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Biology of Helopeltis Theivora (Hemiptera: Miridae) on Acasia Mangium Willd.

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***Abstract*— One of the problems in the management of A. mangium is Helopeltis sp. attack. It is important to study about the biology of Helopeltis sp because current research and report of biology of Helopeltis theivora on A. mangium is very limited. The research was aimed to know the biology of H. theivora. The observations of pest biology were carried out in twenty repititions. Then the result was arranged into the insect life–table in order to easy analysis of the observation. The parameters measured were the number of eggs, fecundity, longevity of nymphs and adult insects. An adult insect had the longest life span. The female and male ratio was 1:1,43. The Female maximum life span is 15 days. The total eggs produced by a female insect was 46,74. H. theivora had a high reproductive capacity with R0 at 11.40, T 28.09, r 0.09 and λ 1.09.**

***Keywords*— A. mangium, H. theivora, life -table**

I. INTRODUCTION

Acacia plant (*Acacia mangium* Willd.) is one of native plants in Indonesia which developed into industrial plants. One of the uses of this plant is as the raw material in pulp industries. Besides being developed as industrial plants, *A.mangium* is also used to rehabilitate the lands.

A.mangium widely spreads in Sumatera, Java, Kalimantan and Papua. Riau is one of the province with a large *A. mangium* plantation. Most of the plantation areas is cultivated by industrial forest companyies (HTI).

Common problems in cultivating *A. mangium* that lead to lower production are; the degraded lands, disease and pests attack, such as *Helopeltis* sp attack. It was reported that *Helopeltis theivora* attacked plantations in Indonesia [2]. *Helopeltis* sp. became a crucial problem in *A. mangium* because they distruct the plants growth.

It was reported that *Helopeltis* sp. attacked the plantation of *A. mangium* and became one of the most destructive pests in some plantations in Sumatera island [5]. The symptom of the attack can be seen from the presence of necrosis on the young leaves and cause tattering on the young leaves, the attack on the growing branch can kill the branch of the plants. When the main branch is tattered, the plant will develop many secunder branches [4].

Helopeltis sp. and *Spirama retorta* attack on *A. mangium* had been reported in Malaysia. The attack made the pests population grew significantly. The number of plants infestated by the pests could reach 60% of the plantation area. The infestated plants showed the tattering leaves up to 20 – 30% [5]. This research was aimed to investigate the bioloby of *H. theivora* pest on *A. mangium*.

II. MATERIAL AND METHODS

The research was carried out under laboratory conditions at Plant Health Pest and Disease-APRIL Technology Center, PT Riau Andalan Pulp and Paper during October 2011 through May 2012.

The insects used in the experiments were *H. theivora* pests on *A. Mangium* plantation. The insects were collected by capturing the adult of *H. theivora* in *A. mangium* plantation and the insects were kept in the laboratory until the females lay the eggs and they grew into new adult bugs. The new adults from the eggs were used in the biological experiments.

One pair of *H. theivora* bugs were kept in a special cage and were fed using a non-pesticide cucumber. The female then laid the eggs on the cucumber. The eggs were kept in a new cage until they hatched. The adult were fed by the new cucumber until they laid new eggs. The hatched eggs were kept until they grew into new adult bugs. The parameters of the observation were the quantity of the eggs, fecundity, the nymphal and adult bugs life span.

The biological research on *H. theivora* was conducted in twenty repetitions. In order to analyze the observation result, the life-table of *H, theivora* was arranged.

The parameters used to arrange the life-table based on Tarumingkeng (1994), were:

x = day of observation or class of age
a_x = individual survival rate on age x
l_x = individual survival proportion on age x
T_x = total survival individual on age x
d_x = individual mortality rate on age x
e_x = life chance on age x

Population and reproduction parameters [1]. were:
R_o = rate of reproduction , $R_o = \Sigma\, l_x m_x$
T = time in one generation (day), $T \approx \Sigma\, X l_x m_x / \Sigma l_x m_x$
r = intrinsic growth rate, $\Sigma e^{-r.x} l_x m_x = 1$
λ = limited growth rate, $\lambda = e^{r}$

III. RESULT

Biological observation showed that *H. theivora* had complete developmental stages starting from eggs, nymphals, and adults. An adult female of *H. theivora* could lay five up to eleven eggs per day.

Nymphals of *H. theivora* could be classified into five instars stages with different characteristics and developmental stages (Figure 1). The average first nymphal instar body length was 1.5 mm with brownish color on the legs and abdomen. The antennae were longer than the body of the insects. The second nymphal had a bigger body size compared to the first nymphal instar, the average body length was 2,2mm with brighter color than the first instar. The third instar body was reddish green and the body length was 3.4mm, and the wings appeared on this instar stage.

