

Survival Resistance Effects of Cypermethrin on Rate of *Aedes Aegypti*

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Abstract: Infectious diseases caused by vectors are still a problem for tropical countries including Indonesia. The number of dengue cases in Indonesia fluctuates every year, in 2017 dengue cases were 17,877 cases with 115 deaths. Incidence Rate (IR) in 34 provinces in 2015 reached 50.75 per 100 thousand population, and IR in 2016 reached 78.85 per 100 thousand population. This figure is still higher than the national IR target of 49 per 100 thousand population. The most common mosquito control is chemical control consisting of synthetic insecticides. The use of insecticides used by the community, because it is considered practical and quickly controlled. Aerosol which in this study was sipermethrin. Preliminary research results state that all existing aerosol insecticides have a very high ratio with this study. The purpose of this study was to analyze the fecundity, fertility and survival resistance of *Ae aegypti*. This study used a quasi-experimental study with post control design only the control group, with a ratio between sipermethrin 0.0055 ppm, 0.0110 ppm, 0.0165 ppm, and 0.0220 ppm. A statistical test of One Way ANOVA and KruskalWallis Hadith to analyze research data. The results showed that there were no differences in the number of eggs, larvae, and number of mosquitoes after sipermethrin exposure, but there were some pupae and survival of *Ae aegypti* mosquitoes after exposure to sipermetrin. Sipermethrin exposure can increase the number of *Ae aegypti* eggs and prolong *Ae aegypti* mosquito.

1 INTRODUCTION

Dengue hemorrhagic fever (DHF) is a disease caused by the dengue virus and transmitted by mosquito bites. Recently, problems of DHF cases have a problem classic it happens almost ascertained appear every year especially at the beginning of the rainy season (BLPK, 2015). In many countries tropical, dengue virus very endemic. In Asia, this disease often attacks in southern China, Pakistan, India, and all country in southeastern Asia since 1981. This virus found in Queensland, Australia. Along the east coast of Africa, this disease is also found in various serotype. Dengue has also spread throughout the Pacific Islands countries and areas. Between 2001 and 2008, the six most affected Pacific island countries and areas were French Polynesia (35869 cases), New Caledonia (6836 cases), Cook Islands (3735 cases), American Samoa (1816 cases), Palau (1108 cases) and the Federal States of Micronesia (664 cases). The total number of deaths for the six

island countries was 34 (official country reports). Although no official reports have been submitted to WHO by Kiribati, the country did experience a dengue outbreak in 2008, reporting a total of 837 cases and causing great concern among the national authorities and among some of the other countries in the region. Historically, dengue has been reported predominantly among urban and peri-urban populations where high population density facilitates transmission. However, evidence from recent outbreaks, as seen in Cambodia in 2007, suggests that they are now occurring in rural areas. Implementing the Bi-regional Dengue Strategy for Asia and the Pacific (2008--2015) is a priority following endorsement by the 2008 resolution WPR/RC59.R6 of the WHO Regional Committee for the Western Pacific (Clark, 2005).

Data from provincial health department central java in 2004 incidence rate was recorded at 19.2 / 10,000 population, In the year 2005 of 2,171 / 10.000, in the year 2006 of 3.39 / 10,000 population, then year

2007 increasing to 6,35 /10,000 , next year 2008 at 5,92 / 10,000 population and in 2009 is 5.74 / 10,000 population where higher incidence of the *incidence rate (IR)* 2 / 10,000 population. Data from the health department of Semarang city noted that the number of sufferers in the year 2008 as many as 5249 people with 18 people died (IR = 36,08 / 10,000 population and CFR = 0.3 %) , the number of sufferers year 2009 is about 3649 people with 42 people died (IR = 23,79 / 10,000 population and CFR 1.15 %) and the number of sufferers year 2010 as many as 5616 people and 47 people died (IR = 372,68 / 100,000 population and CFR = 0.8 %) (Dinkes Provinsi Jateng, 2009). The number of dengue cases in Indonesia fluctuates every year, in 2017 dengue cases were 17,877 cases with 115 deaths. Incidence Rate (IR) in 34 provinces in 2015 reached 50.75 per 100 thousand population, and IR in 2016 reached 78.85 per 100 thousand population. This figure is still higher than the national IR target of 49 per 100 thousand population (Kementerian Kesehatan RI, 2018).

