Brazilian Journal of Biology®

ISSN 1519-6984 (Print)
ISSN 1678-4375 (Online)

Original Article

Potential breeding containers of *Aedes aegypti* (Linnaeus, 1762) and *Aedes albopictus* (Skuse, 1894) at strategic points in a city in the eastern region of Maranhão

Potenciais criadouros de *Aedes aegypti* (Linnaeus, 1762) e *Aedes albopictus* (Skuse, 1894) em pontos estratégicos em um município da região leste do Maranhão

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Abstract

Potential breeding containers for *Aedes aegypti* and *Aedes albopictus* mosquitoes are found in different environments, these places are considered by the National Dengue Control Program in Brazil as strategic points (SP), which have favorable conditions for the development of those insects. The aim of this study is to identify potential breeding containers for *A. aegypti* and *A. albopictus* at strategic points in the city of Codó, Maranhão. This study was conducted in five districts, one in each administrative area of the city. A survey of the types and quantity of existing strategic points in each neighborhood was carried out, and surveys of these properties were carried out to inspect the potential breeding containers, with the collection of the vectors' number of immatures found at them. 125 properties were inspected of which 76.91% and 81.25% were vacant lots in the dry and rainy seasons, respectively. There was a difference between the median of the different strategic points ($H = 21.96$; $p < 0.0001$), For *A. aegypti*, there was no difference between the medians of number of immatures regarding the strategic points ($H = 3.71$; $p = 0.28$). The total number of immature *A. albopictus* was higher in vacant lots than in workshops ($H = 9.41$; $p = 0.02$, $p < 0.05$). 4,356 and 4,911 potential breeding containers were found in the dry and rainy seasons, respectively. Regarding the potential breeding containers, 7 (0.16%) and 47 (0.96%) were found with immature vectors, in the dry and rainy seasons, respectively. There were more positive containers in the rainy season for which there was a difference between the median of the number of mosquitoes per positive container ($H = 15.66$; $p = 0.01$), the number of immatures for the tires group was greater than Vases and Fixed groups ($p < 0.05$); the same result was observed in the analyses of the species in the separate form. The impressive number of potential breeding containers found in the SP in both seasons highlights the importance of developing control strategies for these vectors, with emphasis on places such as vacant lots, workshops, tire shops and junkyards, which are serving as dispersal urban sites of vectors.

Keywords: arboviruses, mosquito vectors, control, containers.

Resumo

Os potenciais criadouros dos mosquitos *Aedes aegypti* e *Aedes albopictus* são encontrados em diversos ambientes, esses locais são considerados pelo Programa Nacional de Controle da Dengue como pontos estratégicos (PE), os quais possuem condições favoráveis ao desenvolvimento desses insetos. Propõe-se nesse estudo identificar os potenciais criadouros de *A. aegypti* e *A. albopictus* em pontos estratégicos na cidade de Codó, Maranhão. Este estudo foi realizado em cinco bairros, um em cada zona administrativa da cidade. Foi realizado o levantamento dos tipos e quantidade de pontos estratégicos existentes em cada bairro, e vistorias desses imóveis para inspeção dos recipientes potencial criadouro, com coleta das formas imaturas encontradas nestes. Foram inspecionados 125 imóveis, para os quais houve diferença entre a mediana dos diferentes pontos estratégicos ($H = 21{,}96$; $p < 0{,}0001$), sendo que os terrenos baldios foram mais frequentes com 76,91% e 81,25% nos períodos seco e chuvoso, respectivamente.

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Received: June 16, 2023 – Accepted: October 23, 2023

Para *A. aegypti* não houve diferença entre as medianas de imaturos em relação aos pontos estratégicos (H = 3,71; p = 0,28). A quantidade de imaturos de *A. albopictus* foi maior em terrenos baldios do que em oficinas (H = 9,41; p = 0,02, p < 0,05). Foram encontrados 4.356 e 4.911 recipientes potenciais criadouros nos períodos seco e chuvoso, nesta ordem. Em relação aos recipientes positivos, 7 (0,16%) e 47 (0,96%) foram encontrados com imaturos dos vetores, nos períodos seco e chuvoso, respectivamente. Só houve predominância de recipiente positivo no período chuvoso, para o qual houve diferença entre as medianas de imaturos das duas espécies (H = 15,66; p = 0,01), sendo que a quantidade de imaturos para o grupo Pneus foi maior que Vasos e Fixos (p < 0,05), o mesmo resultado foi observado nas análises das espécies da forma separada. O número expressivo de recipientes potenciais criadouros encontrados nos PE nos dois períodos, evidencia a importância de se desenvolver estratégias de controle a esses vetores com ênfase em locais como terrenos baldios, oficinas, borracharias e ferros-velhos, os quais estão servindo de local de dispersão dos vetores em área urbana.

