Evaluation of a low-cost trap on capture and possible control of the
Aedes aegypti mosquito population

Avaliação de armadilha de baixo custo para captura e possível controle da
população de mosquito Aedes aegypti

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ABSTRACT

The Aedes aegypti mosquito is the primary vector of Zika, Chikungunya and Dengue in Brazil and other parts of the world. Thus, its control is essential, but also a challenge for public health. This study aims to evaluate the performance of a low-cost trap in capturing eggs and its possible impact on reducing the infestation of Aedes aegypti. The interventional study was carried out in neighborhoods of Salvador, state of Bahia, Brazil, where mosquito capture was evaluated before and after the intervention using the low-cost trap. The study was performed comparing the results of the years 2019 and 2020. In the months before and after the intervention, a control trap, of proven efficiency, was used to determine mosquito infestations in the two districts. The analysis also took into account the rainfall in the periods of weeks prior to data collection. The influence of the low cost trap on the reduction of Aedes aegypti infestation was statistically observed.

Keywords: Arboviruses; Trap; Mosquito control; Aedes aegypti; Dengue; Chikungunya; Zika
RESUMO

O mosquito *Aedes aegypti* é o principal vetor de *Zika, Chikungunya* e *Dengue* no Brasil e em outras partes do mundo. Assim, seu controle é essencial, mas também um desafio para a saúde pública. Este trabalho tem como objetivo avaliar o desempenho de uma armadilha de baixo custo na captura de ovos e seu possível impacto na redução da infestação do *Aedes aegypti*. O estudo de intervenção foi realizado em bairros de Salvador, Bahia, Brasil, onde foi avaliada a captura do mosquito antes e após a intervenção com armadilha de baixo custo. O estudo foi realizado comparando os resultados dos anos de 2019 e 2020. Nos meses anteriores e posteriores à intervenção, foi utilizada uma armadilha de controle, de eficácia comprovada, para determinar as infestações do mosquito nos dois distritos. A análise também levou em consideração as chuvas nos períodos das semanas anteriores à coleta de dados. Observou-se estatisticamente a influência da armadilha de baixo custo na redução da infestação por *Aedes aegypti*.

**Palavras-chave:** Arboviroses; Armadilha; Controle de Mosquito; *Aedes aegypti*; Dengue; Chikungunya; *Zika*
INTRODUÇÃO

The *Aedes aegypti* mosquito came from the African continent (Chiaravalloti-Neto, 1997) and has spread throughout the tropical and subtropical regions of the world (Mousson et al, 2005). It is a mosquito highly adapted to anthropized areas, being considered a domestic vector, commonly found in the human home and its surroundings (Braga and Valle, 2007). The presence of *Aedes aegypti* breeding sites in homes is a risk factor for the occurrence of arbovirus outbreaks and epidemics, as this vector is a proven transmitter of Dengue, Zika and Chikungunya (Kantor, 2016). Controlling *Aedes aegypti* is the only means of preventing these arboviruses, as there are still no vaccines for use in populations, despite some advances (Chancey et all, 2015). The control of *Aedes aegypti* can be done in different ways, such as, for example, insecticides, biocides, release into the environment of sterile males and mechanical traps (Paz-Soldan et al, 2016). Each form of control has its disadvantages and advantages, and success in vector control only occurs with the engagement of the population, regardless of the method used.

Different types of traps have provided entomological data of great value for health surveillance, especially infestation rates, with the purpose of identifying areas with higher vector density, contributing to the targeting and effectiveness of actions to combat *Aedes aegypti* (Focks, 2004). These traps can combine light attraction, volatile essences, release of carbon dioxide and water for laying eggs and can be used in conjunction with chemical and biological agents to help eliminate and reduce proliferation. Among the various commercial and home models, we can mention the Adultrap®, the BG-Sentinel®, the Mosquitrap® and the mosquito net, made from plastic bottles (Zepeda, 2008). Figure 1 shows images of each of these traps.

**Figure 1** – Examples of mosquito traps

Sources: (A) https://www.adultrap.com.br; (B) https://www.bg-sentinel.com; (C) Degener et al, 2015; (D) Zepeda, 2008.
Adultrap is used to capture adult mosquitoes. It is composed by more than 10 parts but is simple and water refill can be done even by rainfall. It shows potential to capture adult vectors despite its high cost. Ferreira et al., 2020 showed that modifying the device can improve the capture of mosquitoes.

