Title

Study of the pH water that affects the hatching rate survival rate and size of Aedes mosquitoes.

Student Name

Mr.Phuwit Thongjerm

Mr.Passawut Maikaen

Teacher Name

Mrs.Patchara Pongmanawut

Mrs.Pacharee Chaipetch

School Name

Princess Chulabhorn Science High School Trang

Country

Thailand

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Abstract

The purpose of this project is to investigate the *Aedes* mosquito size in natural sources and pH, The hatching rate, survival rate, life cycle and size of mosquitoes by visiting the region to investigate natural mosquito breeding areas. Set up six containers in the lab, three for each experiment, with a pH 4 to 9. Fill with ten mosquito eggs, then regulate the temperature. The mosquitoes had the longest average length in nature is pH 8. The highest incubation rate, pH 6 and pH 7. Mosquitoes at the larval stage had the longest survival rates in pH 7 and 8 and did not able to flourish at pH 9. The Aedes mosquito's life cycle at pH 7 and could not grow at all in pH 9. Furthermore, it was discovered that mosquitoes in both the larval and larval stages had the longest average lengths in pH 7. Additionally, when comparing the length of mosquitoes in the nature and a study assessing the size of insects in natural water with varying pH values agreed with each other. The size of Aedes mosquitoes is influenced by the pH of the water. The longest larvae were discovered to have the highest average length among those at pH 7. The size tends to shrink in acidic water. The average length was comparable in the larvae stage, with the adult stage at pH 7 having the longest average length, and pH 5 having the smallest average length. It was discovered that there is a continuous relationship between the two: *Aedes* mosquito sizes decrease when water pH approaches an acidic level.

Keywords: survival rate, life cycle, and *Aedes* mosquito

Introduction

Many nations continue to struggle with the public health issue of dengue hemorrhagic fever (DHF), an infectious disease brought by the dengue virus (Denge Virus), a family of arboviruses. There were five times as many patients between January 1 and February 1, 2023, compared to the same period in the previous year (Department of Disease Control, 2023). A dengue fever infection might cause major consequences. The illness is spreading rapidly. Additionally, the number of patients has significantly increased due to the transmission of disease by mosquitoes or blood-sucking insects. Growth is significantly influenced by the water quality in the area that serves as a breeding ground. Another issue is the growing air pollution brought by the industrial sector's growth. Gases released during the burning of fossil fuels are to blame for this. Burning coal in the electrical sector emissions of waste products and harmful gases, such as those produced during engine combustion. into the atmosphere Rainwater will contaminate such hazardous gasses when there is an excess of them. This leads to an acid rain phenomenon, which is characterized by a shift in the pH level of precipitation. Different sources of water Additionally, there will be changes in the communal area. Rainwater may have a pH of 4.2 to 4.4 in some highly polluted places (United States Environmental Protection Agency : EPA, 2023

Insects that can grow and undergo full form changes are called mosquitoes. A mosquito's life cycle consists of four stages: the egg, larvae , pupa , and adult. In Thailand, mosquitoes are a major vector for the spread of dengue illness. They prefer to reside inside or close to the house. Aedes mosquitoes can breed from the following sources: artificial water container. Water is essential to mosquito life because it fosters the growth of eggs, larvae, and pupae (Harbach, 2007). The water source's pH is a crucial consideration. influencing mosquito growth and life cycle (Malcol E., 2009)

The organizing committee understands the significance of researching water quality parameters that impact Aedes mosquito size and survival rate which in this instance is the water's pH value changing. Future trends in mosquito size that are associated with variations in pH planning how to cope with this kind of disease-carrying bug will benefit from this. Initial life cycle length estimation Including additional advancement into cutting-edge facilities. in connection with mosquito size to keep insects away.

Research questions

1. Does the pH of natural water sources affect the *Aedes ssp*. size ?
2. Does the pH affect the hatching rate?
3. Does the pH affect the survival rate?
4. Does the pH affect the life cycles ?
5. Does the pH affect the size ?