Palavras-chave: arboviroses, mosquitos vetores, controle, recipientes.

1. Introduction

Aedes aegypti (Linnaeus, 1762) and *Aedes albopictus* (Skuse, 1894) are mosquitoes of epidemiological importance. *A. aegypti* (Linnaeus, 1762) is the main vector species of arboviruses in Brazil (Brasil, 2001; Azevedo et al., 2015), as it transmits dengue fever (DENV), Zika (ZIKV), chikungunya (CHIKV) and yellow fever (YFV). In 2022, there were 1,450,270 probable cases of dengue fever, with an incidence of 679.9 cases per 100,000 inhabitants in Brazil. In the same period, 174,517 probable cases of chikungunya were reported, with an incidence of 81.8 cases per 100,000 inhabitants. Regarding Zika cases in Brazil, up to epidemiological week 48, 9,204 probable cases were reported, with an incidence rate of 4.3 cases per 100,000 inhabitants. In the State of Maranhão, in 2022, 7,300 probable cases of dengue, 2,200 cases of chikungunya and 249 of Zika were registered (Brasil, 2023b).

The large dispersion of *A. aegypti* and *A. albopictus* at urban areas is directly related to social problems, such as lack of planning and infrastructure in cities, urban mobility and human habits such as producing garbage, which may serve as breeding containers for vectors, in addition to environmental issues (Barakat and Caprara, 2021; Johansen et al., 2021; Almeida et al., 2020; González et al., 2020; Silva et al., 2020; Orlandin et al., 2017).

A. aegypti and *A. albopictus* are characterized by their ability to easily colonize a variety of sites, even those with little accumulated water. Among the various sites, breeding containers kept by people in home environments stand out (Flaibani et al., 2020; Andrade et al., 2019; Soares-Pinheiro et al., 2017; Soares-da-Silva et al., 2012).

In the fight against those mosquitoes in Brazil, there are priority places in the dispersion of these so-called Strategic Points (SP), which can present conditions that are ideal for the reproduction and complete development of the vectors (Brasil, 2002). Tire shops, workshops and junkyards are considered strategic points, because they can offer a large number of containers that can become breeding ones, such as abandoned tires, cans, garbage and disposables, which, in the rainy season, can accumulate water and become a breeding container for insects, and thus play an important role in mosquitoes' dispersion in urban areas (Barbosa et al., 2019; Tauil, 2001).

Vacant lots located within the city contribute to the increase in the populations of *A. aegypti* and *A. albopictus* as the inhabitants usually dispose their garbage in these spaces. In this sense, many containers can go unnoticed and thus serve as artificial breeding containers, and even as a shelter, for adult female vectors (Sousa et al., 2021).

Considering the epidemiological situation of diseases such as dengue fever, Zika and chikungunya in the country and especially in the state of Maranhão (Brasil, 2023a), it is necessary to study the diversity of potential breeding containers that boost the proliferation of these disease vector mosquitoes in urban areas. Considering this, collecting data in places classified as strategic points that are seem as most vulnerable in the dissemination of the vectors can aid in verifying the real contribution of these areas in the perpetuation of these diseases. In this context, this study aimed to identify potential breeding containers for *A. aegypti* and *A. albopictus* at strategic points in the city of Codó, located in the eastern region of the state of Maranhão, Brazil.

2. Material and Methods

2.1. Area of study

The city of Codó is approximately 290 km away from the state capital. It has a total area of 364,499 km^2 and a total population of 123,368 residents, with a population density of 27.06 residents/km^2 (IBGE, 2022). It is located at an altitude of 47m above sea level, and has the following geographical coordinates: latitude 4°27'18" South and longitude 43°53'9" West. The city is part of Brazil's Legal Amazon, with a predominance of Cerrado vegetation, whose climate is equatorial, characterized by a dry season (July to December) and a rainy season (January to June), with an annual average temperature of 35ºC (IBGE, 2022).