Mosquitrap is a trap used for vector monitoring. This has already been widely used to assess its efficiency as a possible use for reducing the population of mosquitoes, but it has been shown to be ineffective as it allows mosquitoes to reproduce if not properly monitored (Degener et al., 2015).

The BG-Sentinel trap is commonly used for monitoring Aedes aegypti and attracts mosquitoes by visual and olfactory stimuli. It uses a synthetic attractant simulates human skin odors, attracting mosquitoes and a fan sucks the insects in, keeping them trapped in a collector bag (Ball and Ritchie, 2010). BG-Sentinel is an efficient trap, as proven in several studies, but it has a high value and more complex maintenance (replacement of the attractive essence). Thus, it is used to collect mosquitoes for research and identification of infestation rates.

The “mosquitérica” is a trap developed by researchers at Federal University of Rio de Janeiro (Zepeda, 2008), made from disposable plastic bottles. Its construction is simple, but requires some care to be made, installed and maintained. If not properly maintained, the trap can become a breeding site for mosquitoes.

There are still many other initiatives for the development of traps and vector population control, either through the use of recyclable materials (de Santos et al., 2012) or more structured as the study developed by Paz-Saldan et al. (2016). These can also combine the use of mathematical models (Zhang et al., 2016) and artificial intelligence to promote identification (Motta et al., 2019) and infestation prediction to determine control actions.

As an alternative to the aforementioned models, a low production cost trap was developed (Fonseca et al., 2019). Its simple composition by three pieces made of injected thermoplastic enables mass production with a low cost and quality. The trap, also known as LOC (Lethal Ovitrap CIMATEC) has a very simple maintenance: constant replacement of water in the reservoir and does not require energy or chemical/biological agents for its operation. Figure 2 shows the structure and functioning of the LOC, consisting of a cup, a bended funnel and a lid. Openings in the lid allow access for the mosquito to lay eggs on the surface of the funnel, close to the water level. The lid prevents leaves and other waste from falling into the trap and preventing the larva from reaching
the bottom of the cup. It also prevents the trap to become a source of mosquito proliferation. When the larva hatches from the egg, it swims to the bottom of the cup to feed guided by the angular funnel. To return to the surface to breathe, the larva simply floats without swimming. In this way, it does not return through the funnel, but ends up drowning in the flooded region indicated in the figure. The goal of LOC is to eliminate the mosquito larvae early in its life cycle.

**Figure 2 – Cutaway views of the LOC trap**

Both the lid and the funnel were made in black to simulate a sheltered environment, which has the potential to attract female mosquitoes to deposit their eggs (Paz-Soldan et al, 2016). The glass is transparent so that the water level can be monitored in order to replace it. The trap has a volume of 400 ml of water. In sea level environments with high humidity characteristics, in tropical areas, the evaporation of water causes a necessary replacement of water within 3 to 5 days. In order to always have an exposed area for laying eggs, the trap has a drain that limits the maximum amount of water to be placed. The surface of the funnel is textured so that the mosquito can easily attach itself and lay eggs on it. As the trap was developed and designed to be of low cost, the intention is for a household to install at least three traps in its surroundings. The strategy of installing three is due to the fact that, admittedly, the female mosquito seeks to deposit eggs in different places, in order to ensure their survival and hatching (Reiter, 2007; Reinbold-Wasson and Reiskind, 2021). In this way, it is expected that the trap can attract
the female to lay the greatest possible amount of eggs. The LOC trap does not inhibit the nullifying action of other potential breeding sites of the mosquito. The fewer competing breeding sites, the greater the potential attractiveness of the trap. Thus, it is known that its isolated use, without social awareness actions, will not bring significant effect in vector population control (Abramides et al, 2011).

The trap was designed for the use of clean water only, however, attractant elements such as yeast and starch can be added in order to attract and stimulate the adult female mosquito to lay eggs.

In this regard, studies that assess the effectiveness of traps in the early detection and monitoring of vectors can provide sufficient information to support actions to control vector-borne diseases. Therefore, the aim of this study was to evaluate the new low cost ovitrap, Lethal Ovitrap CIMATEC - LOC, in reducing the infestation rate of *Aedes aegypti*, when placed in households in a selected neighborhood in the city of Salvador, Bahia.