Purpose

1) To investigate the *Aedes ssp*. Size in the natural water sources.

2) To investigate the relationship between pH and the *Aedes* mosquito hatching rate.

2) To investigate how the pH of the water influences the *Aedes* mosquito's survival rate.

3) To investigate how the pH of the water influences the mosquito life cycle

4) To investigate the connection between mosquito size and water pH.

Hypothesis

1) The size of *Aedes* mosquitoes in natural water sources is influenced by with pH.

2) The hatching rate is influenced by pH.

3) The survival rate is influenced by the pH.

4) The life cycle is influenced by the pH.

5) The Mosquito's size is influenced by the pH.

Research Methods and Materials *:*

1) *Aedes* mosquito eggs.

2) Camera and lens

3) Clear Container for cultivation.
Size 7.5 × 7.5 × 15 cm 18 containers

4) Distilled water

5) Calcium carbonate (Ca(OH)2).

6) Acetic acid (CH3COOH)

7) pH meter.

8) Thermometer

9) Vernier caliper digital.

10) Dropper

11) Light microscope

12) Beaker

13) Spatula

14) Pig's kibble (pork feed)

15) Filter cloth

16) Stirring rod

Method

Section 1 : Field Investigation of Natural Mosquito Breeding Grounds

1. Study site

The Sikao District and Palian District were the study site. Located at 7°34′18°N 99°20′42°E and 7°10′18°N 99°41′12°E, Trang Province is a community region with a high dengue fever rate as shown in figure 1.

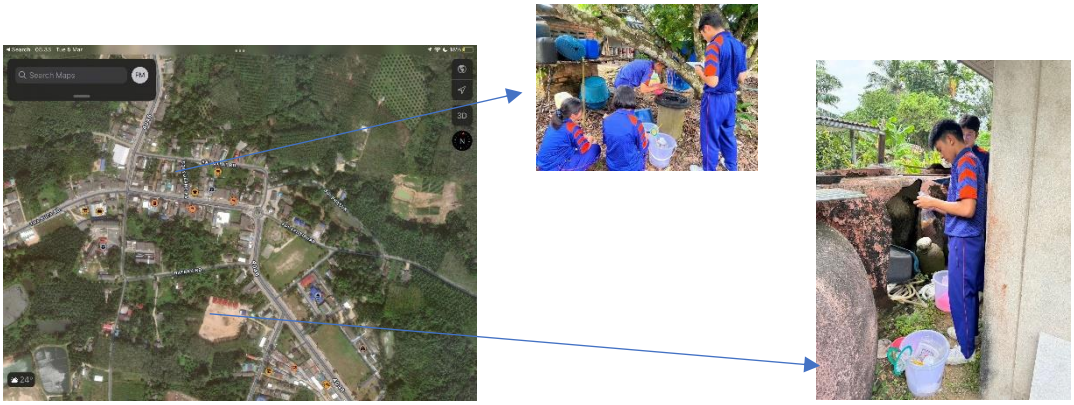

Figure 1 : shows the study site

2. Sample Collection

2.1) Use the Mosquito habitat mapper app to gather information on water pH, larvae, and categorize the different kinds of mosquito larvae in natural water sources. This will allow to conduct an area survey of natural mosquito breeding sites in two districts in Trang Province: eight households in Palian District and five households in Sikao District.

2.2) Gather samples of larvae from naturally occurring water , return them, raise them and then measure the size of the mosquitoes to compare their size with the mosquitoes in section 2. Record data into GLOBE Mosquito Habitat Mapper shown in figure 2.

Figure 2 : Shows recorded data into GLOBE Mosquito Habitat Mapper

Section 2 : Experiment the Aedes mosquito in pH 4-9.

2.1) Soak the paper used to collect *Aedes* mosquito eggs in water to prepare a water tray for sorting the eggs. The mosquito eggs will be able to drop off the paper as a result.

