Impact Of Natural Enemies To Leaf Eating Caterpillar Population On Oil Palm In North Sumatra, Indonesia

Ahmad Saleh, Ameilia Zuliyanti Siregar

Abstract: Setothosea asigna is most important pest of oil palm especially in North Sumatera, Indonesia. The caterpillar could reduce oil palm yield up to 90% and the infestation can spread in huge hectares in years. However there are a lot of natural enemies have recorded and most of them could controlled the outbreak of S. asigna effectively. Nectar, pollen and water are the main food of parasitoids and predators. These foods are produced by flowering plants such as Antigonon leptopus, Turnera subulata and Agreratum conizoides which are practiced in maintaining in oil palm plantations. Two families of predators Pentatomidae and Mantidae then 3 families of parasitoids are visit on these flowering plants in this study site. This study was to determine the impact of the natural enemies to S. asigna population. The results indicated that the Blocks are planted the flowering plants A. leptopus and T. subulata clearly could suppress the population of S. asigna under Economic threshold for 25 months. While the block which has the flowering plant A. conyzoides only, three times outbreak of S. asigna was happened in March, November and December 2015 and continued in February and March 2016. To keeping abundance of natural enemies in oil palm plantations should be encouraged of flowering plants which provided the source of foods of the natural enemies. It should be included for sustainable Integrated Pest Management.

Index Terms: Pest, natural enemies, flowering plant, biological control, IPM..

1 INTRODUCTION

Setothosea asigna van Eecke (Lepidoptera: Limacodidae) is serious pest of oil palm in North Sumatra, Indonesia. The larvae of S. asigna can consume the leaves of 300 – 500 cm² for the development of any larvae [7, 10]. In Indonesia, leaf eating nettle caterpillar, S. asigna was attacking indifferently on the young and old plantations of oil palm with heavy infestation causing yield losses by 70% in the first year after defoliation and 90% when the attack continued in the second year [11, 12]. There are lots of natural enemies of Lepidopteran pests, some of them infect eggs, larvae and pupae of S. asigna. The success of control in biology by the enemy depends on the existence of natural enemies populations that are exist present in the area of oil palm. Their impact is suppressing the pest population. On the other hand, flowering plants as source of their food truly varied in oil palm plantations [13]. If the ecosystem balance is disturbed, then it will ease the occurrence of pest populations increase, so the pest consequently the pest explosion. Using of incorrect chemicals will damage the ecosystem so that it will appear a secondary pest and pest becomes resistant. Integrated pest management Maintain diversity abundance of natural enemies in the oil palm field, it has been planted the flowering plants Antigonon leptopus Hook & Arn (Mexican creeper) and Turnera subulata Sm (Buttercup). The flowering plants are suitable alternative food source because these plants provide beneficial of pollen and nectar for adults parasitoids and some predators [5]. This study was to determine the impact of natural enemies to leaf eating caterpillar population on oil palm plantations in North Sumatera.

