Aedes aegypti Mosquito Breeding in Various Water Media (A Study on Adaptation of *Aedes aegypti* Mosquitoes in Several Growing Media)

Suyud Warno Utomo[1*], Guntur Agus Triwibowo[2]

[1]Department of Environmental Health, Faculty of Public Health
University of Indonesia

[2]Center for Research of Human Resources and The Environment, Postgraduate Program, University of Indonesia
[2]Department of Environmental Health, Faculty of Public Health
University of Indonesia

[*]*Corresponding author's email: suyudwarno [AT] gmail.com*

ABSTRACT-----***Aedes aegypti is a type of mosquito which can carry dengue virus, the cause of dengue fever and can also carry the chikungunya virus and yellow fever. is known to have a medium to grow only in clean water. Environmental changes due to the rapid development have occurred, while the dengue fever is also widespread. It is feared that might have adapted to the environment. The breeding of mosquitoes should be reviewed as input in making a policy of the dengue mosquito control. This research was conducted by growing some mosquito eggs in various media to know the ability of the mosquito eggs to hatch and breed. The water media used here were ground water as a control, rain water, cloth wash water, bathroom waste water, rain water with 80 gr soil, rainwater with the 160 gr soil, the cloth wash water with 80 gr soil, cloth wash water with the 160 gr soil, bathroom waste water with 80 gr soil, bathroom waste water with 160 gr soil. This research is a quasi experimental. Twenty five eggs of A.aegypti were put into each container in which each treatment was repeated three times. The results were analyzed by looking at the graph of observation, showing that can breed in water media in direct contact with the ground. The highest average number of larvae can live in bathroom waste water with 160 gr soil which is an average of 18 on larval stage, 18 pupal stage and 18 adult stage. From the analysis given, it can be concluded that the A.aegypti mosquitoes can breed well in polluted water in direct contact with the ground. Further in-depth study of the behavior changes in the breeding grounds of the needs to be carried out by which the control program can be well targeted.***

Keywords---- *Aedes aegypti*, hatchability, control

---

1. INTRODUCTION

The rapid development today has brought drastic changes in the environment, including the change in the breeding places of mosquito. is a type of mosquito that can carry dengue virus, the cause of dengue fever. Mosquito is also a carrier of *chikungunya* and yellow fever virus (1,8). mosquitoes are spreading very widely in which they are found throughout the tropic and sub-tropic areas, between 35^0 North Latitude and 35^0 South latitude (2).

Dengue hemorrhagic fever (DHF) in Indonesia first occurred in 1968 in Surabaya City where 58 people were infected by this virus and 24 of them died (41.3%). Since 1968 there has been increasing spread of the number of provinces and districts/cities which became DHF endemic, increasing from 2 provinces and 2 cities to 32 (97%) and 382 (77%) districts/cities in 2009. The number of cases increased sharply from 58 cases in 1968 to 158,912 cases in 2009 (3).

The preferred habitat of is water reservoirs inside and outside the house, gutters, axillary, the base of bamboo strips, as well as a temporary reservoir like a barrel, drum, old tires, tin cans, bottles and plant pots. All these habitats contain relatively clean water. also breed well in rock holes and tree holes (4). Sudarmaja (5) in his research in the laboratory showed that eggs can breed well in soapy water and can grow faster when compared with the clean water. In the study conducted by Anies using contaminated water media, such as ground water, sewage, tidal water and storm water as a control to determine the hatchability of eggs of , it is concluded that sewage is the most effective type of water to hatch the eggs of (6). Results of the research conducted by Somes (7) found that the septic tank in Puerto Rico could become breeding places of mosquitoes.

