



Dynamics Of *Aedes Aegypti* Mosquito Population And Time Potential The Spread Of Dengue Hemorrhagic Fever (DHF) In The Landscape Medan City

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Abstract

A study on the dynamics of the *Aedes aegypti* mosquito population and the potential time for the spread of dengue hemorrhagic fever (DHF) in the Medan City Landscape has been carried out with the aim of analyzing the effect of environmental quality (temperature, relative humidity) in the Medan city landscape (village, suburban, city) on population dynamics of *Aedes Aegypti* and analyzing the relationship between environmental data and population dynamics data in order to see the potential time (months) for the spread of dengue fever in the city of Medan. The used methodology: direct observation: environmental parameter measurement (temperature, relative humidity), population dynamics (the number of egg-larvae, larvae-pupa, pupa-adult), the design used: Factorial Completely Random Design (CRD): landscape and observation month, 6 repetitions, Duncan test 5%, analyzed with SPSS 20 computer program. The research results, population dynamics (the number of egg-larvae, larvae-pupa, and pupa-adult) of *A. aegypti*. is high in village (92.66%-96,00%, 90,00%-92,61%, 90,00%-92,61%) followed by suburbs (86,59%-89,37%, 87,78%-91,65%, 87,78%-91,65%) and the lowest is in the city (76,00%-78,12%, 76,00%-78,12%, 76,00%-78,12%). The village landscape has high potential for DHF transmission compared to suburbs and the city with the same spread month potential: September and January. Correlated temperature (-) to *A. Aegypti* population dynamics an increase in temperature causing a decrease (the number of egg-larvae, larvae-pupa and pupa-adult), in the other hand, relative humidity is correlated (+), to population dynamic of *A. aegypti*; an increase in relative humidity causing an increase (the number of egg-larvae, larvae-pupa, and pupa -adult).

Key Words: *Aedes Aegypti*, Dynamics Population, Landscape, Dynamics, Survival

I. INTRODUCTION

Nationality cases of Dengue Hemorrhagic Fever (DHF) increase from year to year. total causes DHF start from 29th January 2018 reach 13.683 with a total of 133 people who died. The number keeps increasing marked by a total of cases that in 3rd February 2019 extend to 16.692 cases with 169 people dead. While on 31st January 2019, the number of sufferers was still around 15.132 and total deaths were 145 (Minister of Health, 2019). Patients of DHF in North Sumatra in 2018 reached 5713 people with 25 of them dead. However, from that amount, Medan City placed in the first place with the highest number of cases compared to other cities or districts in North Sumatra which are 1490 people and 13 of them dead. In 2019, counted that from January to March, there were 2055 cases of DHF in Medan City (Public Health, North Sumatera Provincial Government). The increase in dengue fever cases is not only caused by a lack of environmental hygiene but also due to

changes in environmental quality caused by global warming and causes variations in air temperature and relative humidity in the urban landscape.

Temperature is one of the main environmental drivers that influence mosquito population dynamics *A. aegypti*, and give contribution to spread of DHF (Lambrechts et al., 2009). The variants of temperature can greatly affect mosquito population dynamics and development (Delatte et al., 2009). Besides temperature, humidity can push the spread of disease through mosquitoes. Temperature and humidity can vary greatly across urban landscapes and also can greatly be affected by variation in landscape features such as housing density, housing material, vegetation cover, and ground cover. (Monteiro et al., 2009). To control the population of *A. aegypti* mosquitoes, it can be done with knowing the dynamics of the mosquito population growth, since with knowledge of this, we can describe or predict the increase or decrease of the mosquitos population (Moulay et al., 2010). This of course can be used by a related institution in this matter is the Public Health Office as a policy when is the best time for controlling mosquitoes population as DHF vector. Therefore the controlling of mosquitos population are more efficient and effective reviewed from cost, time and energy.

II. RESEARCH METHODOLOGY

2.1. Time and Research Place

This research was implemented in three places in Medan city: a. Village (Medan Tuntungan), b. Suburbs (Medan Helvetia), c. Downtown (Medan City), for 8 months observations and laboratories of Animal Systematic of Biology Department FMIPA USU Medan.

2.2. Research Design

To determine the effect of temperature and air humidity in 3 Medan City Landscapes (city, suburbs, village) on population dynamics and survival of the mosquito *A. aegypti* using Completely Randomized Design (CRD) Factorial, 6 repetitions. 2 factors; Factor A (landscape shape): A1=Village, A2=Suburbs, A3= City. Factor B (month of observation): B1= July, B2=August, B3= September, B4= Movember, B6= December, B7= January, B8= February.

2.3. Observation of Population Dynamics Parameters

In every form of Medan City landscape (village, suburbs, city) placed 6 black bucket, filled with 500 ml water, and pieces of cardboard where the eggs of *A. aegypti* are laid, then left for ± 2 days and the total of eggs that sticking to the piece of paper will be counted (25 eggs) with distance one bucket to another buckets was 10 m.

