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Diversity of parasitoid Lepidopterans larvae on Brassicaceae in West Sumatra

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ABSTRACT

Nelly N, Rusli R, Yaherwandi, Yusmarika F (2010) Diversity of parasitoid Lepidopterans larvae on Brassicaceae. Biodiversitas 11: 93-96. Diversity of parasitoid lepidopterans larvae on Brassicaceae was conducted in several Brassicaceae areas in West Sumatra. The objective of the research was to study the diversity of parasitoid lepidopterans larvae on Brassicaceae. Sampling was conducted on Brassicaceae plants: cabbage, cauliflower, petsai and sawi. It was taken five samples in every plot, by using W method. Collection technique was done by direct collecting larvae, by using yellow trap and insect net. Adult of parasitoids was identified until family. The result of the research indicated that there was the diversity of parasitoid lepidopterans, the highest diversity was found on sawi. The number of parasitoid Lepidopterans larvae found was 566, 83 species, 9 families. The degree of parasitation on the three plants was low.

Key words: Brassicaceae, diversity of parasitoid, Lepidoptera.

INTRODUCTION

Some of Brassicaceae family is cabbage (*Brassica oleraceae* L var *capitata* L), cauliflower (*Brassica oleraceae* var *botrytis* L), sawi (*Brassica juncea*) and petsai (*Brassica chinensis*). These plants are a kind of an important vegetable in West Sumatra and as vitamin resources for human. Brassicaceae is a host of Lepidopteran pests, such as *Crocidolomia pavonana* Fabricius (Lepidoptera: Pyralidae), *Spodoptera litura* Fabricius (Lepidoptera: Noctuidae) and *Plutella xylostella* Linn (Lepidoptera: Plutellidae) (Sudarmo 2001; Nelly 2006).

Disaster that is emerged by Lepidoptera in several host plants are depended on part of attacked plant. *C. pavonana* larvae eat the young green leaves first and crop center, this larvae eat all of crop center. The heavy attack causes plant die, due to crops are not able to make the new buds (Prijono and Hasan 1992). *S. litura* larvae attack affected host plants, and the hosts are not capable to produce owing to heavy attack, only leaf's veins are left (Permadi and Sudarwohadi 1993). To control Lepidoptera, farmers only used pesticide, whereas using insecticide affect pest natural enemies, which may result in pest resistant, pest resurgence, exploding secondary pest, health problem and environmental contamination (Untung 2006).

Integrated Pests Management (IPM) is an alternative strategy to control pests, through effectively using insecticide, and environmentally sound. Biopest management is a technique to manage the population of pests by predators, parasitoids, and pathogens (Untung 2006). Some of parasitoids that can handle population of pests in Brassicaceae are parasitoids of larvae. Parasitoids of larvae are effective to control Lepidoptera in Brassicaceae (Nelly et al., 2008). Parasitoids of larvae which have been invented include Tachinidae family (Diptera), Ichneumonidae (Hymenoptera), Braconidae (Hymenoptera) (Kalshoven 1981).

Information about parasitoids of larvae in West Sumatra are limited, to support IPM for specific location needs a research about variety aspect of parasitoids of Lepidopterans larvae in West Sumatra. Based on that, this research was done to observe the diversity parasitoids of Lepidopterans larvae in some species of Brassicaceae in West Sumatra.

MATERIALS AND METHODS

Study site

Parasitoid was collected from Brassicaceae plants in Aia Angek, Tanah Datar District and Bukit Tinggi, Agam District, West Sumatra Province; at February to April 2007.

Plotting sample

Parasitoids Lepidopterans larvae were taken from 4 plots, those plots were cabbage, cauliflower, sawi, and petsai. Plots wide were about 300-400 m respectively. In each plot, sub plots (2x2 $m^{2)}$ were made, from which sample was taken. These sub plots were arranged systematically by line with W method. Larvae were collected 4 times with interval 2 weeks.

Collecting parasitoid of Lepidopterans larvae

Collecting parasitoid directly from host larvae

Larvae were collected from plot sample and all larvae kept in a box 35x27x7 cm^3. Larvae were reared in

laboratory until emerging all parasitoids. All adults parasitoid were collected in micro tube with alcohol 70% for identification.

Using yellow trap

Yellow trap was made from a plastic tray with size 15x25 cm^2 and height 7 cm. This trap was set in free place, so insects can reach it easily. That trap was filled up with soap solution 2/3 part of trap height. This solution was used to decrease the surface strain so the insects are trapped and die. There was a trap in each sample plot, and the traps were putted there for 24 hours. All trapped insects were collected in film tubes filled with alcohol 70%, for preservation, and the insects were further identified.

