The effect of giving some artificial diet on the development of assassin bug *Rhinocoris fuscipes* f. (*hemiptera: reduviidae*) in the laboratory

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**Abstract.** *Rhinocoris fuscipes* are predators that play a role in controlling plant pests. This study aims to determine the effect of some artificial diet on the breeding of *R. fuscipes* assassin bug in the laboratory. This research was conducted from July to August 2018, at the Laboratory of Plant Diseases, Faculty of Agriculture, Universitas Sumatera Utara. The research method used a Non-Factorial Completely Randomized Design (CRD) consisting of controls (*T. molitor*), egg yolks, *Artemia salina*, plant foods from soybean (*Glycine max*). The results showed that control treatment $F = 85,397$ ($p <0.05$), egg yolk $F = 17,552$ ($p <0.05$), *Artemia salina* $F = 8,936$ ($p <0.05$), plant feed from soybean juice $F = 8,377$ ($p <0.05$) significant effect on *R. fuscipes* body length, on *R. fuscipes* body width only egg yolk treatment $F = 7.161$ ($p <0.05$) which had a significant effect on body weight and only soybean treatment $F = 12.297$ ($p <0.05$) which was significant.

1. Introduction

Biological control is a strategy to control the effects of environmental pollution due to the use of chemicals for plant protection. The method utilizes insects and organisms that are predators, parasitoids, and poisons to control plant-disturbing organisms (Hallowel, 1997).

The use of predator insects to control pest are very importance function in suppressing pest populations in forest and plantation. Reduviidae has an abundant number and spread throughout in the world, this class predator is a type of predator which high prey ability (so-called "killer ladybugs"), most are predators who are common / not as specific as prey. The range of hosts owned by the class Reduviidae predators is quite extensive, these predators are a class of predators that vary greatly in body size and shape, ranging from small and slim to large medium (Sahayaraj, 2007).

*Rhinocoris fuscipes* is one of the predators that play a role in controlling plant pests. According to Sujatha et al. (2012), *R. fuscipes* can be used as biological control agents in cotton plants, Ricinusssp and peanuts. These predators are generally called assassin bugs because they are greedy in preying on the pests.

The potential of *R. fuscipes* in controlling plant pests is quite good. According to Yayan (2005), *R. fuscipes* assassin bug were able to prey on 5 individuals of *Helicoverpa armigera* pests every day. Besides these assassin bug predators to *Spodopteralitura* duringing in 3rd instar with 4 to 20 prey densities, it was known to be able to prey optimally 12 individuals for one male predator and 16 individuals for one female predator during 24 hours (Setyawan, 2012).
**R. fuscipes** has considerable potential to be used as a biological control agent. Thus, the need for mass breeding by feeding, so that these predators still produce more in carrying out biological control techniques (Martin et al., 2000; Wolfenbarger and Vargas-Camplis, 2002; Fakhrudin et al., 2003).

Based on this background, the authors to determine artificial feeding for mass breeding of **R. fuscipes** assassin bug, which is very much needed as an environmental friendly biological agent.

2. **Materials and methods**

This research was carried out at the Laboratory of Plant Disease, Faculty of Agriculture, Universitas Sumatera Utara. This research was conducted from July to August 2018.

The materials used consist of egg yolks, *Artemiasalina*, corn flour, soybeans, havermouth, calcium carbonate, citric acid, ascorbic acid, yeast, formalin and other supporting ingredients. The tools used for this research are jars, tile fabric, rubber bands, labels, blenders and other supporting tools.

The research method was using non-factorial completely randomized design (CRD). The randomization system was carried out by purposive random sampling. Factor 1: artificial feed as much as 4 factors, namely, P1 = Control (*T. molitor*), P2 = Egg yolk, P3 = *Artemiasalina*, P4 = Vegetable feed from Sari Kedelai (*Glycine max*).

3. **Results and discussion**

3.1. **Body Length**

It takes a balance of nutrients such as carbohydrates, proteins, fats, vitamins and amino acids, related to natural foods from insects. Predator insects have high amino acid requirements as well as carbohydrates, what is needed is the protein content of prey animal tissue. Furthermore, to find out significant results on body length parameters can be seen in Table 1.

|          | Mean Square | F    | Sig. |
|----------|-------------|------|------|
| Repeated | Between Groups | 1,000 | 0,000 | 1,000 |
|          | Within Groups |      |      |      |
| KO       | Between Groups | 3,515 | 85,397 | .000  |
|          | Within Groups | .041  |      |      |
| KT       | Between Groups | 5,140 | 17,522 | .000  |
|          | Within Groups | .293  |      |      |
| AS       | Between Groups | 2,385 | 8,936  | .001  |
|          | Within Groups | .267  |      |      |
| PK       | Between Groups | 5,712 | 8,377  | .001  |
|          | Within Groups | .682  |      |      |

