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Aedes aegypti L. Controlling based on Lethal MosquitoTRAP Modification (LMM) in Mataram City

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Abstract. Dengue hemorrhagic fever is a global public health problem that caused an Arbovirus. Mataram city was a high infected area in West Nusa Tenggara Province, which included six sub-districts. The objective of this study is monitoring and controling dengue virus vectors based on temporal patterns using mosquitoTRAP. This research was explanatory in the cross-section design in 102 households (indoor and outdoor) as an observation site. Based on mosquito collection in October 2018 until March 2019, the amount reached 2,396 mosquitos such as *Aedes albopictus* (41%) and *Aedes aegypti* (59%). The mosquitos collection based on observation site showed no significant difference number (P=0.863). However, the number of mosquitos in temporal pattern showed significant difference number of first, middle, and end rain season (P = 0.001). Mosquitoes population at rain season had shown an increase until March 2019. Therefore, monitoring and controlling Aedes mosquitoes is crucial for prevention of dengue hemorrhagic fever case.

Keywords: *Aedes aegypti*, Lethal MosquitoTRAP Modification, Surveillance.

INTRODUCTION

The distribution of Dengue Hemorrhagic Fever (DHF) vector in residential areas is inseparable from various interrelated factors (Dhang et al. 2005; Ho et al. 2014). Changes in the season from dry to rainy season often result in a lot of potential puddles and support the life cycle of the dengue virus primary vector (Tuan et al., 2017). Apart from environmental factor, community life patterns in densely populated residential areas determine the development or failure of dengue virus vector, *Aedes aegypti* mosquito as a primary vector is found in residential areas with low environmental sanitation (Tainchum et al., 2013).

West Nusa Tenggara Province in 2011 was recorded the number of cases of dengue infection reached 630 cases with six death. Every year there are fluctuations in the increase of dengue cases, in 2012 there were 827 cases, 2013 increased dramatically to 1,600 cases, in 2014 there was a decrease in 872 cases, in 2015 there were 1,300 cases, until 2016 there was a very significant increase to 3,171 cases and finally in mid-2017 there are 1,258 cases. The Health Office of Mataram City noted that of the 50 urban villages in Mataram, there were three worst villages reaching 78 cases namely, West Pagutan,

East Pagutan, West Pagesangan, while the moderate category of dengue virus vector spread was in the Pagesangan Village, Septa Marga, Turidan and Mandalika (Marjito, 2017).

Based on the description of dengue cases in Mataram city, it is closely related to the condition of residential areas that provides vector breeding places. There is a reservoir of water and potential waste found in residential areas that can accommodate rainwater as a place for mosquitoes to lay eggs or known as oviposition (Matysiak & Roess, 2017). Based on the supporting environmental condition, DHF cases are still possible in the following years.

Dengue vector control program is needed to reducing the transmission of dengue virus vectors (Karyanti et al. 2014; Sazali and Rizki 2017). The government controls fogging but then a report emerges from various research results on the danger of organ-phosphoreaster in fogging that triggers health problems in humans, non-target animals, and environment (Krismawati, Kridaningsih, Raharjo, & Natalia, 2017). For this reason, more friendly prevention is needed for the environment and does not risk human health.

Aedes aegypti control is still a viable option for reducing dengue virus infection to humans, the development of mosquito traps and ovitraps has received much attention among researchers. Utilization of mosquito oviTrap is developed to break the life cycle of mosquitoes by around 20.5% in the environment (Sayono 2008; Cahyati et al. 2016). Adult mosquito traps (mosquitoTrap) from plastic materials with sticky modification and natural attractants, in laboratory test traps, are capable of spreading *Aedes aegypti* mosquitoes up to 94%. Highest effectiveness of traps with modification at attractants (Sazali et al. 2014).
Therefore, testing the ability of Lethal MosquitoTRAP Modification (LMM) in the environment needs to be studied and examined to determine the effectiveness of LMM traps in controlling dengue virus vector populations.

MATERIALS AND METHODS

Study area

Location of the study in Mataram City based on six sub-district (Ampenan, Mataram, Sekarbela, Cakranegara, Selparang and Sandubaya) that consisted of 20 household. This location is determined by criteria as follows (1) endemic areas of dengue vector, 15.22 pre-adult mosquitoes found as positive Aedes mosquito, (2) regional characteristics (settlement, vegetation, and topography conditions) are equivalent, (3) HI in June-July 2018, there are fluctuating vectors of dengue virus transmission.