As a collecting area, five neighborhoods in the city of Codó were selected: Centro, São Francisco, Codó Novo, Residencial Zito Rolim and Santo Antônio, located in the five different administrative areas of the city (Figure 1).

2.2. Inspection of the Strategic Points (SP)

A survey of the types and quantity of existing strategic points in the sampled neighborhoods was conducted. The strategic points were categorized into vacant lots (1), tire shops (2), junkyards (3) and workshops (4) according to the classification adopted by the Ministry of Health (Brasil, 2001), with modifications. At each strategic points, inspections in the external and internal areas of these properties were made in order to find containers

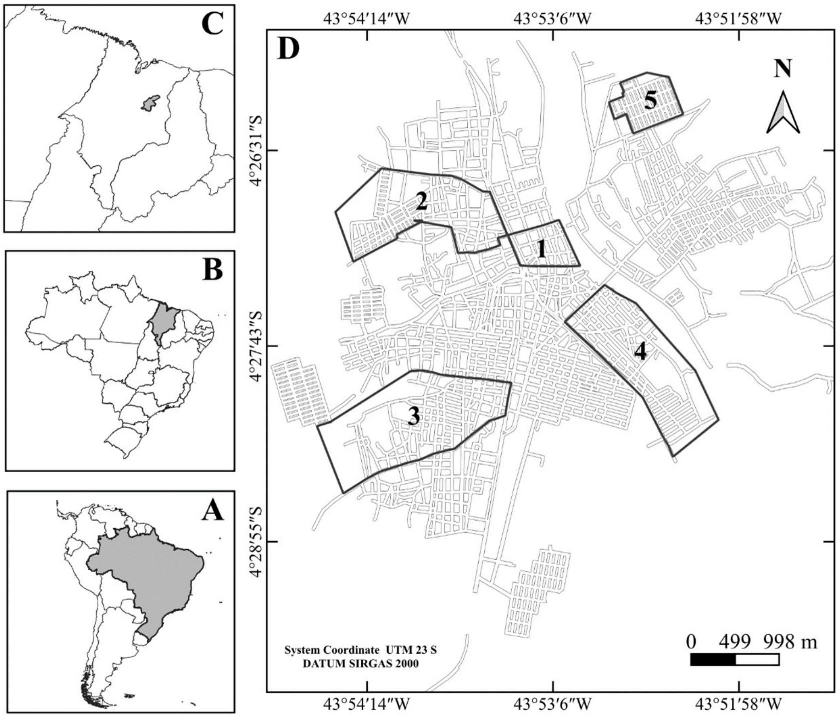

Figure 1. Location of the five selected neighborhoods in Codó, Maranhão, Brazil: **A)** Location of Brazil in South America, **B)** Location of Maranhão (MA), **C)** Location of Codó, Maranhão and **D)** Urban area of Codó, Maranhão (1, 2, 3, 4 and 5 selected neighborhoods). **Source:** Prepared in QGis 3.30.2 based on IBGE territorial grids (IBGE, 2021).

with potential for the development of mosquito vectors. The inspections took place twice in a year's time: once during the dry season (August to October 2021) and once in the rainy season (February to April 2022), with the goal of comparing mosquito breeding containers sites in those two periods in different types of environments.

2.3. Potential breeding containers

Containers found capable of accumulating water and becoming breeding containers for *A. aegypti* and or *A. albopictus* were classified into seven groups, according to Andrade et al. (2019) and Soares-da-Silva et al. (2012): Container Type CT1 - vases (plant pots and meal pots); CT2 - flasks (bottles, cans and plastics); CT3 - tires (all types of tires); CT4 - construction materials and car parts (materials used for construction and car parts); CT5 - storage (tank, barrel, filter, pot, bucket and drum); CT6 - fixed (drains, grease traps and wells); and CT7- others (all recipients that do not fit into the other categories).

The found immature were collected in their entirety, using 3 mL Pasteur pipettes, placed in a 15 mL Falcon centrifuge tube, containing 70% alcohol. A maximum value of 20 immature specimens per tube was standardized for the complete preservation of the specimens.