An infectious disease caused by a vector until now still be a heavy burden for the majority of tropical countries including Indonesia. Infectious diseases through a vector especially because the bites of still endemic in many regions in Indonesia and claimed thousands of lives every year. Hence, needed a material potent, safer and cheaper (including insecticide) that can be used to control vector. The use of pesticides synthesis (use of chemicals synthetic) assessed practical, cheap and fast control has caused consumers to continue to consume these products. Mosquito controls the most do is controlled chemical consisting of an insecticide synthetic organic, organic natural and inorganic. An insecticide synthetic this work more effectively and the results can be seen quickly compared to control biological and physical (Sastrodihardjo, 1997). Means discharging repellent an assortment, burned with fire, evaporated with electricity, applied to the body or sprayed. Repellent fuel and electricity usually the only function repel mosquito, a repellent that which is smeared body function to prevent mosquito came upon of body skin. These three types of repellent as it does not kill mosquitoes, while that can kill a mosquito is repellent that is sprayed (Nurcahyono, 1999).

Comparison in the use of products an insecticide households indicated that most of the people use aerosol, The percentage of the use of aerosol, formula a liquid oil (oil-liquid formulations) by 77 %, repellent fuel is 62 % , repellent liquid of 13 % , and repellent electric was about 6 % (Boewono, 2007). One of the active used in formulation repellent aerosol is cypermethrin. Cypermethrin found in 1975.

An insecticide non systemic this works as a poison contacts and poison the stomach, the use of effective especially to control the Lepidoptera, the Coleoptera, Diptera, the Hemiptera, and other classes. Cypermethrin used in the agricultural sector, households, public health, and animal health (Djojsumarto, 2008). The use of cypermethrin very popular because of effectiveness and low price. A chemical structure cypermethrin resemble spiretrum (poison exterminator insects natural contained in chrysanthemum), with a capacity of poison an elevated biological and more stable poison other than natural. Cypermethrin classified world health organization (WHO) as a risk being (class II), because of its effects the nervous system stimulation (Badjuka, 2008). Preliminary research shows that the percentage of deaths of *Aedes aegypti* mosquitoes in aerosol mosquito repellent with active ingredients of sipermetrin, Raid®, and Tiga Roda Mortein® is 100%. The researchers conducted dilution on aerosol mosquito repellent with active ingredients of sipermetrin to determine differences in fecundity, fertility, and survival of *Aedes aegypti* mosquitoes after exposure to aerosol insecticides.

2 RESEARCH METHOD

2.1 Experiment Design

This research was an experimental study (quasi-experiment) with research used is post test only control group design. Treatment was given at a more group and done the measurement of after he received treatment. The difference between the results of measurement between the two groups showed effect treatment. This test is performed in the laboratory of the Center for Research and Development and Reservoir Vector Disease (B2P2VRP) Salatiga.

2.2 Instruments

Insect / Mosquito test: the mosquito maintained in big hall research and development vector and a reservoir disease (B2P2VRP) Salatiga city. The mosquito that used is *Aeaegypti* mosquito male and female 2-3 old days in full sucrose. Insecticide used in the trial is anti-mosquito aerosols uranium active cypermethrin. The trial using atomizer used to squirt insecticide into a glass chamber. Concentration an insecticide aerosol namely by way to measure solution an insecticide, taken each 1 ml, 0.75 ml, 0.05 ml, and 0.25 ml then dissolved in 100 ml water by concentration of the early 0.22 % the determination of concentration

calculated based on the formula: $v_1 \times n_1 = v_2 \times n_2$, so for each concentration used is 0,0055 ppm, 0,0110 ppm, 0,0165 ppm, 0,02220 ppm. Procedure: before testing glass chamber ascertained uncontaminated. Weighed heavily mosquito aerosol have diluted, then mosquito sprayed well as many as 10 times out the laboratory. After sprayed then repeated as many as three times and counted difference. Counted the number of sprays for testing with the formula.