Several studies have shown that the mosquitoes have had a good adaptability to the water media in contact with the ground. The Officer of Health Office of Port Class I Soekarno Hatta, Wilker Halim in the larvae survey in the airport area

of Halim also has found larvae of in plant pots in direct contact with the ground (8). It is also supported by the results of the research by Upik Kesumawati Hadi, stating that the behavior of the mosquito (vector) of DHF began to change (9)

Regarding the description given above, the mosquitoes have the ability to adapt to polluted water and have a direct contact with the ground as breeding media. Therefore, it is necessary to perform further research on the adaptability of eggs in which they can hatch in various breeding media.

2. RESEARCH METHOD

Research Design

The method used in this study is a quasi-experimental research as the researchers made intervention against the object of research at the Entomology Laboratory of the Health Office of Port Class I Soekarno Hatta.

Sample

The sample used in this research is the Aedes aegypti eggs obtained from the Laboratory of Health Entomology Parasitology of Bogor Agricultural Institute. To increase the level of confidence and minimizes errors, the experiment will be repeated several times. The number of replications performed in this study is calculated by the Feederer formula quoted from Supranto J (10).

$$(t-1)(r-1) \geq 15$$

$$(9-1)(r-1) \geq 15$$

$$(8)(r-1) \geq 15$$

$$8r-8 \geq 15$$

$$8r \geq 23$$

$$r \geq 2{,}87 = 3$$

t (*treatment*) = number of treatments
r (*replication*) = number of replications

Thus, there are three replications and nine treatments.

Location and Research Time

This research was conducted at the Entomology Laboratory of the Health Office of Port Class I Soekarno Hatta from December 2014 until completion.

3. RESULTS

Overview of the Research

The laboratory room is measuring 4 x 7 meters, the average room temperature is 29.3°C with an average humidity of 74.4% and room lighting 15 lux. The 300-ml plastic containers are used as a water media container for mosquito breeding in this study. There are nine treatments and one control of ground water; thus, there are total 10 treatments and three replications, so that total 30 containers are prepared in the study. The addition of the soil is done by weighing 80 gr and 160 gr obtained from the soil around the ditch which is still loose and taken from the Halim PK Complex.

Each container is supplemented with the breeding water to volume of 250 ml, followed by measurement of the temperature and pH of each container, and then recorded. Total 25 of eggs were counted and put into each container and then covered with gauze and tied using a rubber band. Growth of was observed every 24 hour. Besides that, any changes in the pH, temperature, humidity and lighting were measured as well.

Observation

The observation showed that the growth of in ground water media from the eggs hatch to larvae takes 1-2 days, but larval growth was less optimal. The growth of the larvae to become pupae takes 7-8 days, whereas growth of the pupae to become adult mosquito takes one day. In this study cannot grow in rainwater media, cloth wash water medium, cloth wash waste water medium supplemented with 80 gr soil and cloth wash waste water media supplemented with the 160 gr soil. Eggs cannot hatch into larva, pupa and adult mosquitoes. However, with the addition of 80 gr and 160 gr soil, the rainwater media can become a medium for growth of . eggs to hatch into the larval stage takes 2 days, from the larval stage into a pupal stage takes 7-9 days, whereas from the pupal stage into adult mosquitoes takes 1-2 days.

In this study, can grow well on the waste water medium of the bathroom. The eggs can hatch into the larvae on day 1-3; the larva stage change into a pupal stage takes 6-7 days, whereas from the pupal stage into the adult stage takes 1-2 days. Waste water media of bathroom with the addition of 80 gr soil constitutes a good medium for the growth of the *A. aegypti* mosquitoes. The growth of the larva stage begins on the first day and experiences the peak phase of growth on the fourth day, namely with an average of 15.3 larvae and takes four days to become a pupal stage, while the pupal stage to the adult stage takes 1 day, whereas the observation indicated that the waste water media with the addition of 160 gr soil is a good medium for the growth of Aedes aegypti. The eggs hatched on the first day, the larva changes into a pupal stage takes 4-8 days, while the change into the adult stage takes one day.