The tubes were identified with data from the locations, date of collection and type of breeding container. Subsequently, they were sent to the Biology Laboratory in the Science Center of the Federal University of Maranhão, in Codó, for identification of the specimens. The identification of the specimens was carried out with the aid of an optical microscope (*Bioval mold L2000A*, China), with lens of 10, and magnification of 100 X, through which it was possible to observe the morphological characters present in the thorax, head and abdomen, and the analysis used the dichotomous key proposed by Consoli and Oliveira (1994), Forattini (2002) and Harbach (2020).

2.4. Breeding sites productivity

The calculation of the breeding sites productivity was made according to Soares-da-Silva et al., 2012. To determine the productivity (p) of each type of breeding containers, the following equation was used: $p = X1/Z1$. In which X corresponds to the number of larvae and pupae found in a group 1 container, and Z is the number of positive containers (containing larvae and or pupae) of the same group.

2.5. Statistical analysis

Data referring to different types and amounts of strategic points, types and number of potential breeding containers and number of immature *A. aegypti* and *A. albopictus* per breeding containers, for each climatic period, were evaluated for normal distribution using the Shapiro-Wilk test. As those did not fit the normal distribution, corresponding non-parametric analyses were used. Kruskal-Wallis (H) analysis was used to compare

Table 1. Quantity of potential breeding containers and immature *Aedes aegypti* and *Aedes albopictus* mosquitoes by strategic points, found in the dry season, November 2021, and rainy season, February 2022, in Codó, Maranhão.

Strategic points	Number of breeding containers	Number of immature *Aedes aegypti*	Number of immature *Aedes albopictus*	Total number of immatures of both species
	Dry/Rainy	Dry/Rainy	Dry/Rainy	Dry/Rainy
Vacant lots	3,350/3,990	0/138	11/499	11/637
Workshops	67/54	0/0	0/0	0/0
Tire shops	442/315	16/435	0/43	16/478
Junkyards	497/552	30/97	1/84	31/181
Total	4,356/4,911	46/670	12/626	58/1,296

averages. When the difference was verified, the Dunn test was used (Ayres et al., 2007).

The H value calculated for each analysis was compared to the H value defined in the *quantis* table for the Kruskal-Wallis test statistic. Whenever the calculated value was greater than that shown in the table at a given degree of freedom, considering the number of groups compared, and the p value was less than or equal to 0.05, the hypothesis of equal averages was rejected, and it continued with the Dunn test (Siqueira and Tibúrcio, 2011).

3. Results

125 strategic points were found, 88.80% (111) being the vacant lots type, 7.20% (9) consisting of tire shops, 3.20% (4) of workshops, and junkyards with 0.80% (1). There was a difference between the medians of the number of potential breeding containers among the strategic points ($H = 21.96$; $p < 0.0001$) with vacant lots having higher numbers that than workshops ($p < 0.0001$), tire shops ($p < 0.05$) and junkyards ($p < 0.0001$) by Dunn's test.

During the dry season, 4,356 containers were inspected of which 76.91% were found on vacant lots, followed 11.41% on junkyards and 10.15% on tire shops (Table 1). In the rainy season, 4,911 containers were inspected of which; 81.25% were found on vacant lots, followed 11.24% on junkyards and with 6.41% on tire shops (Table 1).

When analyzing the number of strategic points as the most preferred for oviposition activity for both species, it was observed that, for *A. aegypti*, there was no difference among strategic points ($H = 3.71$; $p = 0.28$) (Table 1).

Conversely, for *A. albopictus*, there was a difference among the medians of immatures of the vector among the strategic points ($H = 9.41$; $p = 0.02$). The number of immature *A. albopictus* was higher in vacant lots than in workshops ($p < 0.05$) (Table 1). When analyzing the positivity of the strategic points by season, vacant lots were the most positive in both seasons.

Regarding the strategic points as the most preferred for oviposition activity for the two species together, it was verified that there was no difference between the medians of the number immatures of *A. aegypti* and *A. albopictus* among the strategic points ($H = 5.89$; $p = 0.11$) (Table 1).