From Table 1 shows the significant results of **R. fuscipes** body length. All treatments were significant to **R. fuscipes** body length. In the control treatment obtained the value of F = 85.397 (p <0.05), egg yolk treatment obtained F value = 17.552 (p <0.05), the treatment of *Artemiasalina* obtained the value of F = 8.936 (p <0.05), and the value of F = 8.377 (p <0.05).
Figure 1. Body length chart of sample

Based on observations indicate that the egg yolk treatment is the highest \textit{R. fusipes} body length chart, this is because the composition of soybean feed is very influential on \textit{R. fusipes} long growth, which in soybean feed production refers to the recipe of Sing and Moore (1985) containing peanuts soybean, ascorbic acid, yeast calcium carbonate, citric acid, havermouth. According to Wang et al (2014), ascorbic acid functions as an antioxidant for insects, yeast is a source of protein for insects, havermouth as a source of energy for the long growth of \textit{R. fusipes}.

Growth is a change in predators, both body weight and length in a certain time. The treatment of control feed (\textit{T. molitor}), egg yolk feed, \textit{Artemiasalina} feed and soybean plant food (\textit{Glycine max}) for 53 days showed that \textit{R. fusipes} experienced growth, this can be seen from changes (increases) in body weight and length \textit{R. fusipes}. Specific growth rates are daily growth rates or \textit{R. fusipes} weight gain percentage every day. Increased body length growth can be known through increased growth rates and specific growth rates. Based on statistical analysis using Anova showed the influence of feeding control (\textit{T. molitor}), egg yolk feed, \textit{Artemiasalina} feed and soybean (\textit{Glycine max}) plant feed on \textit{R. fusipes} specific growth rate (p <0.05).

\textit{R. fusipes} long body growth is closely related to protein availability in feed, because protein is an energy source for insects and protein is a nutrient that is needed by insects for growth. In accordance with, which states that the amount of protein will affect the growth of insects. The high and low protein in feed is affected by non-protein energy content which is derived from carbohydrates and fats. This is also in accordance with the report from (Chapman, 1998) which states that almost all insects require optimum protein levels for growth, but the need for each species is different. Insects need protein for their structural needs, as enzymes, receptors, for transport and storage needs.

The feeding of egg yolk (Yolk) gave the best results compared to feeding control (\textit{T. molitor}), feed for \textit{Artemiasalina} and plant-based soybean feed (\textit{Glycine max}) because it has a higher nutritional content compared to other feeds, namely moisture content of 73.70% , 13% protein, 11.59% fat, 0.60% carbohydrate, 0.10% ash.

The daily growth rate of \textit{R. fusipes} which was fed with feed control (\textit{T. molitor}), egg yolk feed, \textit{Artemiasalina} feed and soybean plant feed (\textit{Glycine max}) for 53 days also increased. The results of the calculation of the daily growth rate of \textit{R. fusipes} in each treatment. Based on statistical analysis using Anova showed the effect of feeding control diet (\textit{T. molitor}), egg yolk feed, \textit{Artemiasalina} feed and soybean plant feed (\textit{Glycine max}) to \textit{R. fusipes} daily length growth rate (p <0.05).

3.2. Body Weight

Based on observations showed that egg yolk was the highest total and average body weight of \textit{R. fusipes}, this was because the composition of egg yolk was very influential on the growth of \textit{R. fusipes}, which one was so that the feed nutritional needs of \textit{R. fusipes} were fulfilled and experienced growth significant.
In the egg yolk treatment contains high protein which according to Winarno and Koswara (2002) states that *R. fuscipes* body length growth is closely related to protein availability in feed, because protein is an energy source for insects and proteins which are nutrients that insects are needed for growth. In accordance with, which states that the amount of protein will affect the growth of insects. To see significant results on body weight parameters, it can be seen in table 2.

Table 2. Anova Body Weight

|      | Mean Square | F     | Sig. |
|------|-------------|-------|------|
| KO   | Between Groups | 0.000 | 0.000 | 1.000 |
|      | Within Groups |       |       |       |
|      | Total        | 1.000 |       |       |
| KT   | Between Groups | 0.001 | 2.708 | 0.073 |
|      | Within Groups |       |       |       |
|      | Total        | 5.647 | 1.035 | 0.441 |
| AS   | Between Groups | 0.003 | 3.774 | 0.028 |
|      | Within Groups |       |       |       |
|      | Total        | 5.456 | 1.035 | 0.441 |
| PK   | Between Groups | 0.002 | 12.279| 0.000 |
|      | Within Groups |       |       |       |
|      | Total        | 0.000 |       |       |

Description: KO = Control, KT = Egg Yolk, AS = Artemiasalina, PK = Soybean Feed

From table 2 shows only the treatment of soybean feed (Glycine max) which is significant to the body weight of *R. fuscipes*. In the control treatment obtained the value of $F = 2.708$ ($p <0.05$), egg yolk treatment obtained the value of $F = 1.035$ ($p <0.05$), the treatment of Artemiasalina obtained the value of $F = 3.774$ ($p <0.05$), and the treatment of soybean feed obtained $F$ value $= 12.279$ ($p <0.05$).