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II. MATERIALS AND METHODS

In this study was used the census data of leaf eating caterpillar S. asigna from January 2014 to June 2016. The census was carried out monthly by Estate, one frond each palm sample was taken to count the population of S. asigna. The palm sample was selected one palm from 100 palms. The study was located at Gunung Melayu Estate, PT. PP. Lonsum in Asahan region, North Sumatera, Indonesia (2 º 45 ' 30 "N 2 ° 38 ' 30" N) and (99 ° 32 ' 00 "E-99 ° 32 ' 00" E) and the Altitude 35 m. Three Blocks were selected which the palms were planted in 1996 and 1997, i.e. Block A (Code No. 97111015, 35 ha), Block B (Code No 96111002, 37.6 ha) and Block C (Code No. 97111001, 37.6 ha). The condition of flowering plants in these areas were vary: Block A was planted A. leptopus, Block B was planted T. subulata while no flowering plants in Block C as used for comparison. However, Ageratum conyzoides is naturally growth on harvesting paths and palm circles for all Blocks. The flowering plants were planted on roadside with 30 m distance between the plants. Three plants were represented as samples per Block and the natural enemies were collected by insect net. The time for sampling of was between 09.00 – 11.00 am, by swiping the insect net about 10 cm above of the flowering plant as many as 3 times for each plant. The sampling of insects was repeated for 2nd and 3rd day on the same flowering plant. The census data was done by estate indicated that the high infestation of S. asigna occurred at Block A in 2014. Estate applied the Deltamethrine insecticide by Thermal Fogger K22 Bio machine with dosage 150 cc product /ha. While in 2015 and 2016, the S. asigna infestation increased in Block C and the Bio insecticides (Bacillus thuringiensis, Bt) was applied by Thermal Fogger K 22 Bio machine and followed by applied manually 11 kg the fungus Cordyceps sp in corn. The Economic Threshold for controlling S. asigna in estate practice is five a live larvae per frond. The population of S. asigna was recorded monthly from January 2014 to June 2016 and it was summarized per year and LSD analyzed by ANOVA SPSS 21.00 version.

III. RESULTS

The Figure 1 described on the population of larvae S. asigna at G. Malayu Estate in 2014 , there was the higher reorded into Block A than the lower in Block C. Table 1 showed population live larvae of S. asigna recorded from January until December 2014 at difference Blocks, which the higher in Block B (37.6%) and the lower in Block C (29.4%)

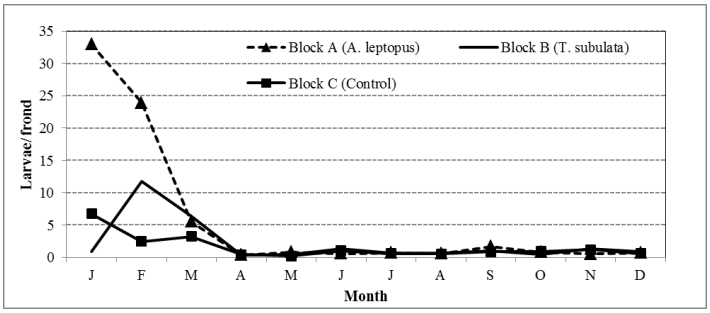

Figure. 1. *The population of larvae S. asigna at G. Malayu Estate in 2014.*

Table 1. *Population live larvae of S. asigna in January to December 2014 at difference Blocks*

Block	Mean number a live larvae of S. asigna per frond		Total a live larvae of S. asigna per frond	%
Block A	6.25 ± 1.32	a	75.0	33.0
Block B	7.12 ± 0.84	a	85.5	37.6
Block C	5.58 ± 0.88	a	67.0	29.4
			Total 227.5	100.0

The mean difference is significant at the 0.05 level (LSD).

The Block C which has the flowering plant A. conyzoides only, it had three times outbreak of S. asigna in March, November and December 2015 (Figure 2). The mean number of a live larvae was significantly different between Block C compared to Blocks A and B (Table 2). Total a live larvae of S. asigna per frond in Block C was 90 while in Block A (33 individuals) and Block B (49 individuals).

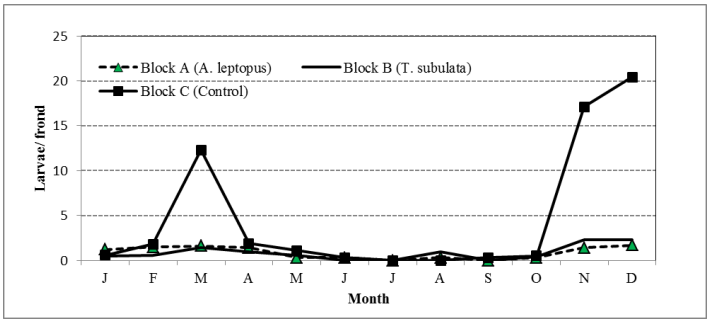

Figure 2. *The population of larvae S. asigna at G. Malayu Estate in 2015*

Table. 2. *Population live larvae of S. asigna in January to December 2015 at difference Blocks*