Table 2. Quantity of immature *Aedes aegypti* and *Aedes albopictus* mosquitoes found in breeding containers in the dry season, November 2021, and rainy season, February 2022, in Codó, Maranhão.

Breeding containers	Number of immatures
	Dry/Rainy
Vases (CT1)	0/0
Flasks (CT2)	11/189
Tires (CT3)	0/890
Constr. material (CT4)	0/78
Storage (CT5)	47/134
Fixed (CT6)	0/0
Others (CT7)	0/5
Total	58/1,296

Legend: constr. material = construction material.

Regarding the oviposition activity for the two species in the breeding containers found in the SP during the dry and rainy seasons, the containers of the tires group stand out as most preferred with 65.73%, followed by flasks with 14.77% and storage with 13.37% (Table 2).

When analyzing the number of immatures of the two species in the dry season, it was verified that there was no difference ($H = 5.15$; $p = 0.52$). In contrast, in the rainy season, it was observed that there was a difference between the number of immatures of the two species ($H = 15.66$; $p = 0.01$), with the number of immatures for the tires group being higher than the Vases and the Fixed groups ($p < 0.05$) (Table 2).

Regarding the number of positive breeding containers for *A. aegypti*, it can be observed that, in the rainy season, the number of positive containers was four times higher than the one found in the dry season. Of the positive containers, 60% were tires (Table 3). In addition to tires, other types of containers have been found with larvae and pupae and immature of the vector (Table 3).

In the rainy season, the amount of immature *A. aegypti* was 14 times higher than in the dry season. When analyzing the number of immatures found in the positive containers, it was observed that there was no difference among the

Table 3. Number of positive containers and immature *Aedes aegypti,* and productivity per container group found in the dry season, November 2021, and rainy season, February 2022, in Codó, Maranhão.

Breeding containers	Number of positive containers	Number of immatures	Productivity
	Dry/Rainy	**Dry/Rainy**	**Dry/Rainy**
Vases (CT1)	0/0	0/0	0/0
Flasks (CT2)	0/2	0/36	0/18
Tires (CT3)	3/14	0/533	0/38
Constr. material (CT4)	0/2	0/41	0/21
Storage (CT5)	2/2	46/56	23/28
Fixed (CT6)	0/0	0/0	0/0
Others (CT7)	0/1	0/4	0/4
Total	5/21	46/670	9/32

Legend: constr. material = construction material.

Table 4. Quantity of positive and immature *Aedes albopictus* breeding containers and productivity per container group found in the dry season, November 2021, and rainy season, February 2022, in Codó, Maranhão

Breeding containers	Positives containers	Number of immatures	Productivity
	Dry/Rainy	**Dry/Rainy**	**Dry/Rainy**
Vases (CT1)	0/0	0/0	0/0
Flasks (CT2)	1/9	11/153	11/17
Tires (CT3)	0/11	0/357	0/32
Constr. material (CT4)	0//4	0/37	0/9
Storage (CT5)	1/1	1/78	1/78
Fixed (CT6)	0/0	0/0	0/0
Others (CT7)	0/1	0/1	0/1
Total	2/26	12/626	6/24

Legend: constr. material= construction material.

number of immature *A. aegypti* among the recipients in the dry season (H = 6.00; p = 0.42) (Table 3). In the dry season, 100.00% of the immature were found in a storage-type container. However, in the rainy season, there was a difference between the number of immature *A. aegypti* among the recipients (H = 14.11; p = 0.02), and the number of immatures in the tires group was higher than vases and fixed ($p < 0.05$). In the rainy season the average productivity was higher in tires (Table 3).

Regarding the breeding containers positive for *A. albopictus*, it was found that in the rainy season the number of breeding containers was 13 times higher than in the dry season (Table 04). In the dry season, only two containers were positive for that species, one from the flasks group and the other from the storage type. In contrast, in the rainy season, 26 containers positive for this species were found, of which 11 belong to the tires group, 9 and 4 identified as flasks and construction materials, respectively (Table 4).

Regarding the number of immature *A. albopictus*, it was observed that the number of specimens was 52 times higher in the rainy season compared to the dry season. It was verified that there was no difference among the *Ae. albopictus* productivity of recipients in the dry season (H = 5.15; p = 0.52). Conversely, there was a difference in the rainy season (H = 14.73; p = 0.02), with the number of immatures in the tires group being higher than vases ($p < 0.05$) and fixed ($p < 0.05$) (Table 4).