2.2) Create a clear glass box of 7.5 x 7.5 x 15 centimeters and divide it into 6 experimental sets with different pH values (4,5, 6, 7, 8, and 9). This will serve as the container for storing Aedes mosquito eggs. Create three sets of experiments in each of pH 4-9. Pour 500 cc of deionized water into the container. Using acetic acid and calcium carbonate, bring the pH of the water in each container down to 4–9. Fill each container with ten mosquito eggs, then regulate the temperature. Keep track of the outcomes and observe the changes.

2.3) Throughout the experiment, make sure to regularly check the water's temperature and pH level. Adjust the temperature and pH level to stay the same if there are any changes.

2.4) Grind the pork feed till fine. It consumed as food by adding 0.2 mg of food to each container (a larva should receive 0.02 mg of food).

2.5) Using the Mosquito Habitat Mapper App, gather data by noting the number of larvae or larvae at each stage of death, the shape and characteristics of the mosquitoes, and the number of days the mosquitoes have changed in each stage.

2.6) Calculate the size by using a digital Vernier caliper, measure the size of the larvae by sorting them out of the container. Using the Pipette Isolate Technic and setting up a container for the purpose of gathering data on larvae size. Observe and note the outcomes.

3) Data analysis : ANOVA Percentage

Result

Section 1 : Field Investigation the size of Mosquito in nature.

According to a study in natural water with varying pH, a mosquito's body length and the water's pH are related. the mosquito's body length in a low-pH container is average compared to its body length in high-pH water, as shown in Figure 3

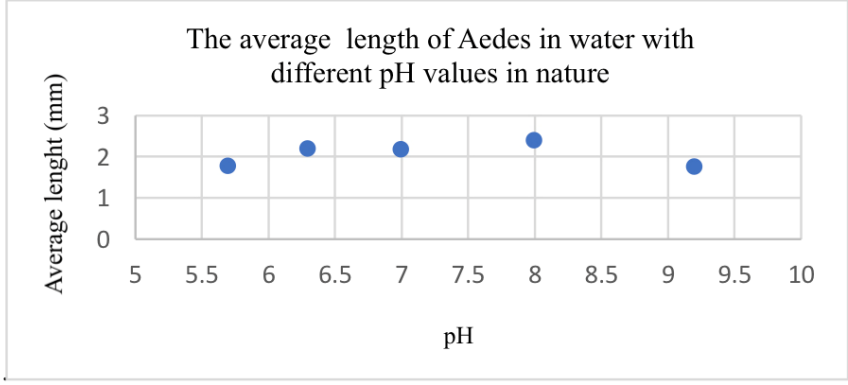

Figure 3 : Graph showing the average length of *Aedes* mosquitoes. in water with different pH values in nature

Section 2 : Experiment the Aedes mosquito in pH 4-9.

1) Study of water pH incubation and survival larval rate of *Aedes* mosquitoes.

1.1) Study of the incubation rate of *Aedes* mosquito eggs

The incubation rate of *Aedes* mosquito eggs was discovered to be affected by the pH level. Specifically, the incubation rate fell by 26.67 percent and 33.33 percent at pH 4 and pH 5, respectively. At 46.67 percent, there was no significant difference ($p>0.05$) between the pH 6 and pH 7 incubation rate show in figure 4.