**METHODOLOGY**

To assess the effectiveness of the LOC trap in attracting the *Aedes aegypti* mosquito, the comparison of its effect between two large urban areas was considered. The objective of the research was to compare whether, using the LOC trap, the mean of mosquito captures by another reference trap (BG-Sentinel) was affected or not.

Figure 3 illustrates the basis of the methodology applied for the analysis of the LOC trap effect. The study took place in two years: 2019 and 2020 and data collection took place in the same period of the two years. In 2019, the study collected only adult mosquitoes using the reference trap. In 2020, the study was repeated, but with one of the locations using the LOC trap to assess its effect in reducing the infestation of adult mosquitoes.
Figure 3 - Methodology used to compare if the amount of mosquitos trapped by BG-Sentinels was influenced by the rainfall and the use of the LOC Traps.

Of the different traps that could be used to prove the efficiency of the LOC, the chosen option was the BG-Sentinel. As it has proven efficiency in attracting adult female mosquitoes, even in situations of low infestation (Maciel-de-Freitas, et al, 2006; Diouf, et al, 2021; Lacroix, et al, 2009) and has already demonstrated its efficiency in other studies to assess the performance of traps (Degener et al, 2015). Thus, it is expected that its use can identify and point out if there is a reduction in the population of *Aedes aegypti* adults with the use of LOC.

**Neighborhood selection**

Two neighborhoods in the city of Salvador, with similar socio-environmental characteristics and history of infestation rates by *Aedes aegypti* were selected to evaluate the effect of LOC. Following the methodology of the *Aedes aegypti* Rapid Index Survey (LIRAa), proposed by the Brazilian Ministry of Health, the following areas were worked on: Sanitary District Railroad Suburb (A) – Intervention (Strate 299 – Bairro de Plataforma I - IIP of 2.8% ) and Sanitary District São Caetano/Valéria (B) – Control (Strat 226 –Bairro Bom Juá, Fazenda Grande do Retiro I - IIP of 2.3%), according to the overall average of the Building Infestation Index (IIP) of the LIRAa indexes from 2013 to 2018. The location of the selected neighborhoods can be seen in Figure 4. These neighborhoods are separated by 5 km in a straight line.
Figure 4 – Study places, neighborhoods: A – Plataforma; B – Bom Juá/Fazenda Grande do Retiro I

Source: Author’s edition using images from Google Maps.

LOC Traps distribution

To carry out the actions to control *Aedes aegypti*, the urban area of the municipalities was divided into strata and the composition of the strata respected the range of 8,100 (eight thousand and one hundred) to 12,000 (twelve thousand) properties, being the ideal number around 9,000 (nine thousand) properties (Ministry of Health, 2013). Thus, 9,000 homes would be needed to compose the stratum in the intervention area. For logistical and operational reasons, it was decided to study 10% of the maximum number of properties per stratum, thus, approximately 1,204 residences were selected in the intervention area. The total was 3,612 traps deployed in the neighborhood of A, with 3 (three) LOCs deployed in each residence, 2 (two) in the surroundings and 1 (one) inside the house.

Field procedures and events

The process started with the installation of 64 BG-Sentinel traps ("BG1" on Figure 5). Half BG-sentinels were installed in neighborhood A and the other 32 in neighborhood B between 03/11/2019 to 04/08/2019. The BG-Sentinels were distributed from 3 to 5 units per hectare with minimum distances of 30 meters between them. The purpose of spacing between the BG-Sentinels traps was to ensure that the cluster effect of the biology of *Aedes* sp. (tendency to concentrate in groups in the same oviposition site) did not interfere with the random placement of traps. Thus, 32 blocks were drawn in both
neighborhoods, where 32 homes received the traps, carefully following the number of traps per hectare and the minimum distance between them. The insects captured in the collecting bags were sent weekly to the Entomology Laboratory of the Zoonoses Control Center in the city of Salvador, for identification and quantification of species, using the Culicidae identification keys of Consoli and Lourenço-de-Oliveira (1994) and Foratinni (2002). Figure 5 presents, in a temporal way, the installation, data collection and monitoring events of the project.

**Figure 5** – Temporal distribution of the events.

The installation of the LOC traps ("LOCi" in Figure 5) lasted ten (10) business days (Monday to Friday), from 22/Apr/2019 to 03/May/2019, and included the participation of twenty (20) disease agents in the municipality from Salvador. Each agent was responsible for installing the traps in six (06) properties/day, totaling 60 homes per agent. The agents of endemic diseases selected by the municipality to work in the project were previously trained with theoretical and practical classes in the field on the installation, operation and maintenance of traps. Additionally, they also received training in the collection, packaging and transport of vector insects.