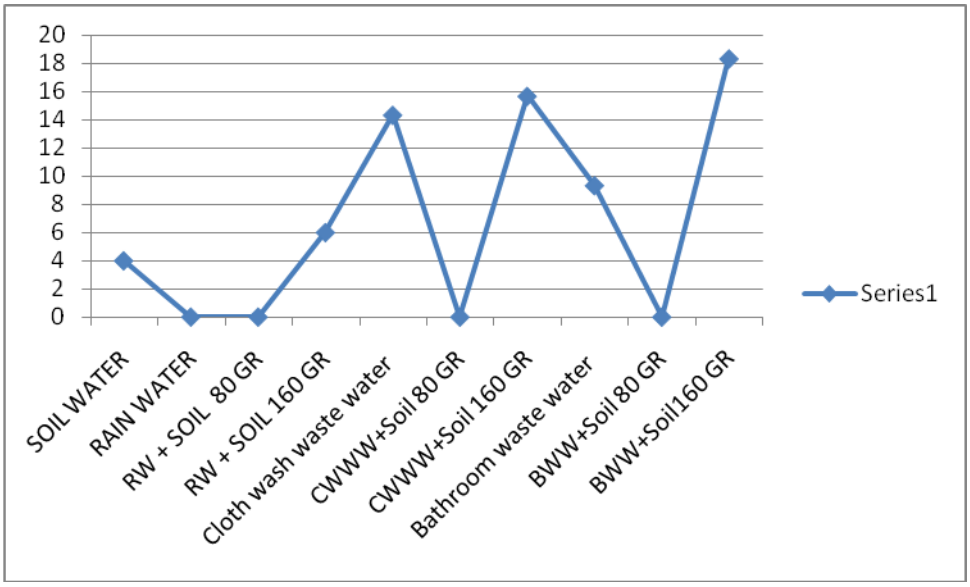

Figure 1 : Graph of means for larval growth of each water media

The figure 1 shows that the bathroom waste water + 160 gr soil represents the best and optimal media for growth of the mosquitoes, followed by the bathroom waste water + 80 gr soil and bathroom waste water.

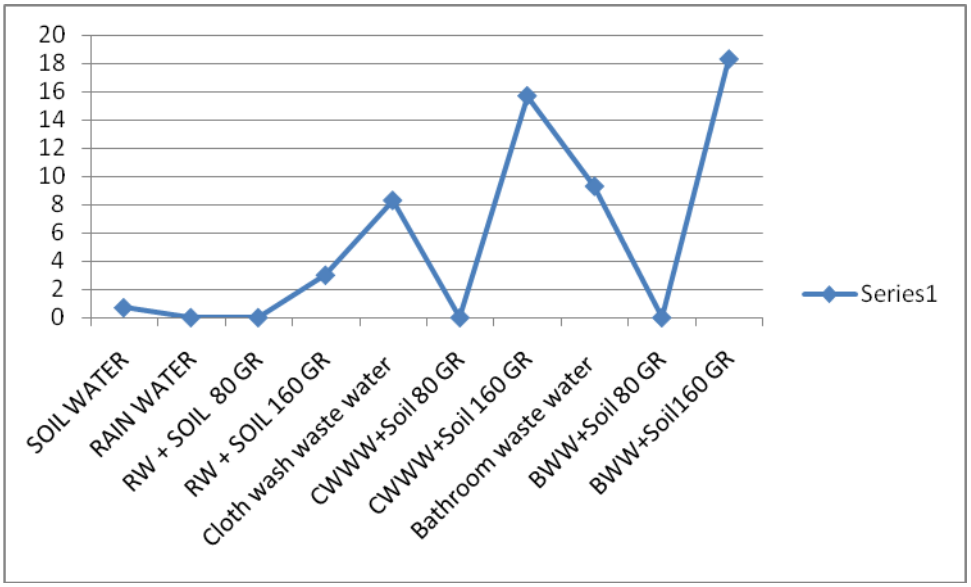

Figure 2 : Graph of means for pupal growth of each water media

Figure 2 shows that the pupal stage in this study grows most optimally in bathroom waste water media + 160 gr soil, followed by bathroom waste water media + 80 gr soil and rainwater media + 160 gr soil.