Lethal MosquitoTRAP Modificatio (LMM)

The main ingredient is obtained from 1600 ml mineral plastic waste, then cut at the end of the bottle thus the top lid forms a funnel that serves as a trap cover. A sticky as modification is provided to tighten mosquitoes in the trap. The next step is the installation of the outer cover using a dark or black plastic sheet to attract the attention of Aedes mosquitoes that are photoperiodic and attractant derived from 30% hay soaking water to produce CO2, ammonia and oc-tenol from the trap.

Mosquito trap placed of the residents at six sub-distric areas, Mataram City. Traps are placed in two units in each house (indoor and outdoor) with a total trap of 240 units. Placement of traps is adjusted to the position where human activities take place, thus traps can function optimally, and attractants function to influence the olfactory system of Aedes mosquitoes into the trap.

Data Analysis

The mosquitoes collection are calculated in the same way on each observation week until the 28th day. Data collection in this study is carried out 4 (four) times and the results of the data collection are tabulated using Excel 2010 and statistically analyzed with a significance level of 0.05 ($p = 0.05$) and a confidence level of 95% ($\alpha = 0.05$). To see the difference in attraction from *Aedes aegypti*, each type of attractant is tested differently (t-test). To see the level of several mosquitoes from each species to the location of the traps, the Tukey HSD test is conducted.

RESULTS AND DISCUSSION

Microclimatic conditions such as air temperature in the village ranged from 29-32^{o}C, air humidity ranged from 60-80%. This region is classified as a plain area thus almost all regions get evenly distributed sunlight (Dinas-Kesehatan-NTB, 2018).This condition supports the development of *Aedes aegypti* mosquitoes in the environment.

The location of the installation of mosquito TRAP Modification (LMM) inside and outside the room is found to be significantly different ($p = 0{,}000 < 0.05$), While there is no difference ($p = 0.963 > 0.05$) for 5 (five) station areas. This is from the overall lethal mosquito TRAP modification installed at each location where there are *Aedes aegypti* mosquitoes trapped with varying collection results. The collection results show that the behavior of the *Aedes aegypti* mosquito is more active in the room at all stations.

Table 1. Mosquitoes collection based on Lethal MosquitoTRAP Modification captures.

LMM/ Parameter Evaluation	Trap Placement Location (LMM)/Station				
	Station I	Station II	Station III	Station IV	Station V
Indoor					
Aedes aegypti	11,25	10,50	11,50	10,75	13,00
Aedes albopictus	4,25	3,75	4,50	4,50	4,75
Non-Aedes	15,50	19,75	19,25	20,75	19,75
Sig	0,000*				
St. Error	±0,582				
Temperature (^{o}C)	28-28,5				
Humidity (%)	95				
Outdoor					
Aedes aegypti	4,75	4,50	6,00	4,50	6,75
Aedes albopictus	8.25	8,75	6,75	7,75	8,00
Non-Aedes	12,25	8,75	6,50	7,75	7,00
Sig	0,001*				
St. Error	±1,062				
Temperature (^{o}C)	29-31				
Humidity (%)	80				

In addition, behavior factor of *Aedes aegypti* mosquitoes was selected of lethal mosquitoTRAP modification of different results. The difference can also be influenced by the location and condition of residential areas, hence the species of mosquitoes found varies. The first group study of *Aedes aegypti* mosquitoes is more dominant than *Aedes albopictus* (p = 0,000 <0.05) location inside the house, while the second group research found more Aedes albopictus with Aedes aegypti outside the home (p = 0,000 <0.05), but non-Aedes mosquitos are more dominant inside and outside the home (p = 0.001 <0.05). These results indicate lethal mosquitoTRAP modification has not specifically caught the Aedes sp. in the environment. This indicates that attractants in the form of CO_2, ammonia, and Octenol that come out of the trap get a response from the non-Aedes mosquito.

Instead of the ability to respond to attractants, the *Aedes aegypti* mosquito's flight distance influences the spread of dengue virus vectors in the environment (Ghaninia et al. 2008; Matysiak and Roess 2017). The mosquitoes trapped in weeks II and III have increased due to the spread of mosquitoes from one observation site, including the rapid adaptation of *Aedes aegypti* mosquitoes to environmental changes (Matysiak & Roess, 2017). In this case, mosquitoes face unfavorable environmental conditions (transitional dry season), limited breeding places as a place to lay eggs so that mosquitoes will look for traps installed in settlements. The presence of attractants in the lethal mosquito TRAP modificationmakes it easier for gravid female mosquitoes to find breeding places in the trap.