2.4. Measurement of *A.aegypti* . Population Dynamics Parameters:

Population dynamics: number of eggs - larva, number of larva-pupa, number of pupa-adult

2.5. Observation of Environmental Factors (Temperature, Humidity)

In every form of Medan City landscape (village, suburbs, city) where the gauze box is placed, temperature and relative humidity is measured in each month of observation (8 months).

2.6. Statistic Analysis

The data that got from every parameter (variabel) population dynamics tested its significance on the effect of the treatment group (independent variable) with a statistical computer programme, SPSS programme release 20. Statistical test at 5% significance level ($p = 0.05$), if there is real difference with ANOVA ($p < 0.05$) Duncan's test was carried out. Environmental Factors Correlation Analysis (temperature, humidity) with population dynamics of *A. aegypti* mosquitoes in each landscape, to get correlation between temperature, humidity on population dynamics and prediction of potency of time (month) for the spread of DHF cases.

III. RESULT AND DISCUSSION

Research Results Variations in Environmental Quality Changes in Medan City Landscape on population dynamics and life pass of *Aedes Aegypti* mosquito and potency of spread time of DHF disease, the data obtained as shown in the following image.

3.1. Population dynamics: number of egg-larva, number of larva-pupa, number of pupa-adult of *A. aegypti*

Based on observations that has been done, number of number of egg-larva, number of larva-pupa, number of pupa-adult of *A. aegypti* for 8 months of observation in all three landscapes, number of egg-larva, larva-pupa, pupa-adult of *A. aegypti*; village, (M. Tuntungan), suburbs (M. Helvetia), downtown (M.Kota) can be seen in Figure 1 (a,b,c).

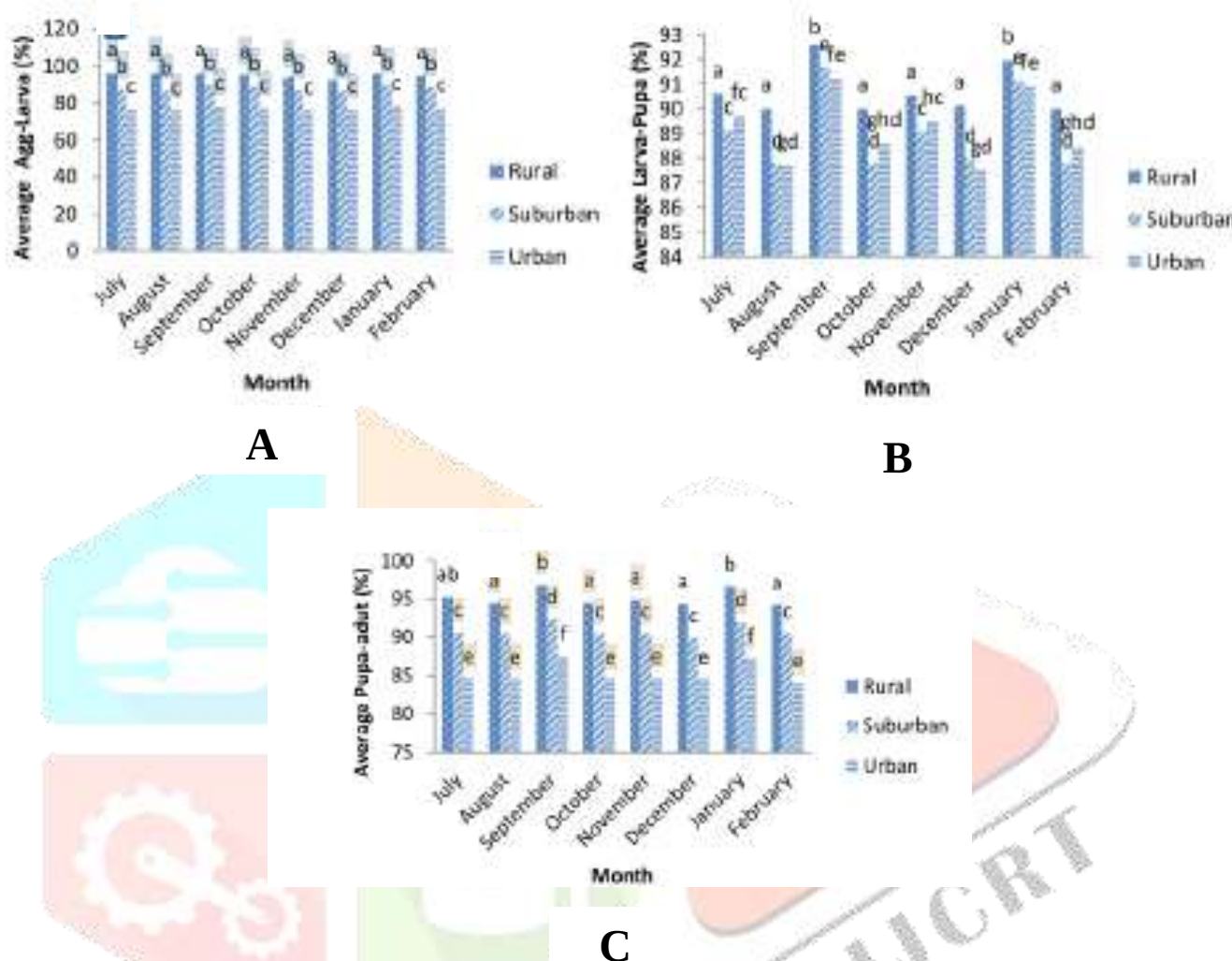


Figure 1. The average number of egg-larvae (a), larvae-pupa(b), and pupa-adult (c) of *A. aegypti* for 8 months of observation in three research locations, village, suburbs, city