After the installation of the LOC traps, they were monitored ("LOC monitoring" in Figure 5) for a period of approximately 10 months, from the end of April 2019 (installation period) to the end of February 2020. The visit of the agents to each residence took place every thirty (30) days. During the visit, traps were inspected, maintained, water replaced and addition of attractant for oviposition (2% beer yeast solution) in order to increase the attractiveness of the traps for *Aedes aegypti*. The use of brewer’s yeast as an attractant for oviposition was due to its ease of preparation, its almost imperceptible smell and its power of attraction, as observed by Côrrea (2013).
The collection of biological material in the LOC traps occurred only once, in August 2019 ("Eggs" on Figure 5). The material was collected from all three (03) traps from 875 households (sample), in order to collect the species of mosquitoes captured by the LOC trap. It was established that regardless of the number of immatures (larvae and pupae) found in each trap, only 10 specimens (sample) would be removed and placed in 70% alcohol for further identification in the Entomology Laboratory of the Zoonoses Control Center (CCZ) of Salvador. The identification of biological material occurred weekly, and followed the taxonomic criteria proposed by Consoli and Oliveira (1994).

In the period from 21/Mar/2020 to 18/Apr/2020, the same methodology of the phase prior to the use of LOC traps was followed, installing the BG-Sentinels traps again in the same houses of the first phase ("BG2" on Figure 5). Thus, it was possible to compare the infestation of adults between the intervention (A) and control (B) neighborhoods, in the pre- and post-use periods of the LOCs traps.

It is informed that before the installation of the LOC and BG-Sentinel traps, those responsible for the houses/states received an information leaflet, which contained the methodology and objective of the project, the frequency of visits and the operation of the traps (water filling, basically). A term of responsibility was also delivered to those responsible for the households, which was signed, stating that they had been instructed about the project, that they had participated of their own free will and that they had the right to withdraw from the study at any without any kind of retaliation or damage.

Rainfall index

Additionally, the rainfall index was analyzed for the previous 4 weeks and during the weeks of collections in stages "BG1" and "BG2", indicated respectively by "RI1" and "RI2" in Figure 5. The rainfall index is a way to analyze whether mosquito-breeding sites were formed in the weeks preceding and during data collection. It is known that mosquitoes such as *Aedes aegypti* have an accentuated proliferation in the weeks following a rainy cycle with temperatures favorable to their development. Thus, it was necessary to analyze together the rainfall data of the city of Salvador where the study was carried out.

However, the city's rainfall index may be flawed, as it is one of the largest cities in Brazil, with a large territory. For this reason, even if the daily index indicates the occurrence of rain, it may not be true for all neighborhoods in the city. Therefore, it was
decided to choose meteorological stations closer to the neighborhoods A and B within a radius of 2 kilometers from the center of each neighborhood. Based on the list of active stations in the aforementioned period data was obtained online at the State System for Environmental Information and Water Resources - SEIA, from the Institute for the Environment and Water Resources - INEMA of the State of Bahia (INEMA, 2020). The stations chosen were: Alto do Peru (lat. -12.939; long. -38.486); Rio Sena (lat. -12.891; long. -38.471) and São Caetano (lat. -12.940; long. -38.475).

As the statistical analysis was performed based on the weekly collection of mosquitoes, the accumulated average weekly rainfall was calculated between the three chosen meteorological stations. Figure 6 shows the graph of the average accumulated rainfall per week for the years 2019 (without LOC trap in neighborhoods A and B) and 2020 (with LOC trap in neighborhood A). Data collection weeks are in order and are represented by positive numbers. The weeks in negative are the weeks that precede data collection. The larger difference between the two years is the incidence of higher rainfall in the weeks before data collection in 2020. Thus, the subsequent weeks, in 2020, should present a greater infestation of mosquitoes, since the development cycle of mosquitoes *Aedes aegypti* is approximately 8 to 9 days (Snetselaar et al, 2014). Consequently, the accumulated rainfall was considered, especially in the two weeks prior to data collection. For the year 2019 it was 21.4 mm and for 2020 the index was 92.0 mm, considering the accumulated value for the two weeks of each year.
**Figure 6** – Comparison between years 2019 and 2020 about the mean accumulated rainfall index over the weeks. Negative weeks are related to the previous weeks of the mosquito capture data acquisition.