The difference in the body weight growth rate of *R. fuscipes* was caused by *R. fuscipes* preference in responding to feed. It can be seen that *R. fuscipes* that consume soy-based plant foods respond faster when fed than other foods. *R. fuscipes* which was given control feed (T. molitor) responded relatively long enough, this was related to the favorite factors of eating *R. fuscipes* itself which had preferred to eat from soybean plant foods, so that the body weight growth rate of *R. fuscipes* was plant-based treatment. soybeans are relatively better.

The difference in the rate of heavy growth is also thought to be caused by differences in the digestibility of feed in the digestive tract which is related to the amount of feed needed and the time opportunity to digest. Whereas in this study the frequency of feeding was only done once a day according to what was recommended by Suharyanto and Tjaronge (2007), the frequency of proper feeding was once a day and provided optimum growth for insects.

In addition to the digestibility of feed that causes growth differences are also caused by the quality of the food itself. This proves that the high protein content has no effect on crab growth. According to Lovell (1989), food quality is not only determined by the high protein content but also determined by the ability of *R. fuscipes* to digest and absorb the food eaten. Furthermore Helver (1989) states, that excess protein in feed can reduce growth because a lot of energy is needed to remove excess nitrogen. It can be seen that *R. fuscipes* which consume soybean feed and egg yolk growth are relatively similar to egg yolk, but for the growth of body weight *R. fuscipes* the soybean feed treatment is better.

3.3. Body Width

In the body width parameter, it showed that only the yolk (Yolk) feed treatment was significant to *R. fuscipes* body width. In the control treatment obtained the value of $F = 3.111$ ($p <0.05$), egg yolk
treatment obtained F value = 7.161 (p <0.05), the treatment of *Artemiasalina* obtained the value of F = 0.396 (p <0.05), and in the treatment of soybean feed obtained F value = 0.668 (p <0.05). As in table 3.

| Table 3. Anova Body Width | Mean Square | F     |
|---------------------------|-------------|-------|
| ULANG                    | Between Groups | 0.000 | 0.000 |
|                           | Within Groups  | 1.000 |       |
|                           | Total         |       |       |
| KO                       | Between Groups | 0.370 | 3.111 |
|                           | Within Groups  | 0.119 |       |
|                           | Total         |       |       |
| KT                       | Between Groups | 0.386 | 7.161 |
|                           | Within Groups  | 0.054 |       |
|                           | Total         |       |       |
| AS                       | Between Groups | 0.107 | 0.396 |
|                           | Within Groups  | 0.271 |       |
|                           | Total         |       |       |
| PK                       | Between Groups | 0.389 | 0.668 |
|                           | Within Groups  | 0.583 |       |
|                           | Total         |       |       |

Description: KO = Control, KT = Egg Yolk, AS = Artemiasalina, PK = Soybean Feed

*R. fuscipes* wide growth growth is caused by sufficient amount of feed nutrients. In the treatment of egg yolk, the amount of nutrients in the feed both protein, fat, and carbohydrate occurs in the balance of nutrients needed for the growth of *R. fuscipes* width. In accordance with Buwono (2000) it is because carbohydrates and fats can meet the body's caloric needs, so the protein is only slightly oxidized to add the calories but is used for the growth of *R. fuscipes*. According to Anggraeni and Abdulgani (2013) the growth of insects is closely related to the availability of protein in feed, because protein is an energy source for insects and proteins are nutrients that insects are needed for growth. The high and low protein in feed is affected by non-protein energy content which is derived from carbohydrates and fats.

The treatment of *Artemiasalina* and soybean feed only consists of one raw material so that the need for essential amino acids does not meet the needs required by *R. fuscipes*. In accordance with Afrianto and Liviawaty (2005) referred to by Arief et al (2009), feed experts recommend combining natural feed with artificial feed to create a balance of amino acids in the insect's body.

4. Conclusion
Control feeding (*T. molitor*), egg yolk feed, *Artemiasalina* feed and soybean plant feed (*Glycine max*) showed significant results on *R. fuscipes* body length, in *R. fuscipes* body weight parameters only treatment of soybean plant feed (*Glycine max*) a significant, wide body parameter was obtained only significant egg yolk treatment.

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