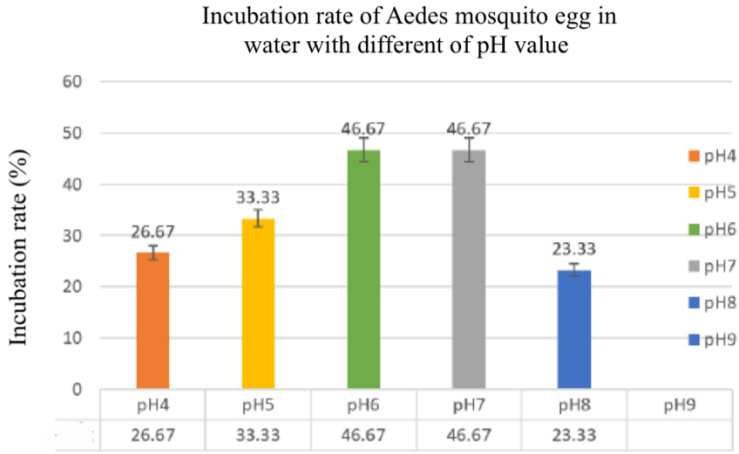

Figure 4 : shows incubation rate of *Aedes* mosquito eggs

1.2) The study of *Aedes* mosquito's survival rate in larvae stage

From a study of the pH that affects the survival rate of mosquitoes in the larval stage, it was found that at pH 6, the average survival rate was similar at 5.38 and 4.70, respectively. At pH 5 on the 6th day of the cycle, The highest survival rate for mosquitoes was 9 larvae, and at pH 8, days 11 and 12 of the cycle had the lowest larval survival rate of 1 mosquito. Larvae cannot grow at pH 9 shown in figure 5.

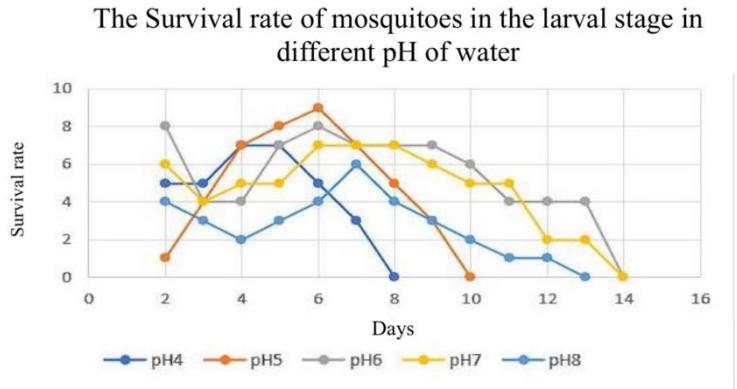

Figure 5 : shows The survival rates of mosquitoes in the larval stage at different pH levels were different at the significance level of .05.

1.3) Study of the pH value of water that affects the life cycle of *Aedes* mosquitoes.

From a study of the pH that affects the life cycle of Aedes mosquitoes, it was found that pH 7 had the longest cycle time at an average of 19.99 days, pH 6 for 19.50 days, and pH 8 pH 5 pH 4, respectively. In pH 9, mosquitoes were unable to grow. Shown in figure 6-9.

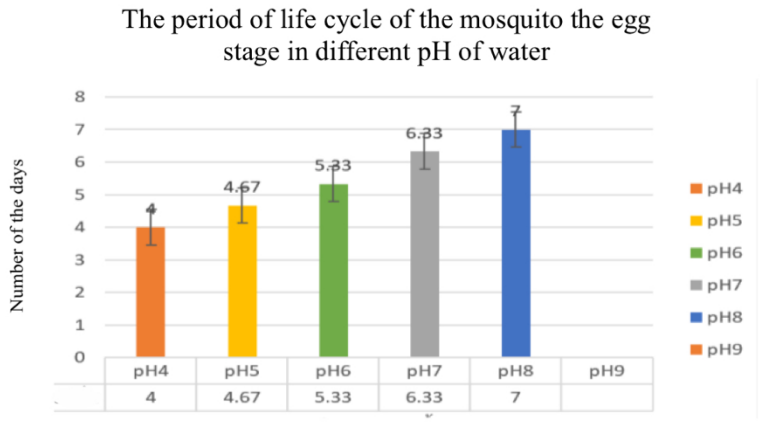

Figure 6 : Shows the period of life cycle in the egg stage.