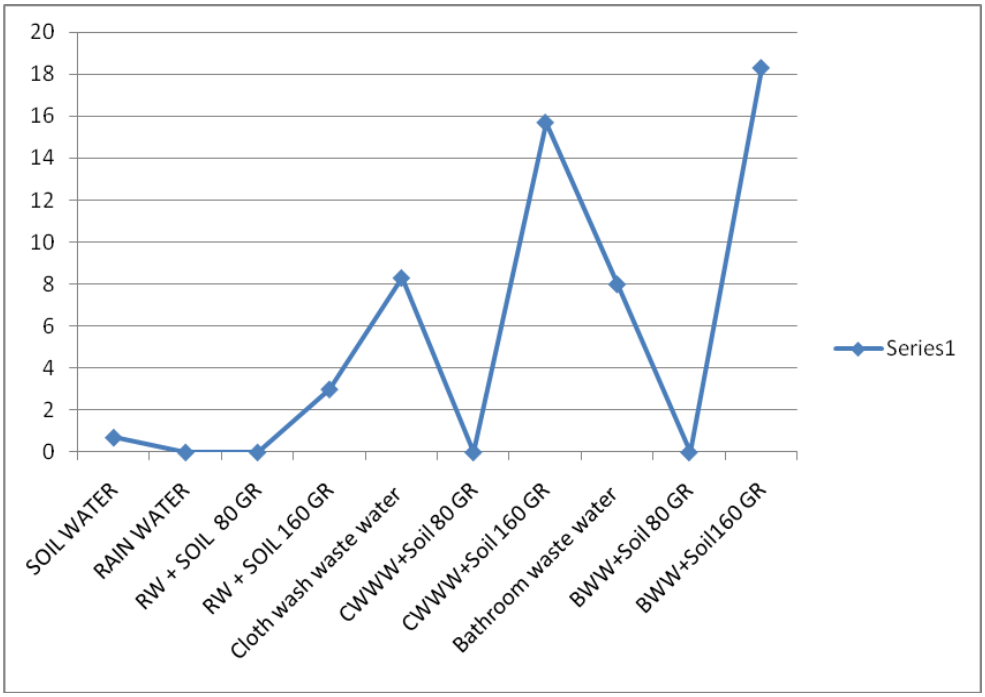

Figure 3: Graph of means for adult mosquito growth of each water media

Figure 3 shows that the adult stage grows most optimally in bathroom waste water media + 160 gr soil, followed by bathroom waste water media + 80 gr soil and water rain media + 80 gr soil.