It was found that there was a difference among the number of immature of *A. albopictus* among the recipients in the dry and rainy periods together (H = 17.03; p = 0.009), the number of immature for the tires group was higher than vases ($p < 0.05$) and fixed ($p < 0.05$). The most productive containers were flasks and storage in the dry and rainy seasons, respectively (Table 4).

4. Discussion

Researching potential breeding containers for *A. aegypti* and *A. albopictus* mosquitoes in Strategic Points (SP), considered as extremely important environments in terms of the spread of these insect vectors in urban areas, is essential to verify the places infested by mosquitoes and the types of containers used by them in those environments. According to the National Dengue Control Program (Brasil, 2002), these places have great potential for housing containers that can serve as breeding containers for mosquitoes. In the current study, the abundance of potential vector breeding containers was found in vacant lots, workshops, tire shops and junkyards, the main places considered SP for mosquito control in urban areas. A study performed in the city of Campinas, São Paulo, southeastern region of Brazil, showed that SP are places of high risk, since they have a large number of containers with immature *A. aegypti* and *A. albopictus* (Barbosa et al., 2019).

In the current study, vacant lots-type SPs had the highest number of potential breeding containers for *A. aegypti* and *A. albopictus*. In a study on infestation by *A. aegypti* in the city of Chapecó, Santa Catarina, vacant lots were some of the places that most had containers that served as breeding containers for the mosquito, since garbage collection almost does not occur in these areas (Lutinski et al., 2013). Disorderly urban growth, associated with improper waste disposal in peridomestic areas may be some of the factors that contribute the most to the vectors' proliferation at those places (Almeida et al., 2020).

Regarding to the strategic points with higher preference for oviposition activity of *A. aegypti*, junkyards stood out during the dry season; however, in the rainy season, the tire shops stood out with higher preference. In a published study on the dispersal and oviposition of this vector at Manguinhos favela, located in the state of Rio de Janeiro, the presence of *A. aegypti* was also evidenced in tire shops located in these communities, highlighting a greater abundance of the species during the rainy season (Ayllón et al., 2018). The presence of tires in those scenarios provides ideal conditions for mosquitoes' development, thus being a crucial factor for its proliferation in the urban environment (Visa Shalini et al., 2022; Parker et al., 2020; Getachew et al., 2015).

In contrast, the higher frequency of *A. albopictus* in vacant lots, during both periods, can be explained by the preference of the species for peridomestic areas, which generally have vegetation, combined with the continuous disposal of garbage at those places, that can function as breeding containers and benefit the vector proliferation in these environments (Martins et al., 2010). These factors show what was highlighted on the research about the reproductive profile of these vectors in Caxias, also in the eastern state of Maranhão, where vacant lots stood out with higher presence of *A. albopictus* compared to *A. aegypti* (Sousa et al., 2021).

The increase of specimens of *A. aegypti* and *A. albopictus* in the rainy season, compared to the dry season, exhibited the same behavior presented by the breeding sites. It was observed in this study that, in addition to the environment, climate variation can influence the eggs density, presence and distribution of vectors (Lubna Rasheed and Zaidi, 2023; Mendonça Silva et al., 2011; García-Rejón et al., 2011). The offering of Potential breeding containers associated with increased rainfall raises the vector density, which may become a critical factor in the dissemination of the studied species, and, consequently, in the arboviruses' dissemination, as it has been pointed out by other authors (Ngugi et al., 2017; Almeida et al., 2013; Monteiro et al., 2014).

The higher number of positive breeding containers in the rainy season is due to the rainfall enhancement and the temperature reduction in the first quarter of the year, combined to the population's habit of accumulating, discarding garbage or any other type of material that can serve as a breeding container (Heinisch et al., 2019; Lutinski et al., 2013). These factors are found in all Brazilian regions, for which the irregular disposal of garbage combined with the lack of basic sanitation contributes to the increase of vector breeding containers (Coury et al., 2021; Montagner et al., 2018).