The ability to respond to odors, *Aedes aegypti* mosquitoes can reach objects as far as 36 meters (Vinauger et al. 2014). Such conditions cause mosquitoes from other places able to enter the study area so that there is an increase in mosquitoes trapped. However, there are not so many *Aedes aegypti* mosquitoes from outside the room so that fewer *Aedes aegypti* mosquitoes are trapped outside the house than inside the house.

Based on the results of the collection of mosquitoes inside and outside the room the pattern of the results of the collection of herbs on lethal can be determined on mosquito TRAP modification. The collection pattern shows a decrease in the number of mosquitoes trapped during four observations. A decrease in the number of trapped *Aedes aegypti* mosquitoes shows that this trap can reduce the population of dengue virus vectors in the Pagutan Induk area. Female *Aedes aegypti* infectious mosquitoes in the environment act as transovarial dengue virus transmitters (Lidiasani et al. 2016; Rohani et al. 2007), in addition to vertical virus transmission, adult *Aedes aegypti* mosquitoes are also able to transmit dengue virus to humans through the process of sucking blood to obtain nutritional intake and egg maturation(Maronotti et al. 1990). After the egg ripening process, female mosquitoes will look for breeding places.

Figure 1. Mosquitoes captured using lethal mosquiTRAP modification. a. *Aedes aegypti* and b. *Aedes albopictus*

Mosquito breeding places has been proven as one of the causes of the presence of dengue virus vectors in the environment (Madzlan et al. 2016; Philbert & Ijumba, 2013). *Aedes aegypti* is one of the primary vectors that prefers clean water reservoirs which are usually widely found inside and outside the home. This is what causes *Aedes aegypti* mosquitoes to be found around densely populated settlements so that transmission of dengue virus always occurs even to extraordinary conditions. The first step that needs attention is controlling the spread of the virus vector and breaking the life cycle as not cause a lot of viral infections to humans(Pham Thi et al., 2017).

The lethal mosquito TRAP modification shows the average pattern of reduction in trapped mosquitoes. The location of trap placement in the house traps many types of non-Aedes mosquitoes then followed by *Aedes aegypti* mosquitoes and at least found *Aedes albopictus* mosquitoes. These three types of mosquitoes in the first week of collection, the number of trapped mosquitoes has a mean decrease until the fourth week.

Location of traps that outside the house has a collection of mosquito species which is dominated by non-Aedes mosquitoes (p = 0,000 <0.05), but the type of *Aedes albopictus* mosquitoes at locations outside the

home is more than that of *Aedes aegyti* (0.030 <0.05). This is certainly very much determined by the behavior of each mosquito having a tendency to choose breeding sites, just as the *Aedes aegypti* mosquito prefers clean water reservoirs, such as bathtubs, potted plants that have stagnant water and several containers that have the potential for breeding sites, while *Aedes albopictus* mosquito prefers breeding places in plantation areas (outside the house), because these mosquito breeds are commonly found on tree trunks that have standing water (Lima-Camara, 2010).

The development of lethal mosquito TRA Pmodification is lethal by adding sticky in the trap so that incoming mosquitoes cannot get back out of the trap. Based on the results of its collection in the trap, it is seen for seven days that the release of traps the average mosquito that was found was not visible in living conditions, the cover and inner walls are equipped with double-sided adhesive which allows any insect that attaches to it can't release the glue on that part. Some traps also found the presence of several eggs and larvae of mosquitoes that have developed in active conditions, this is because in the trap is also equipped with an attractive container that allows mosquitoes to be able to release eggs before they are attached to the lethal trap.

CONCLUSION

Based on the results of mosquito collections and data analysis in this study, it is known that lethal mosquito TRAP Modification can trap several types of mosquitoes. The trap results are not specific to one type of *Aedes aegypti*, *Aedes albopictus*, and non-Aedes mosquitoes. The difference in the place of releasing traps inside and outside the house looks more non-Aedes collection mosquitoes, compared to the type of Aedes mosquito. Trapped mosquito behavior patterns are more active inside the home (11.58) than outside the home (7.21).

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