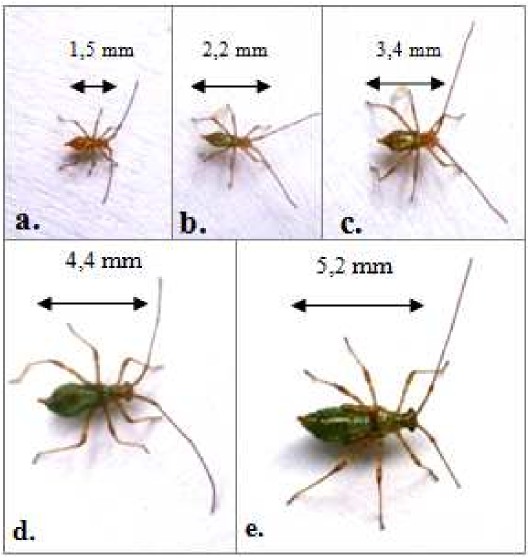

Figure 1. Nymphals of *H. theivora*: a.1st instar, b. 2nd nstar 2, c.3rd instar, d. 4th instar , e. 5rd instar.

On the fourth instar, the body of the insects turned to be light green and the average body length was 4.4 mm, the wings in the fourth instar developed better than in the third instar. The fifth instar had darker green abdomen, especially on the abdomen, and the average body length was 5.2 mm. The spine on the scelletum and the wings were well developed at this stage. Male and female bugs could be classified clearly. Males had a sharper abdomen and the color tended to be black on te top of the abdomen, while females had black ovipositor hidden under the abdomen.

The adult of *H. theivora* were green and were bigger than the fifth instar. They had a pair of wings and a well developed antennae. The male bodies were smaller compared to the females. A male insect body is 5.8 mm in length, while the female were 6.2 mm (Figure 2, 3).

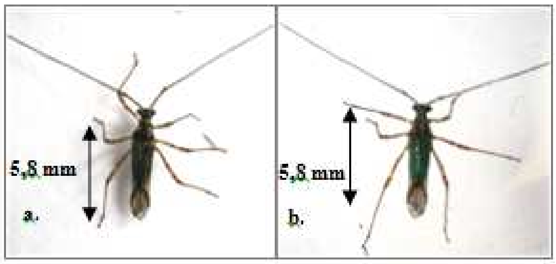

Figure 2. Male adult of *H. theivora*: a. dorsal view, b. ventral view

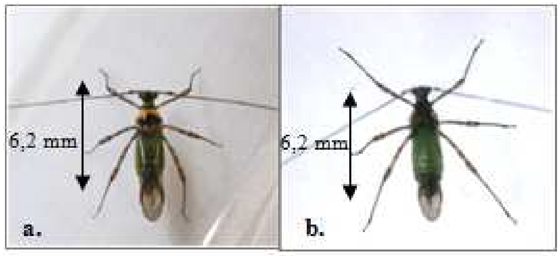

Figure 3. Female adult of *H. theivora*: a. dorsal view dorsal, b. ventral view

The duration on every developmental stage can be seen in Table 1. The research observations showed that the adults had longer life span compared to the other developmental stages. The adult insect had the life span between 9 to 19 days. The average eggs incubation period was 5.87 days, while the developmental stage from one instar to the next instar took 2 to 5 days.

TABLE I
DURATION OF EVERY DEVELOPMENTAL STAGE OF *H. THEIVORA*

Stages	Developmental duration (day)		
	Average	Maximum	Minimum
Egg	5,87±0,07	7	5
1st Instar	3,43±0,11	5	3
2nd Instar	2,28±0,09	3	2
3rd Instar	2,18±0,09	3	2
4th Instar	2,52±0,16	4	2
5th Instar	2,44±0,14	4	2
Adult	13,13±0,35	19	9
Total	31,85	45	25

The development of every developmental stage of *H. theivora* was arranged into the life cycle presented in Table 2. The results of the research showed that 209 of 314 eggs survived and grew into adult bugs. The highest mortality rate occurred in the first to the second instar with 44 individuals, but 34 eggs were unable to hatch. The observation on the specific age and fecundity of *H. theivora* showed that the females emerged on the 20th day and the first mortality occurred at the age of 28 days. The ratio between females and males was 1:1.43 and the last mortality of the females occurred on the age of 33 days. The female maximum life span was 15 days.