Source: Author’s ownership.

**Statistical design**

The statistical project was set by combining the factors presented in Table 1. However, the project is not orthogonal, as there is no combination between neighborhood B and the use of the LOC trap. Table 2 shows the combination of factors that generated the treatments, indicating the absence of use of the LOC in neighborhood B. Data were analyzed using the MINITAB 19.2020.1 (64-bit) software. The rainfall index actually represents the year in which the collection of adult mosquitoes was carried out in the BG-Sentinels.

**Table 1** – Resume of the statistical experiment.

<table>
<thead>
<tr>
<th>Input</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neighborhood</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>LOC Trap</td>
<td>No</td>
<td>Yes (present)</td>
</tr>
<tr>
<td>Rainfall Index</td>
<td>21,4</td>
<td>92,0</td>
</tr>
</tbody>
</table>

Source: Author’s ownership.

**Table 2** – Treatments of the experiment.

<table>
<thead>
<tr>
<th>Year</th>
<th>Week</th>
<th>LOC Trap</th>
<th>Rainfall</th>
<th>Neighborhood</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>1 - 4</td>
<td>No</td>
<td>21,4</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>1 - 4</td>
<td>No</td>
<td>21,4</td>
<td>B</td>
</tr>
<tr>
<td>2020</td>
<td>1 - 4</td>
<td>Yes</td>
<td>92</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>1 - 4</td>
<td>No</td>
<td>92</td>
<td>B</td>
</tr>
</tbody>
</table>

Source: Author’s ownership.
RESULTS

Eggs pool

From the collections carried out in August 2019 (“Eggs” on Figure 5), of the 875 houses with the LOC traps installed, 491 (56.1%) had at least one trap positive for Culicidae. Of the 491 positive houses, 453 (92.3%) were positive for Aedes aegypti. A total of 2,018 specimens of Culicidae were collected in the positive properties. Of these, 1,690 (83.7%) of Aedes aegypti; 210 (10.4%) of Aedes albopictus, 114 (5.6%) of Limatus durhamii and 4 (0.2%) of Culex quinquefasciatus.

The result of the collection of material from the LOC traps showed that the new trap was sensitive to the presence of Culicidae, with a positivity of 56.1% of the properties surveyed. Furthermore, it is very specific for Aedes aegypti, since of the total number of positive households for Culicidae, 92.3% were positive for Aedes aegypti.

Adult Aedes aegypti population

Regarding the survey of infestation of Aedes aegypti adults, through the use of BG-Sentinels, during four (4) weeks of monitoring, in the period prior to the intervention (“BG1”), 753 specimens (470 males and 283 females) were collected from Aedes aegypti in neighborhood A and 341 specimens of Aedes aegypti (229 males and 112 females) in neighborhood B (Table 3).

<table>
<thead>
<tr>
<th>Week</th>
<th>Neighborhood A</th>
<th>Neighborhood B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>1</td>
<td>84</td>
<td>35</td>
</tr>
<tr>
<td>2</td>
<td>75</td>
<td>54</td>
</tr>
<tr>
<td>3</td>
<td>121</td>
<td>63</td>
</tr>
<tr>
<td>4</td>
<td>190</td>
<td>131</td>
</tr>
<tr>
<td>Total</td>
<td>470</td>
<td>283</td>
</tr>
</tbody>
</table>

Source: Author’s ownership.
In the period after the intervention with LOC traps ("BG2"), 434 (206 males and 228 females) specimens of *Aedes aegypti* in neighborhood A and 900 specimens of *Aedes aegypti* were collected in the BG-Sentinels, after four weeks of monitoring (446 males and 454 females) in neighborhood B (Table 4).

Table 4 – Adult *Aedes aegypti* mosquitos captured using BG-Sentinel traps during “BG2” phase.