Using insect net

Adult insects were trapped by insect net in field. Insect net was a cone net with a circle of wire which diameters 30 cm. Samples were collected from each sample plots by swinging the insect net left and right for 20 times. All trapped insects were collected in film tubes filled with alcohol 70% for preservation, and the insects were then identified.

Identification

Adult parasitoid collections that emerged from larvae and traps were identified until family level. And then, identification was done based on morphospecies or code only. Identification followed by Goulet and Huber (1993) and CAB International (1999). In this research was used amount of individual, species, family, diversity, and species disseminating of parasitoid lepidopterans larvae. Especially for degree of parasitation, index of diversity, and species disseminating are analyzed in sub chapter data analysis.

Data analysis

Degree of parasitation (%)

Degree of parasitation were calculated by

$$P = \frac{n}{N} \times 100\ \%$$

P = Degree of parasitation
n = Amount of emerging adult parasitoid
N = Amount each kind Lepidoptera larvae collected

Diversity index of parasitoid larvae

Diversity index of parasitoid larvae species calculated by Shanon Wienner formula with used by Krebs (2000).

$$H = -\sum_{i=1}^{s} pi\ (\log e\ pi)$$

H = Index of diversity
S = Amount parasitoid larvae species
Pi = Proportion morphospecies parasitoid larvae to total populations

RESULTS AND DISCUSSION

Amount of individual, species, family of parasitoid larvae Lepidoptera in several species of Brassicaceae

Observation result about amount of species and family parasitoid are showed by Table 1. The biggest individual and species amount were found in cauliflower. It was because cauliflower has bigger Lepidoptera attack than the others. Some pests attacked cauliflower were *C. pavonana*, *S. litura*, and *P. xylostella*, it was compatible with the result of Cahyono's research (2001) and Nelly et al. (2008). If the larvae populations are high, the parasitoids are a lot too. The dominant parasitoid larvae were from Hymenoptera and Diptera (Goulet and Huber 1993).

Tachinidae was the biggest individual amount and Braconidae was the biggest species amount. Tachinidae can attack 8 insect orders, and Lepidoptera is the common host. Tachinidae is a family in order of Diptera which has the biggest parasitoid species; it is about 8000 species in the world (Habazar and Yaherwandi 2006). *Sturmia* sp. is a species of Tachinidae family which often find in West Sumatra. Populations of these parasitoids are increasing as the increase of host population (Nelly 2006). High population of parasitoids in field was predicted as the ability to survive on insecticide. Cocoon of pupa is predicted as a protecting factor on insecticide too.

Braconidae is a family of order Hymenoptera which has the biggest parasitoid species; it is about 40.000 species and 18 subfamilies. Braconidae has been used for biopest management, mainly for aphids (Homoptera), Lepidoptera, Coleoptera and Diptera (Goulet and Huber 1993). The smallest individual amount was found in petsai. This could be due to petsai has short life period, about 4-5 weeks. So only a little larvae attacked this plant and parasitoids too.

Table 1. Idividual amount, species, and family parasitoid larvae of Lepidoptera in several species of Brassicaceae

Order	Family	Plant							
		Cabbage		Cauliflower		Sawi		Petsai	
		Individual	Species	Individual	Species	Individual	Species	Individual	Species
Hymenoptera	Bethylidae	0	0	1	1	0	0	0	0
Hymenoptera	Braconidae	30	5	37	7	38	5	32	7
Diptera	Cecidomyiidae	10	1	8	1	5	1	6	1
Hymenoptera	Encyrtidae	4	1	8	1	17	1	6	1
Hymenoptera	Eulophidae	18	1	23	1	15	1	11	1
Hymenoptera	Ichneumonidae	24	7	34	10	24	0	13	5
Hymenoptera	Mutillidae	5	2	5	1	4	1	2	2
Diptera	Phoridae	1	1	2	1	0	0	3	1
Diptera	Tachinidae	33	1	52	1	46	1	49	2
Total		125	19	170	24	149	20	122	20

Percentage parasitoid larvae in several species of Brassicaceae showed by Figure 1. Tachinidae was a dominant parasitoid larva, which attack Lepidoptera in some species of Brassicaceae. In cabbage, Tachinidae attacked 27%, cauliflower 30%, sawi 31%, and petsai 40%.

Individual and species amount of parasitoid larvae with some collecting techniques

Result of observation about individual and species amount showed by Table 2. Yellow trap could trap more individual than insect net. Most of insects interest to yellow. Yaherwandi (2005) and Yaherwandi et al. (2006) stated that yellow trap is an effective tool for collecting parasitoid from Hymenoptera. Most of Hymenoptera parasitoid is interested to yellow, so this tool is effective to use in parasitoid diversity study.