TABLE II
LIFE CHART OF H. THEIVORA

Stages	l_x	d_x	L_x	T_x	e_x
Eggs	314	34	297,0	1618	5,15
1st Instar	280	44	258,0	1321	4,72
2nd Instar	236	23	224,5	1063	4,50
3rd Instar	213	4	211,0	838	3,93
4th Instar	209	0	209,0	627	3,00
5th Instar	209	0	209,0	418	2,00
Adult	209		209,0	209	1,00

Female of *H. theivora* laid the eggs on the 24th days or four days after the first female emerged. The highest eggs percentage found on the age of 29 days, was 8.49 eggs per female while the total egg produced by a female was 46.74.

The population and the reproductive parameters of *H. theivora* were presented in Table 3. The result of the research concluded that *H. theivora* had R_0 value 11.40, T value 28.09, r value 0.09 /female/day, and λ value was 1.09.

TABLE III
POPULATION AND REPRODUCTION PARAMETERS OF H. THEIVORA

No.	Parameters	Formula	Value
1	R_o	$\Sigma l_x m_x$	11,40
2	T	$\Sigma l_x m_x x / \Sigma l_x m_x$	28,09
3	r	$\Sigma e^{-rx} l_x m_x = 1$	0,09
4	Λ	e^r	1,09

IV. DISCUSSION

The eggs of *H. theivora* were laid separately under the tissue of the cucumber. The quantity of the eggs could be counted from a pair of fine respiratory filaments projecting from the surface of the cucumber tissue. [8] stated that the presence of the eggs of *H. theivora* could be identified by the presence of two unparallel filaments under the surface of the tea leaves and banks. The eggs were elongated and sausaged shaped, with white color and 0.8-1.0 mm length. A female could lay 4 – 10 eggs per day.

The incubation period of *H. theivora* eggs on tea plants was 4 days and lasted between 24 and 36.8 days. The number of eggs laid by a female was 73 – 136.6 [6]. This statement is in agreement with the result of the observation that showed the female laid the eggs on the age of 24 days or four days after the first female emerged and a female could lay 46.74 eggs.

The hatched nymphs of *H. Theivora* had dark yellow color, and the color then changed into greenish yellow after the second and the third instar, and finally became green [8]. The result showed that there were variations in colour between the species of *H. theivora* on *A. mangium* and on the tea plants. The color variation that is considered as the same species is known as biotype [7]. The variation of the color could also occurre because there was a difference in describing the color of the insects. Therefore, it is very crucial to standardize the color description.

The mortality occurred on *H. theivora* population in the laboratory was the proof of systemic failure in every developmental stage. The mortality rate on *H. theivora* became slower after the third nymphal instar. The constant mortality rate occurred after the developmental stages on the third nymphal instar until the adult bugs showed the stability of developmental stages against the mortality causes.

Mortlity meant the changes occurred from the life to the death due to some systemic failure. Mortality became slower as the age of the insect increased. This was one of the common demographyic principles. The decreasing mortality rates occurred among some species such as *Drosophila melanogaster* and *Callosocruchus maculatus* [1].

The life cycle showed the developmental stages started from the eggs until the adults. The reproduction rates (R_0), the intrinsic growth rate (r), the limited growth rate (λ), the period of one generation (T), and the proportion of every age on stable age distribution (px) were counted based on the life chances (lx) and fecundity (mx) [1].

H. theivora R_0 value was 11.40. This value showed that a female could reproduce 11.40 females/generation; in other words, the population doubled 11.40 times in every generation. In unlimited environment, the population of *H. theivora* could spread quickly because they had reproductive rate **(**R_0)>1.

The period for one generation of *H. theivora* was 28.09 days. This value showed that in 28.09 days a female could reproduce half of its generation. The intrinsic growing rate of *H. theivora* was 0.09 /female/day, and the limited growth rate was 1.09 /female/day. This value showed the great population of *H. theivora* per day.

Parameter r was the intrinsic growth, which presented the ability to grow in one population. It was assumed that r>0, because every population had the ability to grow, therefore the population grew and created a growing population model which was also known as the logistic equation. The bigger r value meant the higher chance of one species to develop its population in particular environtment. Besides, r was also used as a biological parameter that was used to compare the growing ability between various species [9].

V. CONCLUSIONS

H. theivora had complete developmental stages starting from eggs, nymphals, and adults. An adult female bug of H. theivora could produce 5-11 eggs per day. Nymphals of H. theivora had five instar stages with different characteristics and developmental stages. Adult bugs had longer life span compared to any other developmental stages. The ratio of the female and the male was 1:1.43. The female maximum life span is 15 days. The total eggs produced by one female was 46.74 eggs. H. theivora had R0 value 11.40, T value 28.09, r value 0.09 /female/day, and λ value was 1.09.

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