Heavy mosquito aerosol before sprayed (w0) = ...gr
 Heavy mosquito aerosol before sprayed1 (w1) = ...gr
 Heavy mosquito aerosol before sprayed2 (w2) = ...gr
 Heavy mosquito aerosol before sprayed3 (w3) = ...gr

a. The average heavy mosquito aerosol that is sprayed:

$$= \frac{(w0-w1) + (w1-w2) + (w2-w3) \text{ gram}}{3 \times 10 \text{ spray}}$$

 =gram

b. The number of spraying

$$= \frac{\text{The average heavy mosquito that is sprayed (gram)}}{0,70 \text{ (gram)}}$$

 =times

Notes = 0,70 is standard in use B2P2VRP reference to upkv/uim/Malaysia

Then released 30 tail mosquito into glass chamber and awaited 1 minute, Mosquito sprayed according to calculation the number of sprays, observed for 20 minutes and noted the number of mosquito that dead or faint in any period of time. Afterward in holding for 24 hours and given cotton moistened 10 % sucrose. Then specify the percentage death mosquito *Ae aegypti* male and female. The mosquito that life did maintenance and fed blood marmot to produce sum eggs

- a. Measuring figures the number of eggs
 The number of eggs mosquito calculated based on the ovum produced by mosquito girl after subjected to the process of marriage. Calculation eggs are done every day for 8 days

- b. Measuring figures the number of larvae Ovum produced immediately taken and incorporated in a tray that contains water. Old Hatchery for ± 12 days and the calculation is done on larval instar III-IV. Eggs that hatch becomes larvae after ± 12 days regarded as the number of eggs that hatch and eggs which do not hatch become a larva regarded as egg not hatch.

- c. Measuring survive mosquito
 Many whose larvae survive (%) is the number whose larvae into a pupa, long whose larvae survive in the day is long whose larvae into a pupa, many the pupa who survive (%) is the number the pupa who became mosquito, long a pupa who survive in the day is long a pupa who became mosquito, Many mosquitoes that survive (%) is how many mosquitoes survive to die, and the length of mosquito that survive (day) is the length of mosquito that survive to die.

2.3 Statistical Analysis

Statistical test One Way ANOVA and KruskalWallishave used to analyze data research. ANOVA ($\alpha=0,05$) with an analysis of variance concentration of cypermethrin 0.0055 ppm, 0.0110 ppm, 0.0165 ppm, and 0.0220 ppm.

3 RESULTS AND DISCUSSION

Household insecticide efficacy is determined from the percentage of dead mosquitoes test after storage (holding) after insecticide exposure for 24 hours.

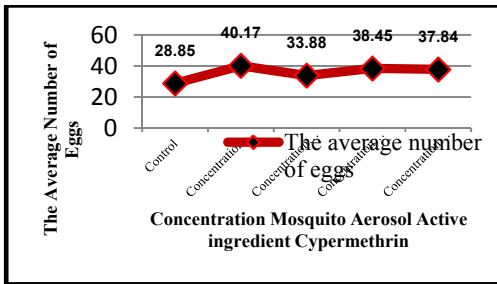
Table 1: Description The death of *Aeaegypti* after 24 hours Exposure holding Aerosol in Salatiga B2P2VRP Laboratory

Group intervention	Cypermethrin concentration (%)	Water volume (ml)	Ae aegypti Death						Total	Average	Percentage (%)
			U1	U2	U3	U4	U5	U6			
P1	0,0220 ppm	1000	20	22	27	25	25	26	145	24,2	80,6%
P2	0,0165 ppm	1000	18	21	18	21	22	20	120	20	66,7%
P3	0,0110 ppm	1000	20	24	22	17	23	23	129	21,5	71,7%
P4	0,0055 ppm	1000	16	14	7	21	17	16	91	15,1	50,6%
C	0	1000	1	1	0	1	2	1	6	1	3,3%

Where C = Control; P1-P4 = Various concentration; and U1-U6 = Repetition of each concentration.

Based on Table 1 it is known that the percentage of deaths in the highest concentration of 0.0220 ppm concentration was 80.6%. While at the lowest concentration on a concentration of 0.0055 ppm *Ae aegypti* mosquito mortality percentage was 50.6%.