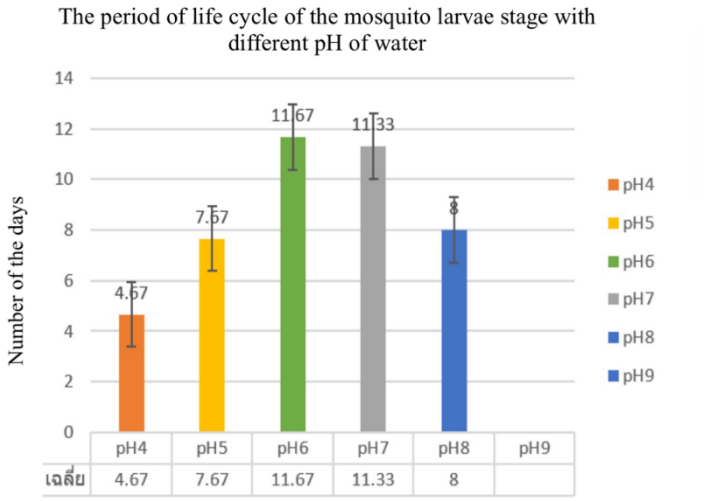

Figure 7 : shows the period of life cycle in larvae stage

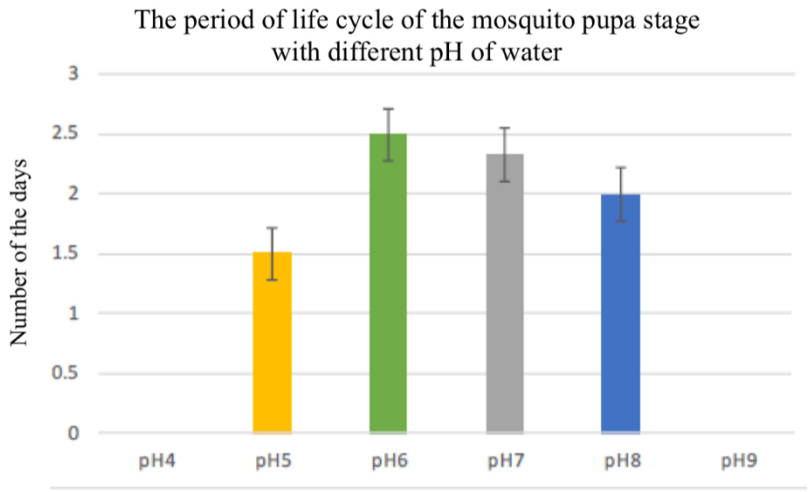

Figure 8 : shows the period of life cycle in pupa stage

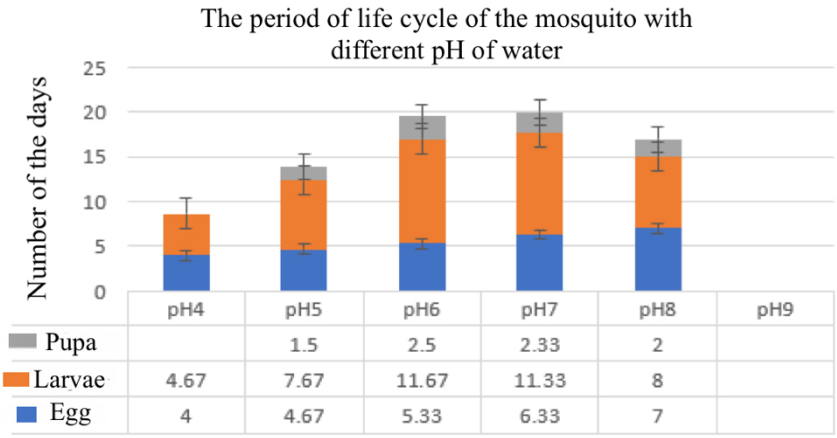

Figure 9 : shows the period life cycle in egg ,larvae ,pupa stage

1.4) Study of the pH value of water that affects the size of mosquitoes in the larval stage

The average length of mosquitoes in the larval stage was found to be maximum at pH 7(6.23 mm), the larval stage of the mosquito is the largest.The average length size showed the next trend at pH 8. The water with the pH 4 tended to have the lowest average length size of mosquitoes in the larval stage, while the water with the largest average length size was 5.62 mm. These values were followed by pH 6 and pH 5, respectively. The larval stage of the mosquito has the smallest length, at 0.3 mm. And length of mosquito larvae in different pH levels was different at the .05 significance level shown in figure 10.