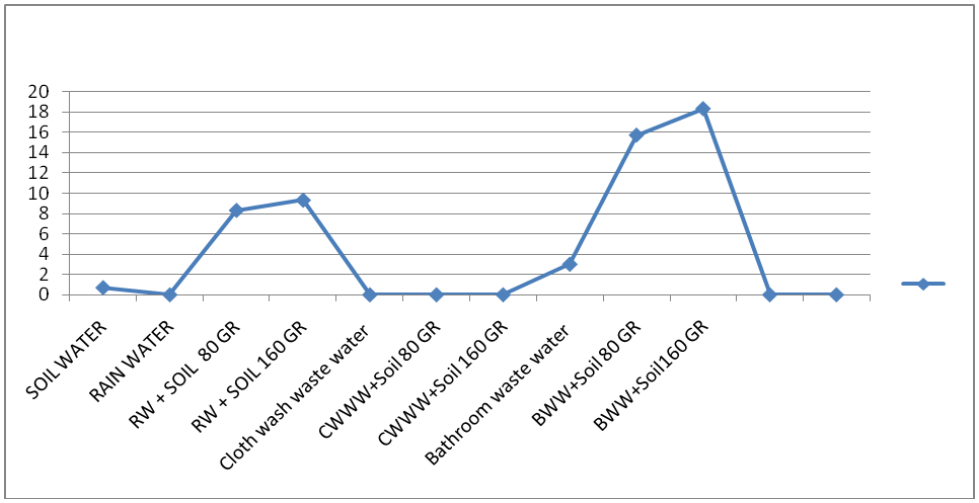

Figure 4: Graph comparing the water media + 80 gr soil and 160 gr soil

Figure 4 indicates that the breeding water media will have a significant effect on the growth of when supplemented with the soil, the more soil the more optimal growth.

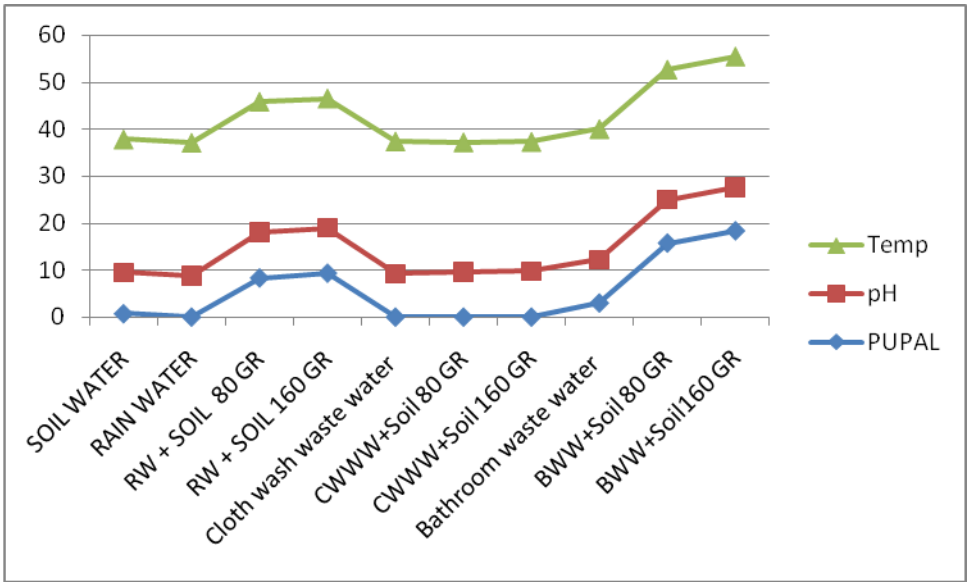

Figure 5: Graph comparing the average pH, water temperature and pupal growth

Figure 5 shows that the breeding water media of rainwater + 160 gr soil has the lowest temperature by 27.5^{o}C and the rainwater media has the highest temperature by 28.4^{o}C, while the rainwater media has the lowest pH at 8.7 and rainwater media + soil has the highest PH at 9.7.

4. DISCUSSION

Results of Research

Groundwater media containers

Groundwater media is used as a control in this study because we consider that mosquitoes can breed better in this water media. Groundwater media used in this study were taken from the Halim Pk area which is one of the endemic areas in East Jakarta. After measuring the average pH in the groundwater media by using a pH meter, it showed that the pH is 8.8, in which it is alkaline, not optimal pH for growth of eggs, while the optimal pH for the growth of eggs is 7 (11). Water surface temperature is 28.3^{0}C, room temperature of 29.3°C and humidity of 61.2%. This temperature is the optimal temperature for growth of mosquitoes (12.13). The number of eggs hatched from three times replications are the average of four eggs, 1 pupa (Figure 2) and 1 adult mosquito (Figure 3). in the control media do not grow optimally, where it could be due to the poor nutrition needs for the development of the larvae. (14).