<table>
<thead>
<tr>
<th>Neighborhood A</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>33</td>
<td>25</td>
<td>58</td>
</tr>
<tr>
<td>2</td>
<td>45</td>
<td>43</td>
<td>88</td>
</tr>
<tr>
<td>3</td>
<td>60</td>
<td>55</td>
<td>115</td>
</tr>
<tr>
<td>4</td>
<td>68</td>
<td>105</td>
<td>173</td>
</tr>
<tr>
<td>Total</td>
<td>206</td>
<td>228</td>
<td>434</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Neighborhood B</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>126</td>
<td>118</td>
<td>244</td>
</tr>
<tr>
<td></td>
<td>72</td>
<td>56</td>
<td>128</td>
</tr>
<tr>
<td></td>
<td>142</td>
<td>137</td>
<td>279</td>
</tr>
<tr>
<td></td>
<td>106</td>
<td>143</td>
<td>249</td>
</tr>
<tr>
<td>Total</td>
<td>446</td>
<td>454</td>
<td>900</td>
</tr>
</tbody>
</table>

Source: Author’s ownership.

The total number of mosquitoes collected in each BG Sentinel trap per week was evaluated using analysis of variance (ANOVA) between the treatments listed above. Thus, it was possible to calculate the impact, with a 95% confidence interval, of the rainfall, neighborhood and presence of the LOC trap. In the model, without data adjustment, the variables that had an impact were the accumulated rainfall in the two weeks prior to data collection and the presence of the use of the LOC trap. Neighborhoods had a low impact on the average number of mosquitoes collected by BG-Sentinels. Table 5 presents the ANOVA result.

Table 5 – Analysis of Variance

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>Adj SS</th>
<th>Adj MS</th>
<th>F-Value</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainfall</td>
<td>1</td>
<td>39060</td>
<td>39060</td>
<td>8.47</td>
<td>0.013</td>
</tr>
<tr>
<td>LOC Trap</td>
<td>1</td>
<td>48180</td>
<td>48180</td>
<td>10.45</td>
<td>0.007</td>
</tr>
<tr>
<td>Neighborhood</td>
<td>1</td>
<td>21218</td>
<td>21218</td>
<td>4.6</td>
<td>0.053</td>
</tr>
<tr>
<td>Error</td>
<td>12</td>
<td>55315</td>
<td>4610</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
<td>107277</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Author’s ownership.
The residual analysis of the results presented a high value, thus, a new analysis was performed on the results applying a Box-Cox transform with optimization of the λ value. The application of the transform reduced residues and resulted in an increase in the impact of neighborhoods on the results, with its effect becoming significant. However, we must remember that the experiment was not orthogonal, as neighborhood B did not collect data with the influence of LOC traps.

The effects were plotted to indicate their impact on adult mosquito capture. The graph is shown in Figure 7, where it is possible to verify graphically how the presence of the LOC trap and the rainfall in the two weeks prior to collection with the BG Sentinel affected the mosquito population. In addition, the small influence of neighborhoods is noted when compared to the other two variables.

**Figure 7** – The main effect of the variables on the captured mosquitoes show that positive impact of the rainfall index on increasing the Aedes population and the negative impact of the LOC trap on decreasing the aedes population. The different neighborhood shows no distinctive impact on *Aedes aegypti* population.

![Main Effects Plot for Aedes](image)

Source: Author’s ownership.

Figure 8 shows the plot of results in boxplot format. It is possible to observe that, for neighborhood A, there is a significant reduction between 2019 and 2020, with rainfall levels 21.4 and 92 respectively for the two weeks prior to the collection of results. Similarly, it is observed that there is a significant increase in the capture of *Aedes aegypti* mosquitoes for neighborhood B between 2019 and 2020.
DISCUSSION AND CONCLUSIONS

Through the analysis carried out, there is evidence that the LOC trap has an influence on the reduction of the population of mosquitoes, especially *Aedes aegypti*. However, as this is a study that depends on many external and internal factors to the study, it is necessary to be cautious about these results. It is noteworthy that the residents of a house, when receiving the LOC traps, neighborhood A, should be more aware of the control of mosquito breeding sites and, probably shared information with their neighbors. The effect may have been positive in reducing the population of *Aedes aegypti*, but this is indirect in relation to the trap technology. It is a social behavior stimulated by the study procedures.

It is important to emphasize that we believe that the trap is a way to reduce the population of *Aedes aegypti*, however, it will not have an effect in isolation. Other actions to reduce competing breeding sites will always be necessary. A broad and effective action in the distribution of traps in certain populations with high infestation rates, accompanied by awareness campaigns should lead to a reduction in the population of vectors, as well as in the incidence of diseases carried by them. Due to the low cost of production and maintenance, the LOC trap can be a viable, economical and safe alternative for public health actions.
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