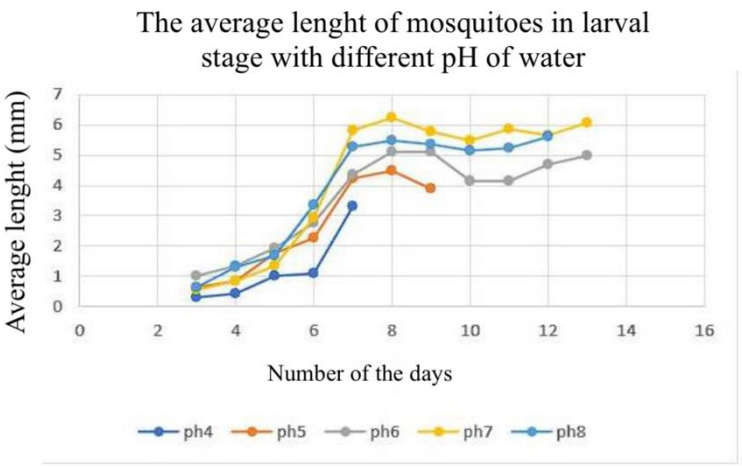

Figure 10 : Shows the average length of mosquitoes in the larval stage at pH 4-9.

1.5) Study of the pH that affects the size of mosquitoes in the pupa stage.

The size of mosquitoes in the larvae stage is influenced by the pH found the trend of mosquito size at each pH was rather stable. The average length of mosquitoes at the larval stage was maximum at pH 7. The longest mosquito, measuring 2.83 cm, is in the larval stage. The next average length is pH 8. The longest average length measured was 2.49 cm, with pH 6 and pH 5. Mosquitoes in the larval stage had the lowest average length in the water due to its pH. At 1.84 cm, mosquito larvae are the tiniest and the mosquito larvae cannot thrive at pH 4 or pH 9 shown in figure 11.

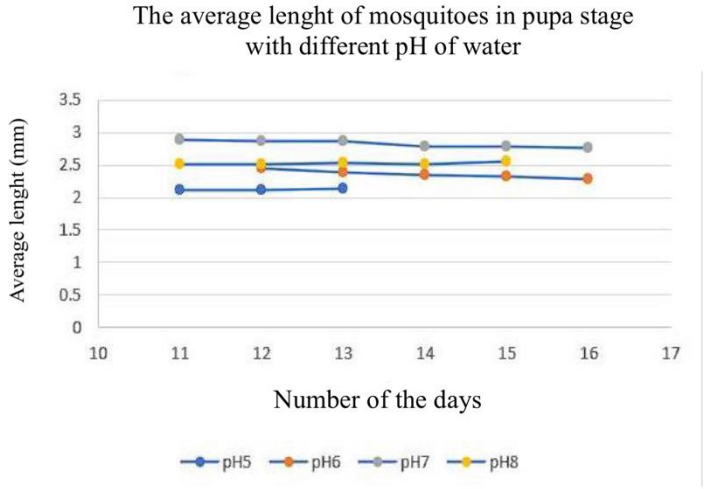

Figure 11 : shows The average length of the mosquito larvae in different pH levels was different at the .05 significance level.

1.6) Study of the pH that affects the size of mosquitoes in the adult stage.

From a study of the pH that affects the size of mosquitoes in the adult stage, it was found that the trend of the size of mosquitoes in the adult stage at each pH was quite stable. At pH 7, the average length of mosquitoes in the adult stage was relatively constant. The highest value of the mosquito's size in the adult stage is the longest at 2.83 mm. and pH 8 (2.49 mm),pH 6 and pH 5, the pH of the water having the lowest average length of mosquitoes in the adult stage. The size of the mosquito in the larval stage was the least at 1.84 mm, and in pH 4 and pH 9, no adult mosquitoes were found. The pH of the water with the lowest average length of adult mosquitoes was pH 5, which was followed by pH 6 (2.49 mm). The larval stage of the mosquito had the smallest size, measuring 1.84 mm, and no mosquitoes were discovered at pH 4 or pH 9 shown in figure 12.