Rainwater media container

The treatment media of rain water is not a good medium for the growth of mosquitoes, because no eggs are hatched in this medium, this is because the pH of rainwater obtained from rainwater reservoir in the Halim area is 8.7 (Figure 5). This pH tends to be alkaline, exceeding the optimal pH for growth of the mosquitoes, which is pH 7 (11). Furthermore, the average temperature of the water surface as showed in Figure 5 is 28.4^{o}C, the research room temperature at 29.3^{o}C and average humidity of the research room at 61.4% which is the optimal humidity for the growth of mosquitoes (12). However, note that the pH of this rain water medium is unlike most acidic rain water, but when this media is supplemented with 80 gr soil and 160 gr soil, it can become the breeding place of (Figure 4).

The addition of 80 gr soil and 160 gr soil in this treatment is done to determine whether there are changes in the growth habits of where they commonly only like to breed in a clean water not direct contact with the ground (15). Results of this treatment will drastically change the concept of the knowledge that the mosquitos just like to breed in the clean place not in direct contact with the ground, while the results of the research indicated that this medium is capable of being the optimal medium for mosquito growth with an average larvae produced by 14.33 (Figure 1) with three times replications, and an average pupa of 8.3 (Figure 2) and adults of 8.3 (Figure 3).In addition to the old theory is no longer relevant, the addition of soil is also made possible because the soil has a lot of nutrients and nutritions in supporting the growth of (16).

Cloth wash waste water media container

The treatment media of cloth wash waste water is obtained by collecting the your laundry residue of the washing machine containing residual detergent and dirts adhered to the clothes. Results of this media treatment is the same as a result of the media treatment of rain water where no larva managed to grow; despite the addition of 80 gr soil and 160 gr

soil, they could not grow well. This may be due to the fact that this media contains detergent, containing a disinfectant material, thereby it adversely affected the ability of the eggs to hatch, these results are consistent with the study conducted by Sudarmaja in 2009, saying that eggs are not able to grow in detergent water (5)

Bathroom waste water media container

Three pupae grow in the bathroom waste water media without addition of the soil. The number of pupae increases to 15.7 when the media is supplemented with 80 gr soil, and the number of pupae increases to 18.3 when the media is supplemented with 60 gr soil (Figure 4).This media becomes a favorable place to grow because it contains nutrient to meet the needs for food for the larvae in bathroom wastewater media and the addition of soil containing organic substances (14).

Data analysis

The graph 4 shows that the breeding water media which is the most optimal to support the growth of is a bathroom wastewater medium plus 160 gr soil; thus bathroom wastewater should be taken into account seriously because every household inevitably produces waste water from the bathroom. This strongly supports the growth of mosquitoes in the neighborhood houses. This relevant to the results of the research by Upik Kesumawati Hadi (9)

Implications for Health

Results of this study are expected to provide more comprehensive information about the ability of mosquitoes to breed in dirty water in direct contact with the ground. These results of this study are expected to change the old paradigm, stating that mosquitoes thrive only in clean water without no direct contact with the ground.The mosquito control programs must adapt to the habits of mosquitoes breeding. The mosquitoes not only can grow in the clean water but also in the water reservoirs, especially domestic wastes.

The increased knowledge about the environmental health, especially wastes that can be used to breed by the mosquitoes should be promptly delivered and promoted. Knowledge of environmental health including environmental sanitation must be prioritized. Preventive policy should also be adjusted thereby the health workers of Environmental Health in the field is more accurately in providing counseling services.It is very essential to increase knowledge and education about environmental health to the Environmental Health staff about changing behavior of mosquitoes which can breed in dirty water media in direct contact with the ground, where according to the old concept, they can only grow in clean water media.

5. CONCLUSION AND SUGGESTION

Conclusion

1. Eggs can hatch into larva, pupa and adult in the bathroom waste water, rain water with soil, bathroom waste water with the soil but they cannot hatch on rain water, cloth wash water and cloth wash water with soil.
2. The most optimal water media for growth of is the bathroom waste water + 160 gr soil at an average of 18.33 larvae.
3. Mosquitoes in this study can grow well in dirty water in direct contact with the ground.

