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THE EFFECTIVENESS OF OVITRAP INSTALLATION IN REDUCING THE ENTOMOLOGY INDEX IN DENGUE FEVER ENDEMIC AREAS

Efektivitas Pemasangan Ovitrap dalam Menurunkan Indeks Entomologi di Daerah Endemik Dengue

Norsita Agustina[1*], Purwo Setiyo Nugroho[2,3], Chandra Chandra[1]
[1]Faculty of Public Health, Universitas Islam Kalimantan Muhammad Arsyad Al Banjari, Banjarmasin, Indonesia
[2]Institute for Population and Social Research, Mahidol University, Thailand
[3]Faculty of Public Health, Universitas Muhammadiyah Kalimantan Timur, Samarinda, Indonesia
*Email: norsita8903@uniska-bjm.ac.id

ABSTRAK

Demam berdarah dengue (DBD) adalah virus dengue yang ditularkan melalui nyamuk Aedes aegypti sebagai vektor utama penyebab penyakit ini. Di wilayah Kabupaten Banjar. Tujuan dari penelitian ini adalah untuk mengidentifikasi entomologi larva Aedes aegypti, karakteristik wadah dan keberadaan larva pada kejadian demam berdarah di Desa Gambut. Jenis penelitian yang digunakan adalah eksperimen semu dengan desain kelompok kontrol yang tidak setara. Populasinya semua rumah di desa Gambut. pengambilan sampel menggunakan teknik random sampling. Sampel yang diambil adalah 100 rumah tinggal. Pendataan dilakukan dengan pengamatan langsung terhadap setiap kontainer rumah. Indeks entomologi dihitung berdasarkan House Index (HI), Container Index (CI), Breteau Index (BI) dan untuk menentukan risiko penularan berdasarkan density figure (DF) variabel independen menggunakan ovitrap. Analisis data menggunakan uji statistik uji wilcoxon. Penelitian ini mendapat persetujuan etis dari RSUD Umum Ulin Banjarmasin dengan nomor izin :117/VIII-Reg/RSUDU/2024. Hasil penelitian menunjukkan bahwa nilai Indeks Rumah di desa Gambut adalah 51%. Nilai Indeks Kontainer adalah 25% di desa Gambut dan 23%. Nilai Breteau di desa Gambut adalah 88%. Kepadatan larva Aedes aegypti berdasarkan HI, CI dan BI di kedua desa berada pada skala 6-8 dan termasuk dalam kategori risiko tinggi berdasarkan kepadatan vektor. Ada perbedaan yang signifikan antara CI dan BI antara sebelum dan sesudah pemasangan ovitrap (p = 0.000). Hal ini menjelaskan bahwa indeks entomologi di Kecamatan Gambut masih rendah, sehingga perlu pengendalian larva Aedes aegypti dengan melakukan 3M Plus (Menutup saluran air dan mengubur barang bekas) dan memberantas sarang nyamuk yang berkembang biak seperti membuat inovasi ovitrap dan menanam tanaman yang tidak disukai nyamuk. seperti tanaman serai dan lavender.

***Kata kunci**: demam berdarah, entomologi, ovitrap, kepadatan larva*

ABSTRACT

Dengue hemorrhagic fever (DHF) is a dengue virus that is transmitted through the Aedes Aegypti mosquito as the main vector that causes this disease. This research aims to identify the entomology of Aedes sp larvae, container characteristics, and the presence of larvae in dengue fever incidents in Gambut Village. The type of research used was a pseudo-experiment with a non-equivalent control group design.The population is all the houses in Gambut village. Random Sampling Technique. The samples taken were 100 residential homes. Data collection was carried out by direct observation of each home container. The entomological index is calculated based on the House Index (HI), Container Index (CI), Breteau Index (BI), and to determine the risk of transmission based on the density figure (DF), the independent variables use ovitraps. Data analysis using the Wilcoxon test statistical test**.** The study received ethical approval from Ulin Regional General Hospital, Banjarmasin, with clearance number: 117/VIII-Reg/RSUDU/2024. The

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research results show that the House Index value in Gambut village 51%. The Container Index value is 25% in Gambut village, 23%. The Breteau value in Gambut village 88%. The density of Aedes aegypti larvae based on HI, CI, and BI in both villages is on a scale of 6-8 and is included in the high-risk category based on vector density. There were significant differences between CI and BI before and after ovitrap installation (p = 0,000). This explains that the entomological index in Gambut District is still low, so it is necessary to control Aedes aegypti larvae by carrying out 3M Plus (Closing drains and burying used goods) and eradicating breeding mosquito nests, such as making ovitrap innovations and planting plants that mosquitoes don't like. Such as lemongrass and lavender plants.