According to Figure 1, the average mortality after 24 hours of exposure to mosquito aerosol active ingredient cypermethrin the highest concentration of 0.0220 ppm 24.2 tail, while the average in the lowest concentration of 0.0055 ppm of 15.1 tail and on average control by 1 tail.

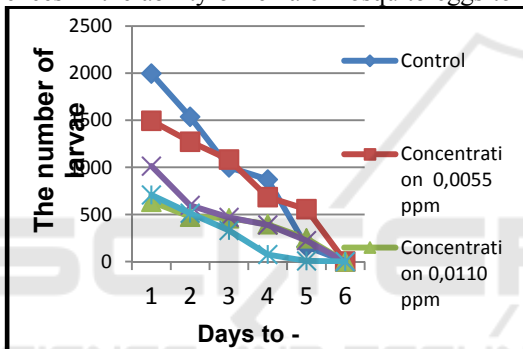


Figures 1: The Average Number of eggs

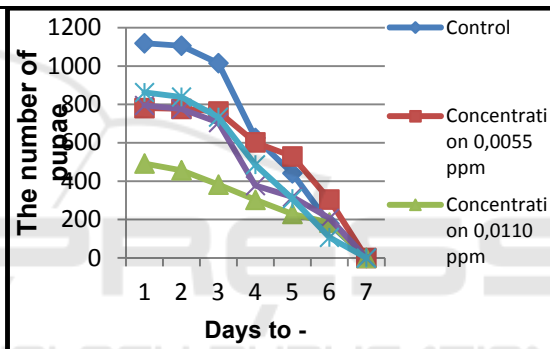
The average number of eggs highest after exposed mosquito aerosol active made cypermethrin of 40,17 the eggs in concentration 0,0055 ppm. While the average number of eggs lowest of 33,88 the eggs in concentration 0,0110 ppm, to control the average ovum produced of 28,85 eggs.

Differences in the number of eggs this shows differences in the ability of female mosquito eggs to

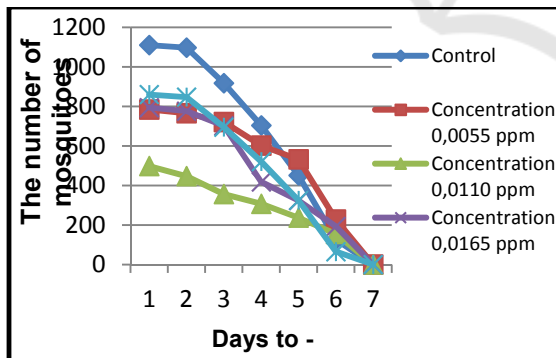
process become ripe and ready issued. In this ability and behavior, mosquito girls suck blood as nutrients maturation eggs very influential. Research conducted by Ullah et al. (2006) on female rabbit should be given treatment of cypermethrin where histology the changes observable in the ovaries of the rabbit proliferation of connective tissue in the cortex that causes decay epithelial along with the proliferation of connective tissue in the tissues of the uterus, so as to affect the reproductive system. While research conducted Jalal et al. (2010), of mammals mice male cypermethrin points to the harmful effects that cause a decrease in an enzyme on the biosynthesis of testosterone, so it influences the sexual behavior of the male. [12] The analysis showed ANOVA which means there is no difference the number of eggs *Ae aegypti* mosquito after being exposed to aerosol active ingredient cypermethrin among treatment with various concentrations of control.



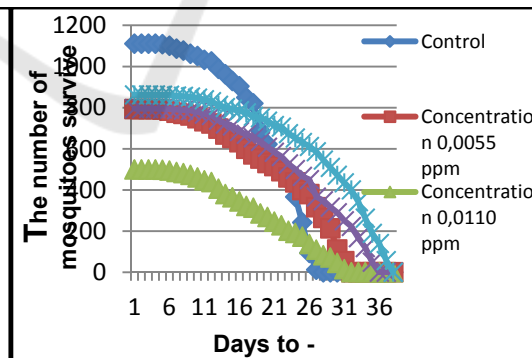
Figures 2: The number of larvae



Figures 3: The number of larvae



Figures 4: The number of Mosquito



Figures 5: The number of Mosquito Survive

Based on Figure 2 until Figure 5, the number of larvae days for all concentration levels are calculated for 6 days. The highest number of larvae at a concentration of 0.0055 ppm day 1 (1495 larvae). Lowest number of larvae at a concentration of 0.0110 ppm day 1 (635 larvae). The number of pupae per day to for all concentration levels are calculated for