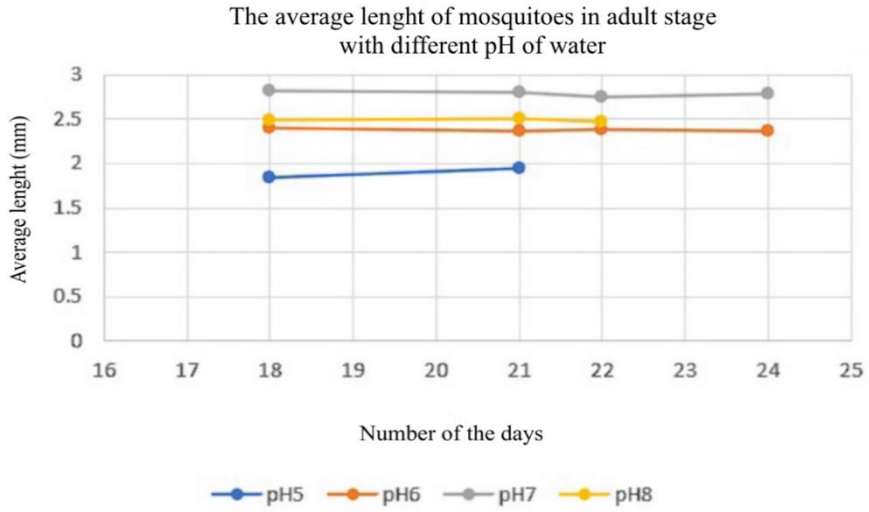

Figure 12 : Shows the average length of mosquitoes in the adult stage at pH 4-9

Discussion

From the results of the experiment, it can be concluded that at pH 4 of the acidic water, Aedes mosquito larvae cannot grow, and at pH 5, pH 6, pH 7 and pH 8, Aedes larvae can grow into larvae and adults. The longest life cycle of Aedes mosquitoes is pH 7 and the shortest is pH 5, which is consistent with the work of Clark, Fis, & Remold, 2004, which stated that the influence of pH affects the reduction in the percentage of larval growth. In changing to the period. And the size of the Aedes mosquitoes, it was found that pH5 had the lowest value, pH6 and pH8 had similar values, while pH7 had the highest value, corresponding to the size of the Aedes mosquitoes found in the natural source is at pH5 where the size of the Aedes mosquitoes is the least and at pH8 the Aedes mosquitoes are the largest. Therefore, the studied data has been used as a database to eliminate the breeding grounds of Aedes mosquitoes that are carriers of dengue fever. From the results of the experiment, it can be seen that when the value of pH slightly. It affects the life cycle of Aedes mosquitoes.

Conclusion

Results from a study of the pH that affects the rate of egg incubation. The survival rate of the larvae and larvae of Aedes mosquitoes was found to be at pH5 and pH4, the hatching rate of Aedes mosquitoes decreased respectively, while at pH6 and pH7 the hatching rates were not different, pH8 had the lowest hatching rate.It was found that the pH had a different effect on larval survival at the significance level of 0.05. At pH4 Aedes mosquito larvae cannot grow at pH 8 and have a survival rate. The survival rate of Aedes mosquito larvae was less at pH 4 and pH 5 than pH 6 and pH 7. The survival rate of Aedes mosquito larvae was different at the significance level of 0.05. The survival rate of Aedes mosquito larvae was different at pH 5 – 8 the larvae of Aedes mosquitoes were able to develop into 100% mosquitoes. At a pH of 4, mosquito larvae could not grow. The life cycle of Aedes mosquitoes found that the pH effects on the stages of the life cycle of Aedes mosquitoes.It has a shorter cycle when the the pH of the water is acidic (pH5). At pH 4, mosquito larvae cannot survive. So there is no robber and adult. The size of Aedes mosquitoes found that in the larval stages pH 5 and pH 4 the size of the larvae decreased respectively. At pH 6, pH 7 and pH 8 the size of the larvae was not different and pH had a different effect on the size of the larvae at the significance level of 0.05. As for the size of the larvae at pH 5 was the least, pH 6 and pH 8 had similar with pH 7. At pH 5 pH 6 and pH 8 have the lowest values, while pH 7 has the highest values. This is consistent with the size of Aedes mosquitoes found in natural sources, that is, when the pH of the water is acidic, the Aedes mosquitoes will decrease in size. At pH 5.7, the Aedes mosquitoes have the lowest size, and at pH 8, the Aedes mosquitoes have a large size.