Keywords: dengue hemorrhagic fever, density of larvae, entomology, ovitrap

INTRODUCTION

With a third of the global population at risk of infection, and an annual toll of nearly 400 million infections, dengue has become one of the most intractable public health challenges of recent decades.[1,2] Dengue virus poses a major global public health threat, particularly in the Americas, accounting for approximately 80% of reported cases. This increase in cases is attributed to several factors, including population growth, migration, housing shortages, limited access to clean water, and climate change, which facilitate the global spread of Ae. Aedes aegypti increases the risk of ABV transmission.[3,4] Control strategies in dengue endemic countries typically include activities for reducing the abundance of potential sites where the immature stages can develop, and insecticide treatment of sites that cannot be eliminated. Adult mosquitoes are targeted by periodic space spraying, usually outdoors, or residual treatments at breeding habitats or indoor resting sites.[3] The structure of surveillance systems and therefore the data collected by different mosquito control programs are widely varied due to differences in geography, climate, economy, and other logistic factors.[5] For improved dengue control, reliable epidemic forecasting systems for early detection of temporal anomalies in disease incidence are needed, as well as more effective control strategies that affect both entomological and epidemiological endpoints.[6]

Dengue Hemorrhagic Fever (DHF) continues to pose a significant public health challenge in Indonesia. According to the Indonesian Ministry of Health, Indonesia ranks first in Southeast Asia in terms of DHF cases, with over 90,000 cases reported in 2013. DHF cases have increased annually and often recur in the same areas, with a nationwide resurgence every five years. The Aedes aegypti mosquito is the primary vector for DHF transmission and predominantly inhabits human settlements. Its pre-adult stages develop in man-made containers found both inside and outside homes, typically containing relatively clear water. Various factors influence the oviposition behavior of Aedes aegypti, including the type and color of water containers, the water itself, temperature, humidity, and local environmental conditions.[7,8]

Loosely covered water places are preferred as egg-laying sites compared to open places.[9] Data collected from the Banjar District Health Office showed an increasing trend in the incidence of DHF. The highest number of DHF cases in Banjar Regency is in Gambut village, especially Gambut Village. The Gambut Health Center Working Area is the 2nd highest area for dengue incidence, with 35 cases and 1 death. The index ratio is 76.7%. The highest number of DHF cases was in the Gambut Village.[3] Breaking the chain of transmission by mosquito vectors can be done by avoiding or reducing contact with mosquitoes, killing mosquito larvae, and eliminating mosquito breeding places.[10]

A comprehensive strategy with locally specific dengue vector control methods is needed, considering the physical environment (weather, settlements,

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breeding habitats), socio-cultural (knowledge, attitudes, and practices), and vector aspects.[7] Data collected from the Banjar District Health Office shows an increasing trend in the incidence of DHF. The highest number of DHF cases in Banjar District is in Gambut village, especially Gambut Village. The Gambut Health Center Working Area is the 2nd highest area for DHF incidence, with 35 cases and 1 death. The index ratio is 76.7%, which is where most cases of DHF sufferers are in the Gambut Village Area. Environmental and home conditions greatly affect the existence of mosquitoes, especially the Aedes aegypti mosquito, which is the vector that causes Dengue Hemorrhagic Fever (DHF). Based on the results of the preliminary survey, it was found that there were 46 houses that had containers outside the house that contained mosquito larvae. In addition, the houses also have poor lighting and are not adequate. These findings suggest that environments with open water reservoirs and poor lighting are ideal places for mosquitoes to breed. Therefore, preventive measures are needed to reduce the risk of spreading dengue and other diseases caused by the Aedes aegypti mosquito. One effective prevention method is to carry out early detection of the presence of mosquito eggs around the residential environment. This detection can be done using an ovitrap, which functions to find out the existence of mosquito eggs and their potential breeding grounds. This research aims to identify the entomology of Aedes sp larvae, container characteristics, and the presence of larvae in dengue fever incidents in Gambut Village.