7 days. The highest number of pupae the concentration of 0.0220 ppm on day 1 of 863 pupae. Pupae for all concentration the test and control is six days, and long a pupa survive for all concentration the test and control are 2 days. The Mosquito amount per day for all concentration levels are calculated for 7 days. The highest number of mosquito at a

concentration of 0.0220 ppm day 1 of 860 mosquitoes. *Ae aegypti* mosquitoes survive after exposure mosquito repellent active ingredient cypermethrin with various concentrations, calculated over 38 days beginning one day after pupae turn into

adult mosquitoes until all adult mosquitoes die. The percentage of mosquitoes survive is 100%. The number of mosquitoes days to survive the concentration is calculated for 38 days. While the control is calculated for 28 days.

Table 2: Data normality and homogeneity of eggs, larvae, pupae, mosquito and mosquito survive

Concentration	Eggs		Larvae		Pupae		Mosquito		Mosquito Survive	
	N	H	N	H	N	H	N	H	N	H
0,0220 ppm	√	x	√	x	√	√	√	x	√	x
0,0165 ppm	√		√		√		x		√	
0,0110 ppm	√		√		√		√		√	
0,0055 ppm	√		√		√		x		√	
Control	√		√		√		√		√	

Where N = Normality; H = Homogeneity; √ = Data normality or homogeneity; and X = Data Not normality or homogeneity.

Table 3: Analysis ANOVA difference the number of eggs, larvae, pupae, Mosquito and Mosquito Survive after aerosol exposure

Variable	p-value	Information
The differencethe number of eggs	0,850	Not Significant
The differencethe number of larvae	0,151	Not Significant
The differencethe number of pupae	0,000	Significant
The differencethe number of mosquitoes	0,980	Not Significant
Difference Mosquito Survive	0,044	Significant

Differences in the number of eggs this shows differences in the ability of female mosquito eggs to process become ripe and ready issued. In this ability and behavior, mosquito girls suck blood as nutrients maturation eggs very influential (Kusnawati, 2006). Research conducted by Ullah et al. (2006) on female rabbit should be given treatment of cypermethrin where histology the changes observable in the ovaries of the rabbit proliferation of connective tissue in the cortex that causes decay epithelial along with the proliferation of connective tissue in the tissues of the uterus, so as to affect the reproductive system. While research conducted Jalal et al. (2010) of mammals mice male cypermethrin points to the harmful effects that cause a decrease in an enzyme on biosynthetic testosterone, so it influences the sexual behavior of the male. In pregnant female animals in the laboratory by the treatment of cypermethrin effect on their offspring. In pregnant rabbits treated with cypermethrin resulted in an increased number of the organs and caused abnormalities in the offspring framework. In rats treated cypermethrin also can lead to the development of the appearance of the teeth, open your eyes and certain progress is slow. It also carried out on male rats by cypermethrin show adverse effects on the reproductive system, namely the proportion of abnormal sperm are increased and with increasing concentrations of cypermethrin. Another study also showed an increase in the

concentration of protein in the testes and disrupting the function of sex hormone (Cox, 1996). The analysis showed ANOVA value p-value = 0,850 > p. sig 0,05) which means there is no difference the number of eggs of *Ae aegypti* mosquito repellent after being exposed to aerosol active ingredient cypermethrin among treatment with various concentrations of control.

The difference in the number these larvae can cause by because at the time when maturation eggs, a mosquito to lack of protein intake in full of the blood that her, So although eggs formed but after he was born cannot have developed, or hatch becomes a larva. Sufficiency protein in every eggvary depending upon the number of the proteins in the blood which is inhaled by mosquito girl (Depkes RI, 2008). The analysis showed p-value = 0,151 > p. sig 0,05) which means there is no difference the number of larvae *Ae aegypti* mosquito after exposed to aerosol active ingredient cypermethrin between treatment with a variety concentration and control. This research in accordance with research conducted by Purnomo (2001) of the influence of selection malathion on mosquitoes *Ae aegypti* to power eggs shows that power eggs selected with malathion the organophosphate to 20 generation the gnat does not affect or no different significant.