Acknowledgement

We would like to thank Assoc. Prof. Dr. Mullica Jaroensutasinee from Walailak University,who gave advice Consultation on the project process. We would like to director and teachers of Princess Chulabhorn Science High School Trang especially Mrs.Patchara Pongmanawut and Mrs.Pacharee chaipetch the project advisors who help and give advice, suggestions that are useful in doing this project as well as community public health information and the villagers, who cooperated very well in collecting data for this research study.

Citations

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Optional badge

I AM A COLLABORATOR

We collaborate methodically as a group for both experiments and community data collection, which makes us good collaborators. Pasawut will be the observer when they travel to the community area to gather samples of larvae in the wild. and calculating the quantity of larvae in the container, collecting samples of the larvae to cultivate, and determining the adult mosquitoes' size .Regarding Phuwit, he is the one that documents data from each source that is examined. Furthermore, in collaboration with the Communicable illness Control Centre at 11.1 Phang Nga, a community organisation, our group has requested information and knowledge regarding mosquito breeding, illness

I MAKE AN IMPACT

Our research indicates that the life cycle is impacted by the pH of the water. The issue of changes in the pH of natural water sources brought by air pollution and other harmful gases is one that affects everyone and is directly related to the survival and growth rates of Aedes mosquitoes. It is important for you to be aware of the spread of dengue fever, which now has a large number of cases and is probably going to continue to rise. Going to collect data in communities in Trang province makes villagers aware of the problem of disease spread and has the knowledge to eliminate and destroy mosquito breeding grounds which are the cause of the problem. From the results of the study, it was found that when

the pH of water is acidic, it results in smaller mosquitoes. Therefore, equipment used to prevent mosquitoes such as Mosquito nets must therefore be adjusted to reflect the changing size of mosquitoes. By visiting communities in the province of Trang to gather data, locals become aware of the issue of disease transmission and are equipped to eradicate and demolish mosquito breeding places, which are the root of the problem. The study's findings showed that smaller mosquitoes are produced when water has an acidic pH. As a result, tools for keeping mosquitoes away, including mosquito nets, need to be modified to account for the insects' fluctuating sizes.

I AM A STEM STORYTELLER

Studying the issue of dengue fever—which has spread and seen an increase in patients—was the initial motivation behind our investigation. Air pollution is another significant issue that has an impact on natural water sources' pH. altered by a discernible drop in the number of water sources that serve as a haven for dengue-carrying Aedes mosquitoes. There is still a lack of conclusive evidence about the relationship between Aedes mosquito size and water source pH, based only on observations of smaller insects. Because of this, our crew is curious to know if the water's pH will change and if it will affect the Aedes mosquito's life cycle and growth rate. Therefore, our experiment was designed in 2 parts, one was to study the breeding grounds of mosquitoes in nature and found that the pH of natural water sources had changed and affected the growth rate of mosquitoes, and another step. It involves bringing the eggs of Aedes aegypti mosquitoes to breed in water with different pH values ranging from pH4-9 in order to measure their size and compare with the size of Aedes mosquitoes found in natural water sources.