METHODS

Materials and Methods

The type of research used was a pseudo-experiment with a non-equivalent control group design. The population is all the houses in the Gambut sub-district. This research was conducted in August 2024 in DHF endemic areas, namely Gambut Village. The population was housed with DHF cases only. Random Sampling Technique. The sample taken was 100 residents' houses (WHO standard). For the entomological index, it is calculated based on the House Index (HI), Container Index (CI), and Breteau Index (BI), and determines the risk of transmission based on the density figure (DF). The characteristics of the samples taken are houses that are indicated to have experienced dengue or houses that are within a radius of 100 meters from houses that have experienced dengue in and people who are willing and give permission to place an ovitrap are placed for 7 days.

Research of Instrument

The presence of larvae was observed by using a flashlight on each container containing water to see the presence of larvae. The data were then analyzed using the larval index (WHO standard). Measurement of the larval population can be done by calculating the CI (container index), HI (house index), BI (breteau index), and DF (density figure) indices, which refers to Health Minister Regulation No. 50 of 2017 concerning Environmental Health Quality Standards and Health Requirements for Vectors and Disease Carrying Animals and Their Control.[11] while the independent variables use ovitraps. Data analysis using the Wilcoxon test statistical test.

Manufacture of ovitrap

The 16 oz plastic cup is painted black on the outside and then dried for ± 4 days until there is no smell of paint. Cut the filter paper 27 cm long and 2.5 cm wide strip. On the inside of the mouth of the glass, give a little water, then stick the filter paper following the mouth of the glass. Contents: 263 ml or 3/4 part ovitrap

Research Etchis

The study received ethical approval from Ulin Regional General Hospital, Banjarmasin, with clearance number: 117/VIII- Reg/RSUDU/2024.

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RESULT

Study Area Characteristics

This research was conducted in the Gambut subdistrict, selected based on secondary data obtained from the Gambut Public Health Center, which identified the area as having a high incidence of dengue fever cases in 2023. Data collection involved interviews using Google Forms and the installation of ovitraps in the homes of dengue patients, neighboring houses, and both indoor and outdoor settings. A total of 100 residential units were sampled. Additionally, interviews were conducted with residents who lived in or occupied the buildings where ovitraps were placed. The results of the entomological index in the Gambut can be seen in Table 1. The results show that the HI value in Gambut village was 51%. The CI value in the Gambut village was 25%, and in the West Gambut village, it was 23%. This data is presented in Table 1.

Table 1. Entomology index in Gambut village

Entomology index	Village Gambut	Density Figure	Category
HI	51%	7-8	High
CI	25%	6	High
BI	23%	6	High

Table 2. Types of Containers with Aedes aegypti larvae in Gambut

Container type	Gambut village			
	-	%	+	%
Inside house				
Dispenser	20	13	18	12
Bathup	32	20	84	59
Bucket	97	61	28	20
Outside house				
Trash tires	5	3	7	5
Trash drums	4	2	5	3
Trash cans	3	1	1	1
Total	161	100	143	100

Table 3. Container Index and Breteau Index Frequency distributions before and after Ovitrap installation

Variable	Before (n=100)		After (n=100)	
Container Index				
High	25	25.0	8	8.0
Low	75	75.0	92	92.0
Breteau Index				
High	29	29.0	0	0.0
Low	71	71.0	100	100.0

Based on Table 3 above, it can be said that the container index before the installation of ovitrap was categorized as high as 25 houses with positive containers, then after the installation of ovitrap decreased to 8 houses with positive containers. Meanwhile, in Breteau, the indexes before the installation of the ovitrap were categorized as high, as many as 29 houses with positive containers; then after the installation of the ovitrap, there were no houses with positive containers.