Suggestion

1. For the Ministry of Health of the Republic of Indonesia should do further researches to ensure that the mosquitoes have been able to adapt to dirty water and direct contact with the ground and various combinations of water media.
2. It is necessary to increase knowledge and education for Environmental Health staff about changes in the growing behavior of mosquitoes in which we have known for a long time that they can only grow in the clean water; however, the results of the current study proved that they are able to multiply in dirty water and contact with the ground.
3. People should be more cautious against mosquitoes that are capable of breeding in dirty water and direct contact with the ground.

6. REFERENCES

1. WHO, 2005. *Pencegahan dan Pengendalian Dengue dan Demam Berdarah Dengue. Panduan Lengkap*. Alih bahasa: Palupi Widyastuti. Editor Bahasa Indonesia: Salmiyatun. Cetakan I. Jakarta: Penerbit Buku Kedokteran EGC. hal 58 – 77
2. Hasanuddin, 2005. *Uji Kerentanan terhadap Malathion dan Efektifitas Tiga Jenis Insektisida, Propoksur Komersial di Kota Makassar*. Jurnal Med.Nasional .26 (4), 235 – 239.
3. Kementerian Kesehatan RI. 2010. *Buletin Jendela Epidemiologi.* Jakarta : Pusat Data Surveilans Epidemilogi Kementerian Kesehatan RI. Vol 2, Agustus 2010

4. Vezzani D, Rubio A, Velazquez SM, Scheigmann N, Wiegand T. *Detailed Assessment of Microhabitat Suitability for (Diptera: Culicidae) in Buenos Aires, Argentina*. Acta Tropica 2005 95: 123-131
5. Sudarmaja, I Made., 2009. *Pemilihan Tempat Bertelur Nyamuk pada Air Limbah Rumah Tangga di Laboratorium.* Jurnal Veteriner Vol. 10 No. 4 : 205-207
6. Pandujati, Anies. 2009. *Daya Tetas Telur pada Air Tercemar*. Undergraduate Theses dari Universitas Muhammadiyah Semarang diakses dari digilib.unimus.ac.id pada 29 November 2014.
7. Somes, Gerard. 2011. *Genetics and morphology of in septic tanks in Puerto Rico*. Yale University, ProQuest, UMI Dissertations Publishing, 2011. 1505374
8. Christophers SSR. 1960. *Aedes aegypti (L) The Yellow Fever Mosquito*. Cambridge At the Univ. Press. London
10. Supranto, J. 2000. *Teknik Sampling untuk Survei dan Eksperimen*. PT Rineka Cipta, Jakarta
11. Sukamsih.2006. *Perbedaan Berbagai pH Air terhadap Kehidupan Larva Nyamuk di Laboratorium Balai Besar Penelitian Vektor dan Reservoir Penyakit Salatiga Tahun 2005.*Undergraduate Theses dari Universitas Muhammadiyah Semarang diakses dari digilib.unimus.ac.id pada 28 Oktober 2014
12. Misnadiarly. 2009. *Demam Berdarah Dengue (DBD)*. Jakarta: Pustaka Populer Obor.

13. Dickerson, Catherine Zindler. 2007. *The Effects Of Temperature And Humidity On The Eggs Of Aedes aegypti (L.) And Aedes Albopictus (Skuse) In Texas.* ProQuest UMI Number: 3296363
14. Kementerian Kesehatan RI. 2011. *Informasi Umum DBD.* Jakarta : Kementerian Kesehatan RI
15. Nelson and Pnat., 1976. *Observation on The Breeding Habitat of Aedes aegypti in Jakarta*, New York : WHO Vector and Rodent Control Research Unix Vol. IV No. 1&2

16. Azizah Susilawati, Siti. 2014. *Modul Kuliah Geografi Tanah*. Solo ; FKIP Prodi Geografi UMS