This research much different from research conducted by Siswiyowati (2008) the number of eggs

mosquito *Ae aegypti* that hatch the results of exposed mosquito aerosol with the active propoxur and transfluthrin of 82,33 %. Long days required by for the larvae survive was 6 - 15 days. It is less according to research Sihite(2010) in repellent sear with the active ingredient transfluthrin and d-alethrin that long pupae 6 -11 days. The results of the analysis showed value = 0,000 < p. sig 0,05) which means there is a difference of the number of pupae *Ae aegypti* mosquito after exposed to aerosol active ingredient cypermethrin between treatment with a variety concentration and control. This research not according to research conducted by Purnomo (2001) about the effects of the selection malathion on mosquitoes to the development of larvae into a pupa shows that success larva develops into a pupa selected competent malathion organophosphate with the to 20 generation gnat does not affect or similar significant.

Long days required by to a mosquito are 2- 15 days. It is less according to research Sihite(2010) in repellent sear with the active ingredient transfluthrin and d-alethrin that long a pupa survive consisting of 3 -11 days. Test normality the number of mosquitoes before and after transformation data using Shapiro-Wilk suggests that the concentration 0,0110 ppm and concentration 0,0220 ppm not normal. The analysis showed $p\text{-value} = 0,980 > p. \text{sig } 0,05$) which means there is no difference the number of mosquito *Ae aegypti* after exposed to aerosol active ingredient cypermethrin between treatment with a variety concentration and control. Research in accordance with research conducted by Purnomo(2001) of the influence of selection malathion on mosquitoes *Ae aegypti* to successful eklosi (the pupa changed into adult mosquito) shows that the success of selection eklosi with malathion the organophosphate to 20 generation the gnat does not affect or no different significant.

Ae aegypti mosquito survives that is exposed to aerosol active ingredient cypermethrin is 100 % on all treatment concentration. The higher concentration cypermethrin so longer mosquito to die. Long days required by *Ae aegypti* mosquito survive on concentration 0,0220 ppm is 38-day, *Ae aegypti* mosquito survive on the concentration 0,0165 ppm is 37 day and long days needed mosquito ae mosquito to survive on concentration 0,0110 ppm concentration and 0,0025 % is similar 32 day. While long days needed mosquito ae mosquito survive in control is 28 days.

Results of the analysis showed $p\text{ value} = 0,044 < p. \text{sig } 0,05$) which means there is a difference in mosquito survive after is exposed anti-mosquito aerosol active made cypermethrin between treatment a variety concentration and control. Research conducted by Sihite (2010) on exposure against mosquitos *Ae aegypti* adult that mosquitos *Ae aegypti*

exposed to cause fertility, (long live this life mosquito).

4 CONCLUSION

Based on the result of this research can be concluded that mosquitos *Ae aegypti* who has is exposed anti-mosquito aerosol active made cypermethrin can multiply the number of eggs and the higher concentration, the longer mosquito survive.

The results as follows: there is no point differences fecundity mosquito *Ae aegypti* after is exposed anti-mosquito aerosol active made cypermethrin with a variety concentration between treatment by control. There is no point differences the number of larvae mosquito *Ae aegypti* after is exposed anti-mosquito aerosol active made cypermethrin with a variety concentration between treatment by control. There is a difference the number of pupae after is exposed anti-mosquito aerosol active made cypermethrin with a variety concentration between treatment by control. There is no difference the number of a mosquito after is exposed anti-mosquito aerosols uranium active cypermethrin with a variety of concentration between treatment by control. There is a difference mosquito survive after is exposed anti-mosquito aerosols uranium active cypermethrin with a variety of concentration between treatment by control.

Advice for the namely the use of chemical doses insecticide in circulation too high and least possible harm not using insecticide is constantly for causing mosquito be old age, add eggs. The concentration it cannot be used forever for some time fore can cause resistance to mosquitoes. Community more attention to the impact of the use of the chemical insecticides for the environment, man and insects.

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