Table 4. One-Sample Kolmogorov-Smirnov Test Results

	CI		BI	
	Before	After	Before	After
Kolmogorov-smirnov	4,142	5,102	4,121	5,100
Asymp.Sig.(2-tailed)	0.000	0,000	0,000	0,000

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DISCUSSION

Entomological Index in Aedes aegypti Mosquitoes

Based on Table 1, the density of DHF vectors based on the calculation of HI, BI, CI, and the Density figure between Gambut village shows that the HI value in both villages is high, above 40%. The HI value in Gambut Village was 51%. The CI value in the Gambut village was 25%. The BI value in the Gambut village was 29%. The DF in the Gambut urban village is 7 (High Density).

Based on the HI value in both Gambut, the Density figure is in the high category because it is at the 7-8 level; this shows that there are still many houses that are positive for *Aedes aegypti* larvae and the high spread of DHF. According to the World Health Organization, an area is considered high risk for spreading DHF if HI >10%, while it is considered low risk if HI <1%. House Index (HI) is the most widely used indicator to monitor the level of mosquito infestation. The HI value represents the percentage of houses that are positive for DHF vector breeding and, therefore, reflects the size of the population at risk. HI does not consider the number of containers with adult mosquitoes. The spread of *Aedes aegypti* mosquitoes is influenced by population density, and the distance between houses affects the spread of *Aedes aegypti* mosquitoes from one house to another. The closer the distance between houses, the easier it is for mosquitoes to spread from house to house because the flight distance of *Aedes aegypti* mosquitoes ranges from 50- 100 meters.

This study was also limited by the fact that it is a before-and-after evaluation and that we did not include randomized control clusters in the design, but used routine entomological surveillance data from the whole municipality as 'control' data. However, it is not likely that temporal trends in vector density should selectively affect the intervention clusters only, and bias, if any, could not explain the differences that we observed. [12]

The impact of commercially treated curtains and a relatively small number of drum covers on vector abundance was less dramatic when compared to previous cluster randomized trials [15,16], although the level of coverage, recognized to have important implications for the effectiveness of interventions, was high in Poptun and similar to those preceding studies. However, several factors may have reduced the efficacy of insecticide-treated materials [13]

Containers that are outside the house and have tested positive contain *Aedes aegypti* mosquito larvae, including used tires and used drums. This type of container is generally made of plastic material that has damp and dark properties. This condition creates an ideal environment for mosquitoes to lay eggs because it provides a sense of security and comfort, so the number of eggs laid is higher, which leads to an increase in the number of larvae. After it was known that the entomological index in the region was quite high, the community began to realize the importance of Mosquito Nest Eradication (PSN) activities. The steps taken include: draining the bathtub regularly, changing the water for birds to drink, and disposing of water that is stagnant in used tires. In the context of the research, larvae were examined before the installation of the ovitrap to determine the value of the Container Index (CI) or container index. Based on the results of the examination, most areas with cases of Dengue Hemorrhagic Fever (DHF) in dengue endemic areas, especially in Gambut District, have a CI of ≤ 10%. This shows that the work area of Gambut village is relatively safe from the risk of transmission of the dengue virus, especially after the installation of ovitraps as a monitoring and prevention measure.

The spread of *Aedes aegypti* mosquitoes is influenced by population density, and the distance between houses affects the spread of *Aedes*

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aegypti mosquitoes from one house to another. The closer the distance between residents' houses, the easier it is for mosquitoes to spread from house to house because the flight distance of *Aedes aegypti* mosquitoes ranges from 50- 100 meters.[14] The presence of Aedes aegypti larvae is a sign of a mosquito population in an area. The density of mosquito larvae based on the HI value is a giving of information on the number of houses where mosquito larvae are present. A high HI value indicates that there are many breeding sites for DHF mosquito larvae, which results in a higher transmission of DHF.[15]

DHF vector density indices, such as House index (HI), Container Index (CI), Breteau Index (BI), and Free Larvae Rate (ABJ), are entomological parameters that have direct relevance to the dynamics of disease transmission.[15] Based on the HI and BI values, it shows that the density of *Aedes aegypti*. in the Special Vector Research area in 2015 is quite high. This illustrates that the community has not actively participated in Mosquito Nest Eradication. The average larva-free rate (ABJ) is below the program's set value of 95%, so it does not meet the program's criteria.[14]