The average number of *A. aegypti* eggs that hatched and became larva was different between locations in each month of observation. It was higher in villages (92,66% - 96,00%), followed by suburbs (86,39%-89,37%) and the lowest was in the city, M.Kota (76,00%-78,12%). But, when viewed in the month of observation in the three locations was not different among one month with others. It means the total average of hatched eggs that became larva have the same population dynamics (Figure 1a). The average amount of *A. aegypti* larva which became pupa was different between locations in every month of observation. The highest percentage was in village (90,00%-92,61%), then followed by suburbs (87,78%-91,65%) and the lowest was in the city (76,00%-78,12%), likewise, if you look at the month of observation at the three locations, there are differences between one month and another. It reached the highest percentage in September and January which are; 92,61%, 91,65%, 91,22% for September and 91,96%, 91,15%, 90,91% for January (Figure 1b). The average number of *A. aegypti* pupa which developed into adults was different in every location in each month of observation. It was high in the village (90,00%-92,61%), then suburbs come after (87,78%-91,65%) and the last place was city (76,00%-78,12%), the same when it reviewed in month of observation in all three locations, there was a different between one month with another. September and January had the highest percentage which; 92,61%, 91,65%, 91,22% for September and 91,96%, 91,16%, 90,91% for January. It shows that for the three locations the average amount of larva that became pupa, there were differences in population dynamics between observations, high in September and January (Figure 1c).

In general, the number of eggs that hatched and became larva, larva became pupa and pupa transform became adult were higher in the village rather than in suburbs and in the city. This matter was found in observation, Murdock *et al.*, (2017). It happened because there was temperature and humidity differences in all places. Village Landscape has the lower average of temperature (25°C) and humidity relatively higher (82%) compared to suburbs landscape, temperature (28°C), relative humidity (78%) and city landscape, temperature (30°C), relative humidity (75%). As explained, development and larva survival in the city is lower, so that adult mosquitos less appear and experience lower per capita growth rate than in non-urban locations because urban locations generally have higher temperatures than non-urban locations (Marcombe *et al.*, 2012, Leisnham *et al.*, 2012). Next, Singh *et al.*, (1967) explained that increase in relative humidity can lead to the increase of death in larva which in the end will decrease the number of adults that appear. The shape of the city landscape and season affect the growth and survival. It will be high in fall and low in summer, it happened because many larvae died due to high temperature (Courtney *et al.*, 2017). There is no difference in the number of eggs to larva between the months of observation at the three locations and the different number of larvae become pupa and pupae become adult between months of observation in the three locations which is higher in September and January. This is because fluctuations in temperature decrease and humidity increases in January and September do not affect the development of eggs into larvae, larvae into pupa and pupa into adults. As the results of research Courtney *et al.*, (2017) described the emergence of adult mosquitoes in summer decreased by 18% for every 1°C increase in average daily temperature and 7% for every 1% increase in daily average relative humidity.

3.2 Correlation of Temperature, Relative Humidity to Population Dynamics

From the results and discussion that have been explained, it can be seen that temperature and humidity on the three types of landscape greatly affect the development of egg-larvae, larvae-pupa, and pupa-adult. Based on correlation analysis between temperature and humidity to population dynamics (the number egg-larvae, larvae-pupa, pupa-adult) obtained a result that temperature produce correlation (-); an increase in temperature causes a decrease (the number of egg-larvae, larvae-pupa, pupa-adult), otherwise relative humidity produces correlation (+), an increase in relative humidity causes an increase (the number of egg-larvae, larvae-pupa, pupa-adult)

IV. CONCLUSION

From the research of Dynamics of *Aedes Aegypti* Mosquito Population and Potential Time of Spread of Dengue Hemorrhagic Fever (DHF) in Medan City Landscape can be conclude that : Population dynamics, the number of egg-larvae, larvae-pupa, and pupa-adults of *A. aegypti* is high in villages followed by suburbs and the lowest in the city. Next, the village landscape has a high potential for DHF transmission compared to suburbs and the city with the potential for the same distribution month in the three landscapes: September and January. Correlated temperature (-) tp population dynamics of *A. Aegypti*; an increase in temperature causes a decrease (the number egg-larvae, larvae-pupa, pupa-adult), On the other hand, relative humidity is correlated (+), to population dynamics of *A. Aegypti*; an increase in relative humidity causes an increase (the number egg-larvae, larvae-pupa, pupa-adult).

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