The higher preference of mosquitoes for tires, flasks and storage evidences that these containers play a fundamental role in the dispersal of vectors. The large quantity of tires, bottles and containers used to store water are ideal environments for the development of these vectors (Soares-da-Silva et al., 2012). Other studies also highlight tires as being one of the main factors responsible for immatures' production (Baak-Baak et al., 2014), in addition to flasks and storage-type containers, since, in most cases, they do not even need rain to remain with water (Oliveira et al., 2017).

Tires are considered containers with ideal characteristics for the reproduction of these mosquitoes in urban environments. This type of breeding site has a large capacity to store water, it is dark in color and it has a cover that provides shading on the inside, thus providing low evaporation that enhance the development of immature (Lutinski et al., 2018; Pinheiro et al., 2014; WHO, 2009). Other authors also highlighted in their studies the preference of immature for tires-type containers, evidencing the preference of these vectors for that type of container as the main reproduction habitat (Lizuain et al., 2019; Shriram et al, 2018).

Furthermore, the interspecific competition of *A. aegypti* and *A. albopictus* mosquitoes for potential flasks-type breeding containers as an oviposition site is relatively common, since the presence of immature in those containers is frequently observed (Hiscox et al., 2013). The frequency of larvae and pupae in this type of breeding site was also evidenced in other studies carried out in other Brazilian cities (Sousa et al., 2021; Batista et al., 2021), therefore, the presence of Flasks favoring the maintenance of these mosquitoes in areas urban.

The storage-type containers group are also pointed out as being largely responsible for the permanence of these vectors in the domestic and peridomestic environments. These potential breeding containers are responsible for housing immature of both species, in addition to benefiting the development of the entire life cycle of the vectors (Costa et al., 2016; Kamgang et al., 2010; Tsuzuki et al., 2009). Other studies have also reported the presence of immature of these vectors in storage-type containers, such as buckets, tanks, watersheds, etc. (Vannavong et al., 2017). Those water reservoirs are present in the most diverse environments, therefore, for a more effective control, it is necessary to identify those potential breeding containers considered ideal for the oviposition activity of these vectors (Cavalcanti et al., 2016).

In this study, the containers group that showed the highest productivity for *A. aegypti* was tires, and the flasks and tires groups for *A. albopictus*. Other studies also show this preference of mosquitoes for those containers, which highlight tires as positive breeding containers for the presence of *A. aegypti* in all life stages (Salvi et al., 2021), and of *A. albopictus* in containers of the flasks and tires groups (Lutinski et al., 2020). Tires, as well as disposable materials such as bottles, cans, among others, can significantly influence the spread of these mosquitoes (Ferreira-de-Lima et al., 2020; Fernandes et al., 2014; Reis et al., 2010).

Furthermore, the SP inspection has showed how the *A. aegypti* species is present in the city along with *A. albopictus*. The coexistence of the two species in urban areas is increasingly evident in the Americas (Rey and Lounibos, 2015), as both are frequently recorded in large urban centers (Ferreira-Keppler et al., 2017; Fonseca-Júnior et al., 2019). It is still observed that the number of *A. aegypti* specimens has been higher compared to *A. albopictus*; this predominance of *A. aegypti* was also recorded in other studies, which points to the high adaptability of the mosquito in urban areas, and to the fact that it is able to use different types of breeding containers (Arduino et al., 2020; Barbosa et al., 2020).

It is also worth noting that the significant number of containers characterized as potential breeding containers, found at strategic points during both periods, shows how important it is to develop control strategies for fighting these vectors, with an emphasis on places such as vacant lots, workshops, tire shops and junkyards, considering that they function as a place for vectors dispersion in urban areas.

5. Conclusions

Through this research, it was possible to identify that vacant lots are the main strategic points found with potential breeding containers of *A. aegypti* and *A. albopictus* in the city of Codó, Maranhão. The groups of flasks and tires are the most frequent potential breeding containers at strategic points; however, tires were the breeding containers with the highest number of immature vectors, therefore, with higher preference for oviposition by female mosquitoes. In the rainy season, a higher number of *A. aegypti* and *A. albopictus* specimens was registered.

Acknowledgements

To the Universidade Federal do Maranhão (UFMA), the Universidade Estadual do Maranhão (UEMA) for Internal Call nº 05/2023 - PPG-UEMA and the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), for financial support for the scholarship and research funding.

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