Based on Handayani's research (2023), Kwarasan Village is an area adjacent to Sanggrahan Village with the riskiest entomological index value among other areas. Mosquitoes are disease vectors that can suck human blood from one person to another alternately in a short period of time (multiple biters).[16] The bacterial diversity of our populations does not seem to differ significantly based on geographical origin, temperature, climatic factors, or elevation. Studies with *Aedes aegypti* adults and larvae demonstrated that bacterial diversity was not affected by geographic area and larval habitat characteristics such as water temperature and pH, in agreement with our observations [3]

The use of traps in a preventive context allows for the reduction of mosquito vector populations density in urban areas located in epidemic or endemic regions, especially where adulticide treatment is not feasible (especially where there are exclusion zones for insecticide treatment: proximity to a river, lake shores, hospitals, insectarium, etc.).[17]

Presence of Aedes Aegypti larvae in containers

The most common types of containers found positive for *Aedes aegypti* larvae in Gambut were bathtub and bucket containers (Table 2). The results of this study are like those of research in Gambut, stating that Aedes spp larvae are mostly found in bathtub and bucket containers. This indicates that houses in Gambut villages are at high risk as breeding grounds for *Aedes aegypti*. Efforts are needed to control dengue vectors through community participation in controlling *Aedes aegypti* mosquito larvae. One of the activities that can be done is carrying out Mosquito Nest Eradication regularly and at least once a week, and making ovitrap innovations to minimize the presence of larvae in containers, which is expected to reduce the density of *Aedes aegypti* mosquito larvae. The larvae eradication activities can reduce the density of *Aedes aegypti* mosquito larvae as a vector of DHF. In addition, it is necessary to increase counseling activities related to larvae eradication in all communities so that the community actively participates in the larvae eradication activities carried out in the environment in Gambut Villages. Larvae eradication activities can reduce the density of *Aedes aegypti* mosquito larvae as a vector of DHF.[18]

From the research results, the dominant place where there are larvae at the time of the survey is the bathtub in the house. This is because most residents have a bathtub large enough so that it takes a long time to change running water, and draining the water in the bathtub is done for a long time, so it has the potential for mosquitoes to easily breed. The solution to reducing larvae in

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community bathtubs can be done with abatement, namely, using abate powder to eradicate mosquito larvae. The abate powder is used by sprinkling abate powder into the water reservoir with a dose of 1 gr of abate powder for a bathtub containing 10 liters of water. The abated powder can be replaced for up to 2-3 months. Based on observations in the field, mosquito larvae are often found in man-made containers inside and outside the house. Mosquito larvae are often found in water reservoirs that have minimal lighting and high humidity. In addition, mosquito larvae were also found in mossy water containers.

Research conducted by Novia (2015) in the Tegalsari Subdistrict explained that the BI value with a high risk of DHF was obtained from a higher number of larval-positive containers than the number of larval-positive houses.[19] The surface condition of water containers that do not have light causes mossy container conditions to increase mosquito hatching due to low temperature and light. In addition, the availability of closed water containers, container materials, frequency of draining water containers, and water sources also affect the presence of mosquito larvae with dengue cases. Lack of environmental cleaning activities and closure of places that allow mosquitoes to nest are among the causes of many positive containers in residents' homes. One solution that can be done to reduce the number of mosquito larvae in the environment outside the home is to drain water reservoirs around the house, close water reservoirs, and bury used items that have the potential to become stagnant water and become a place for mosquitoes to nest. [20]

Based on the results of observations in the field, houses with negative results are mostly houses with water storage containers in the form of dispensers. Meanwhile, houses with positive results were mostly found in houses with water containers in the form of bathtubs and buckets. The presence of mosquito larvae in a container is closely related to the type, position, and number of containers in a house. Aedes aegypti mosquito larvae are most commonly found in buckets, tubs, and crocks. Mosquito larvae will hatch in water storage containers used by the community to store water.[9]

The bacterial diversity of our populations does not seem to differ significantly based on geographical origin, temperature, climatic factors, or elevation. Studies with *Aedes aegypti* adults and larvae demonstrated that bacterial diversity was not affected by geographic area and larval habitat characteristics such as water temperature and pH, in agreement with our observations [21]

Comparison of Container and Breteau Indices Before and After Ovitrap Installation

This study aims to evaluate the effectiveness of ovitrap installation in reducing the density of Aedes aegypti mosquito larvae through the measurement of three entomological indicators, namely House Index (HI), Container Index (CI), and Breteau Index (BI). Based on previous studies, it is known that the use of ovitrap can significantly reduce these three indicators. Ovitrap is an alternative method that is cheap and effective in controlling Dengue Hemorrhagic Fever (DHF) vectors, because the ingredients are easy to obtain and can be used in any type of water.

