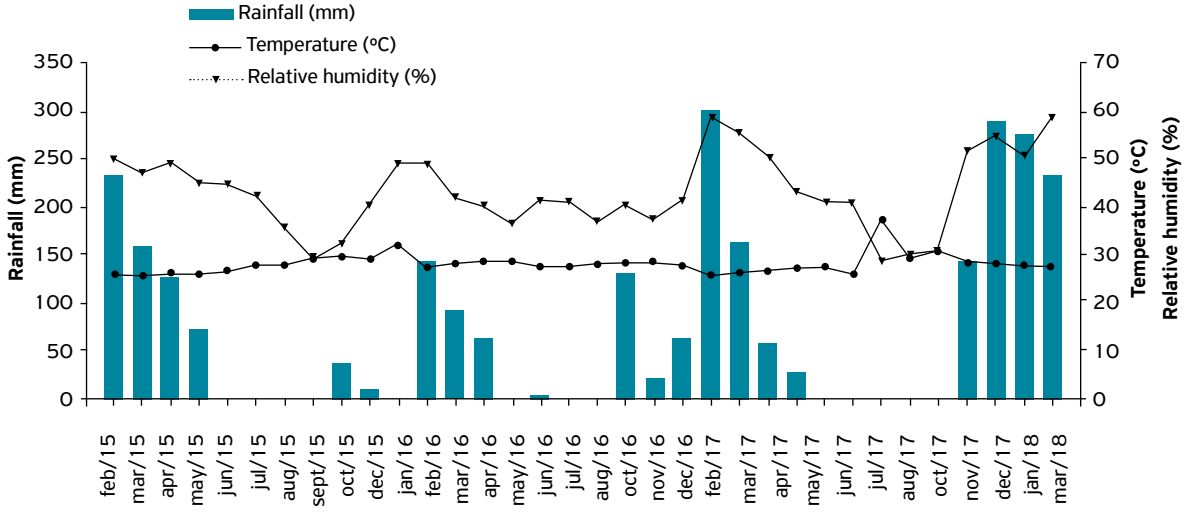

Figure 2. Monthly averages of rainfall (mm), temperature (°C) and relative humidity (%) in native forest areas (A) and cashew orchards (B) during the collection of fruit fly species (Diptera, Tephritidae) in the municipality Alvorada do Gurguéia, Piauí, Brazil (February 2016 to April 2018).

DISCUSSION

Population fluctuation

Population fluctuation of fruit flies, both in the orchard and in the native forest fragment, showed the highest population peak during May 2016 (Fig. 1c), March, June and November 2017 (Fig. 1a,d), and January and March 2018 (Fig. 1b,d). These peaks coincide with the beginning of the rainy period and an increase in the relative humidity of the air in the evaluated region (Fig. 2). According to RONCHI-TELES; SILVA (2005), climatic factors may indirectly affect the population fluctuation of fruit flies, as they may favor the ripening of the hosts in which their larvae grow.

Species richness varied between the two periods: February 2016 to January 2017 (scarce rains) and February 2017 to April 2018 (rainiest period) (Table 2). There was no use of biocides (insecticides, fungicides, herbicides) in the orchard, which minimized the mobility of fruit flies (ALUJA et al., 2012). The increase in rainfall in the second year (February 2017 to April 2018, Table 2) provided ripening conditions to the respective host plants and increased the abundance of fruit fly species.

Abiotic factors, such as rainfall, can strongly influence climatic components, such as temperature and relative humidity in the studied areas. In a study by MALAVASI et al. (2000) in the Northeast Region of Brazil, *A. fraterculus* predominated in the coastal region, which is more humid, and *A. zenildae* predominated in warmer areas, as in the case of the Cariri Cearense region. In the present work, these species were recorded in the south central Piauí in a Cerrado-Caatinga transition area with a hot and humid climate, which probably favored the high populations of these two species.

Faunistic analysis

Quantitative research on the species richness of fruit fly and their spatiotemporal variations in native forest areas is scarce in the neotropical region. The richness found in this study was small when compared to studies of fruit fly species in other tropical regions (ALUJA et al., 2003; BOMFIM et al., 2007; CANESIN, UCHOA, 2007; HERNÁNDEZ-ORTIZ; PÉREZ-ALONSO, 1993; RONCHI-TELES; SILVA, 2005). Therefore, faunal studies using quantitative parameters (dominance, abundance, frequency and constancy) and species diversity indices help to understand the general patterns of biology, ecology and behavior of communities (URAMOTO et al., 2005).

Among the species obtained in the present study, with fruit sampling and collections in McPhail traps, only *A. zenildae*, *A. obliqua*, and *A. fraterculus* have economic and quarantine importance (ZUCCHI, 2000). The greater dominance of species found in the second period (February 2017 to April 2018, rainiest period) can be explained by the presence of host plant species in the vicinity of the traps (Tables 2 and 3), where species of Anacardiaceae, Myrtaceae, Malpighiaceae and Rutaceae occur, constituting potential fruit hosts for fruit flies (ZUCCHI, 2000).

Inventories of fruit flies in the Neotropical Region employing both methods simultaneously are rare: traps and fruit sampling in undisturbed environments, although these locations are more suitable for studies of the population dynamics of fruit flies. However, fruit fly populations in commercial orchards and in unmanaged orchards also exhibit irregular fluctuations from year to year, which are dependent on regional climatic factors that influence host fruit availability (ALUJA, 1994; ALUJA et al., 2012).