Block	Mean number a live larvae of S. asigna per frond	Total a live larvae of S. asigna perfrond	%
Block A	2.75± 0.56a	33.0	19.1
Block B	4.08±0.88a	49.0	28.3
Block C	7.57±2.01b	90.0	52.6
	Total	227.5	100

The mean difference is significant at the 0.05 level (LSD)

The population of live larvae of S. asigna at Block C was significantly higher compared to others Blocks such as described in Figure 3 and Table 3. The population live larvae of S. asigna in January to June 2016 at difference Block resulted Block A and Block B is similar, while in Block C are difference mean number of a live larvae of S. asigna per frond.

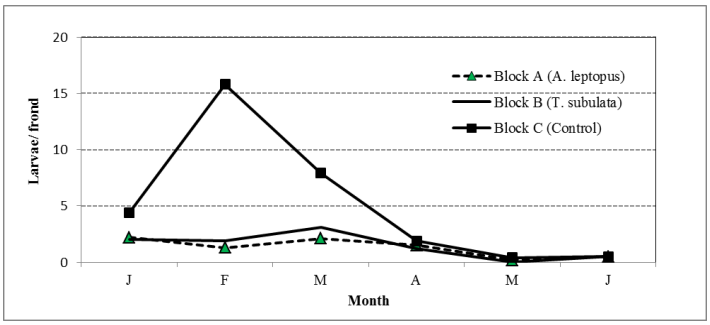

Figure 3. *The population of larvae S. asigna at G. Malayu Estate in 2016*

Table. 3. *Population live larvae of S. asigna in January to June 2016 at difference Block.*

Block	Mean number a live larvae of S. asigna per frond		Total a live larvae of S. asigna per frond	%
Block A	3.42 ± 0.62	a	20.5	20.4
Block B	4.33 ± 1.03	a	25.5	25.4
Block C	9.07 ± 1.89	b	54.4	54.2
		Total	100.4	100

The mean difference is significant at the 0.05 level (LSD).

From the observation of natural enemies visited to flowering plants, it was found 5 families of insects. There were consists families of Pentatomidae, Mantidae, Eulophidae, Icheneumonidae and Tachinidae (Table 4) . There are shown that 40 % family Pentatomidae visit on these flowering plants was significantly difference with other families as followed, Tachinidae (26.8 %) , Eulophidae (21.3%) and Icheneumonidae (10.2 %), while family Mantidae only 1.1 %.

Table 4. *The abundance of natural enemies of S.asigna on flowering plants A. leptopus, T. subulata and A. conyzoides in Gunung Malayu Estate.*

Natural enemies (Family)	Mean Number of insects on Flowering plants		Total Number of insects	%
1. Pentatomidae	7.60 ± 1.15	a	205.20	40.6
2. Mantidae	0.21 ± 0.08	b	5.80	1.1
3. Eulophidae	3.99 ± 0.59	c	107.60	21.3
4. Icheneumonidae	1.90 ± 0.22	bc	51.40	10.2
5. Tachinidae	5.02 ± 0.77	d	135.80	26.8
		Total	505.80	100

The mean difference is significant at the 0.05 level

The abundance of natural enemies in oil palm plantations should be encouraged the flowering plants which provide source of foods of the natural enemies. Nectar, pollen and water are the main food of natural parasitoids and predators. These foods are produced by flowering plants can be seen in Table 5, such as Antigonon leptopus, Turnera subulata and Agreratum conyzoides, these plants are practiced and maintaining in oil palm plantations in North of Sumatera. From Table 5 clearly indicated that number natural enemies at Block C was significantly very low compared to others Block A and B. The population only 5.6 % out of total insects visits to flowering plants (505.8).