In this study, the initial stage was an examination of larvae to determine the value of the entomological index before the installation of ovitraps. This inspection includes all containers inside and outside the house, including water reservoirs such as dispensers, bird drinking places, cans, open used bottles, used drink cans, used tires in the yard of the house, and flower pots filled with water. Facts on the ground show that Aedes aegypti mosquito breeding grounds are not limited to household clean water reservoirs such as bathtubs,

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drums, barrels, and buckets, but are also found in various other places that are often overlooked, such as dispensers, flower pots, cans, and used tires.

Based on the results of initial observations on the first day before the installation of the ovitrap, it was found that 30 out of 100 houses where the research was located still had larvae in water reservoirs (containers). Furthermore, 100 ovitraps were installed, which were placed both inside and outside the house for 7 days. The ovitrap is replaced every 3 days to monitor the effectiveness of catching mosquito eggs. After 7 days, the larvae examination was carried out again throughout the house. The results of the inspection showed a significant decrease, namely, only 7 out of 100 houses still had larvae in containers. These findings suggest that the installation of ovitraps has a positive impact on the decline of mosquito larvae populations. Measurements of the entomological index before and after ovitrap installation resulted. This confirms that the installation of ovitraps is very effective in reducing mosquito breeding and plays an important role in efforts to prevent the spread of the Dengue Hemorrhagic Fever (DHF) virus.

In the installation of the Ovitrap index (OI), measurements were made by dividing the number of positive ovitraps containing Aedes aegypti mosquito eggs by the number of ovitraps installed. OI describes the number of ovitrap-positive eggs from several observed ovitraps. OI is a way of describing the egg-laying activity of adult mosquitoes both inside and outside the house. The ovitrap method can also detect mosquitoes from unreached nesting places and surrounding areas.[22]

The results suggest that exposure to the evaluated insecticides could influence the composition of the gut microbiota of Ae. aegypti. In agreement with these findings, previous studies have shown that some bacterial communities in mosquito guts can affect their susceptibility to insecticides. A more complete understanding of the role of the microbiome on insecticide resistance will enable the development of strategies to mitigate the emergence of resistance and extend the longevity of currently used formulations. [23]

Limitations

This study is limited by the fact that it only focused on the presence of mosquito eggs in ovitraps, without conducting a quantitative analysis of the egg density of Aedes aegypti. Randomization was not applied in selecting the study locations; instead, selection was based on relatively similar environmental conditions. This is evident from the pre-survey results, which showed that entomological indices (House Index, Container Index, and Breteau Index) in the case areas were relatively higher than those in the intervention areas. Consequently, it is unclear whether the observed reduction was truly due to the effect of the tested ovitraps or merely a result of natural variation. This study did not include species-level identification of larvae or adult mosquitoes, leaving the dominant Aedes species in the study area unidentified. The lack of proper control makes it difficult to attribute observed reductions solely to the intervention. The absence of species-level identification of Aedes mosquitoes further limits the generalizability of the findings.

CONCLUSIONS

From this study, it can be concluded that based on the density of *Aedes aegypti* larvae with the types of HI, CI, BI, and DF in Gambut Village (HI: 51%, CI: 25%, BI: 23%), it can be categorized that in Gambut Village. And for the presence of the most containers, namely bathtubs and buckets, where Aedes aegypti 161 mosquitoes breed. It is recommended that container draining activities should be intensified in Gambut, while monitoring of containers for larvae should be done regularly in Gambut village, e.g., frequency of

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container draining, monitoring schedule. The installation of ovitraps was effective in lowering the entomological index (container index and breteau index) before and after the installation of ovitraps.

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