In McPhail traps, specimens of *A. alveata* in the cashew orchard occurred with high frequency (28.21%) (Table 1). To date, it is not known which fruit species is the host for *A. alveata* in the south central region of Piauí. This species was obtained from wild plum fruits in northern Piauí. However, wild plum *Ximenia americana* L. (Olacaceae), is a native species registered as the first host of *A. alveata* in Brazil (ARAÚJO et al., 2014). Its occurrence was also verified in other surveys with McPhail traps in semiarid and coastal regions from Rio Grande do Norte in the Caatinga area in northern Minas Gerais state in studies performed by ARAÚJO et al. (2000) and by ALVARENGA et al. (2000).

Anastrepha dissimilis was less abundant and was characterized as an accessory species. This species has already been recovered from three host fruit trees: *Passiflora caerulea* L., *Passiflora elegans* Mast. and *Passiflora edulis* Sims (Passifloraceae) in southern Brazil (GARCIA; NORRBOM, 2011; MARSARO JÚNIOR et al., 2014). The low level of abundance of *A. dissimilis* and *A. manihoti* in this study may be the result of the absence of their preferred hosts. Another possibility may be local competition for other species of *Anastrepha* or the presence of their natural enemies.

Several species of *Anastrepha* can be classified as specialists (monophages), colonizing a single fruitful host. For example, larvae of *A. manihoti* develop exclusively on fruits of *Manihot esculenta* Crantz (MARSARO JÚNIOR

et al., 2017). *Anastrepha manihoti* has a registered distribution in some Brazilian regions: Amazonas and Rondônia (RONCHI-TELES, 2000), Pernambuco (HAJI; MIRANDA, 2000), Santa Catarina (GARCIA et al., 2002), Rio de Janeiro (FERRARA et al., 2004), Roraima (MARSARO JÚNIOR et al., 2011), Bahia (SANTOS et al., 2011) and Minas Gerais (CAMARGOS et al., 2015). Among the six Anastrepha species obtained in the present study, *A. manihoti* is reported for the first time in the state of Piauí.

There was a significant difference in fruit fly communities by the diversity index (H) in the two study periods in which there was only one rare species (Table 1). The advantage of diversity lies in the survival of the community. For example, rare species (*singleton species*), apparently without economic importance, can contribute to the maintenance of community stability, exerting important indirect functions (ROSA DE OLIVEIRA, 2015; SILVEIRA-NETO et al., 1976). Therefore, the presence of these species is indicative of the host diversity around the study area. The values of the diversity index, species richness index (Margalef) and uniformity index corroborate that the fruit fly community in south central Piauí has average species diversity and contributes to the equitable distribution of abundance and dominance of these species.

The greatest uniformity of species occurred in the cashew orchard in both periods evaluated (February 2016 to January 2017, scarce rains and February 2017 to April 2018, rainiest period), (Table 2). Therefore, with a more equitable distribution in the orchard compared to the native forest area, probably due to the presence of hosts in the orchard's surroundings throughout the year, host succession of the fruit fly species was enabled.

Fruit sampling and climatic occurrences

The fruits of *M. tomentosa* (wild guava) were sampled in rainy periods. This Myrtaceae hosted *A. zenildae*, *A. obliqua* and *A. fraterculus* and contributes to the maintenance of the population in the two studied areas. Myrtaceae in the Neotropical Region are responsible for maintaining resources for fruit flies, and their fruits are suitable for the larval development of a great diversity of Tephritidae species (NICÁCIO; UCHOA, 2011; UCHOA et al., 2002; URAMOTO et al., 2008).

Several species of Anastrepha have a wide geographical distribution, such as *A. obliqua* observed in 25 Brazilian states, followed by *A. fraterculus* (23) and *A. zenildae* (18) (ZUCCHI; MORAES, 2021). All these three fly species were obtained from the fruits of *M. tomentosa* (wild-guava). Myrtaceae species are important host for fruit flies of the *Anastrepha* genus and *C. capitata*. In Brazil, only from this plant family, 74 host fruits have been for these Tephritidae flies have already been reported (LEITE et al., 2017; ZUCCHI; MORAES, 2021).

Fruit collections took place in periods when there was a greater volume of precipitation (Fig. 2). This rainy season offered favorable conditions for flowering, and fruit ripening in that area of the Cerrado-Caatinga. With the incidence of rains and an increase in the relative humidity of the air in the region, populations of fruit fly species remained stable in the surveyed areas. It was observed that as rainfall increased, there was an increase in the abundance of fruit flies, mainly *A. zenildae, A. obliqua*, and *A. fraterculus*, with population peaks following the rainiest periods. Similar results were verified by AZEVEDO et al. (2010) in the state of Ceará, where they found that the gradual increase in precipitation rates was correlated with the increase in the capture of fruit flies. The results are also congruent with those of BATEMAN (1972) and ALUJA (1994) carried out in commercial orchards. Therefore, the population fluctuations of adult tefritids are associated with the availability of host fruits and local climatic conditions.

CONCLUSIONS

Anastrepha zenildae, A. obliqua and *A. fraterculus* occur in an area of native forest and cashew orchard in the south of the state of Piauí; *A. alveata, A. manihoti* and *A. dissimilis* occurred only in the cashew orchard. *Anastrepha manihoti* is for the first time reported in the state of Piauí, collected in McPhil traps. *Anastrepha zenildae, A. obliqua* and *A. fraterculus* are new associations, infesting fruits of *M. tomentosa* (Myrtaceae) in Brazil.

The availability of host fruits influences the population fluctuation of fruit flies, mainly in the native forest area. *Anastrepha zenildae* was the most successful species (most abundant and dominant in the region, followed by *A. obliqua*, being the two most economically important pest species, in addition to *A. fraterculus*, in the two surveyed areas. The period of greatest abundance of fruit flies in the south-center of Piauí is the rainy season with mild temperatures (February to April).

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AVAILABILITY OF DATA AND MATERIAL

All data generated or analyzed during this study are included in this published article.

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CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest related to the publication of this manuscript.

ETHICAL APPROVAL

Not applicable.

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