Table 5. *The abundance of natural enemies of S. asigna visit to each flowering plant.*

Flowering plant	Mean Number of insects/ plant		Total number of insects	%
1. Block A (A. leptopus)	5.5 ± 0.77	a	250.3	49.5
2. Block B (T. subulata)	5.0 ± 0.57	a	227.0	44.9
3. Block C (Control)	0.6 ± 0.10	b	28.5	5.6
		Total	505.8	100

The mean difference is significant at the 0.05 level

From Table 6 showed number insects on flowering plants in first and second day collected was not significant, 37.4 and 39.8 %, but in the third day the number of insects was lower (22.8 %). The mean number of insect are difference after third day (total=115.5; 2.5 ± 0.50) with 22.8% but both of similar in first and second day.

Table 6. *The abundance of natural enemies on flowering plants in different day collected.*

Samples collected (Day)	Mean Number of insects/ day		Total number of insects	%
First day	4.2 ± 0.67 a		189.3	37.4
Second day	4.4 ± 0.68 a		201.0	39.8
Third day	2.5 ± 0.50 b		115.5	22.8
		Total	505.8	100

IV. DISCUSSIONS

In January and February 2014, the population of S. asigna was high at Block A for 11 Ha out of 35 Ha. To reduce the population, it was applied Deltamethrine insecticide by using Thermal Fogger K 22 Bio machine in February with dosage 150 cc product /ha. The result shown that the population was going down in March and keep under Economic Threshold level (ET), 5 larvae/ frond for following months. For other Blocks B and C, the population of S. asigna was slightly above the ET. The population S. asigna in February at Block B was 11.7 larvae/ frond and at Block C only 6.7 larvae per frond. These Blocks did not treated by insecticide, nevertheless the population was under control below ET up to December 2014 (Figure. 1). Application chemical insecticide will effect to predator and parasitoids [3] such as in Block A, however the natural enemies have recover soon duo to enough source of food from A. leptopus. The flowering plant A. leptopus is one of the recommended beneficial plants in oil palm Plantations which produces nectar [1, 12]. Population of S. asigna in 2015 as shown in Figure. 2, it indicated that the outbreak of S. asigna at Block C in February, November and December, while at other Blocks A and B were below ET. As a result, the treatment at Block C was given in November by Bt 500 gr/ ha which applied by using Thermal Fogger K22 Bio for 11 ha and in December were applied bio pesticide Bacillus thuringiensis (Bt), 500 gr / Ha for 20 ha. Re-outbreak of S. asigna occurred in February 2016 at Block C and to reduce the population it was treated by Cordyceps fungus which bred on milled corn. The fungus was spreading manually as much as 11 kg/ ha to palm circle and under stacking of fronds. Instead for other Blocks A and B, the population of S. asigna was keep under control below ET (Figure. 3). It was clearly from these results that there are strong impact of natural enemies in controlling population of S. asigna at Block A and B were keep under control (< 5 larvae per frond) through in 25 months. The flora condition at Blocks A which was planted flowering plant of A. leptopus while at Block B was planted T. subulata. These plants produce pollen and water which as food source and size of natural enemies [4, 6,17]. While the Blocks which planted with the flowering plants A. leptopus and T. subulata, could maintain an abundance of natural enemies so that the population of S. asigna was under control. The existing of Parasitoid Ichneuminidae at Block C was insufficient to suppress the S. asigna population. However the natural enemies must have a continuous food supply, if the biological control in Integrated Pest Management will succeed [6]. To support these insects survive or complete their life cycle, different source of food may be required [3, 14]. The flowering plants are an ideal alternative food source because there is supplying useful a mounts of pollen and nectar for adult parasitoids and some predators [6, 15,16]. These flowering plants are being widely adopted by plantations of oil palm pests in balance with nature [1].

V. CONCLUSIONS

1. Abundances of natural enemies could maintain of S. asigna population become under control.
2. Flowering plants A. leptopus and T. subulata produced a source of food for natural enemies such as families Pentomidae, Mantidae, Eulophidae, Ichneumonidae and Tachinidae.
3. Sustainable of Integrated Pest Management in oil palm plantations should emphasis practice to use the biological control method.

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