Larvae of *P. xylostella* is a big host of parasitoid larvae. *P. xylostella* is not only attacked by Ichneumonidae, but Braconidae too. According to Kalshoven (1981) parasitoid larvae of *P. xylostella* which has been invented as *Diadegma eucerophaga* Horst or *Diadegma semiclausum* Hellen (Hymenoptera, Ichneumonidae). This Parasitoid was introduced in 1950 for the first time to control *P. xylostella*. This parasitoid can grow, because it has easy character to find the host, and the high parasitation ability even though in low population. This parasitoid can attack larvae *P. xylostella* from instart first to fourth in field (Sastrosiswojo 1996).

Larvae *C. pavonana* were the smallest individual and species amount which were parasited by parasitoid larvae. To control *C. pavonana*, farmers still use synthetic insecticide. They thought this is the easiest way to against pests. According to Sahari (1999) using insecticide can kill pest's larvae and parasitoids around the farm.

Percentage amount of parasitoid larvae that were collected with some collecting techniques showed by Figure 3. The dominant parasitoid larvae in yellow trap were Braconidae (31%). In insect net, the dominant family was Tachinidae (56%). According to larval collection, the dominant parasitoid in *C. pavonana* were Ichneumonidae and Tachinidae, it were 50% respectively. In *S. litura*, the dominant family parasitoid larvae were Braconidae (37%), whereas in *P. xylostella*, the dominant family parasitoid larvae were Ichneumonidae (77%).

Diversity index, disseminating, and variety of species

Observation result for diversity, disseminating, and variety of species in Brassicaceae showed by Table 3. Diversity in some Brassicaceae species was not different significantly. The highest diversity was found in sawi. In general, diversity rate of parasitoid larvae Lepidoptera were heterogenic. This was clearly shown by four of those plants were found 3 families parasitoid larvae, which their numbers were more than the other family. The families were Ichneumonidae, Braconidae, and Tachinidae. They were the biggest family which attacked Lepidoptera.

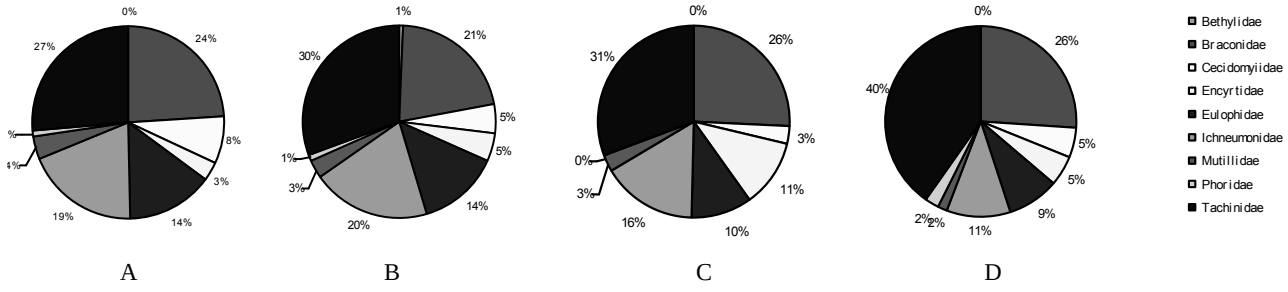

Figure 1. Percentage individual and family parasitoid larvae of Lepidoptera in several species of Brassicaceae: A. cabbage, B. cauliflower, C. sawi, D. petsai.

Table 2. Individual and species amount of parasitoid larvae which were collected by some collecting techniques.

Order	Family	Technique				Larvae collection					
		Yellow trap		Insect net		CP		SL		PX	
		Individual	Species	Individual	Species	Individual	Species	Individual	Species	Individual	Species
Hymenoptera	Bethylidae	1	1	0	0	0	0	0	0	0	0
Hymenoptera	Braconidae	105	7	22	5	0	0	4	4	6	3
Diptera	Cecidomyiidae	9	1	20	1	0	0	0	0	0	0
Hymenoptera	Encyrtidae	27	1	4	1	0	0	4	1	0	0
Hymenoptera	Eulophidae	62	1	5	1	0	0	0	0	0	0
Hymenoptera	Ichneumonidae	48	10	24	9	3	1	0	0	20	6
Hymenoptera	Mutillidae	11	3	5	1	0	0	0	0	0	0
Diptera	Phoridae	6	1	0	0	0	0	0	0	0	0
Diptera	Tachinidae	70	2	104	1	3	1	3	1	0	0
Total		339	27	184	19	6	2	11	6	26	9

Note: CP = *C. pavonana*, SL = *S. litura*, PX = *P. xylostella*

Table 3. Diversity index, disseminating, and variety of species

	Cabbage	Cauliflower	Sawi	Petsai
Diversity index	3.36	3.40	3.64	3.42
Disseminating index	0.12	0.11	0.15	0.12
Species variety	36.00	42.00	42.00	43.00

The highest disseminating species was found in sawi. Diversity rate influenced disseminating degree. Disseminating rate in four of plants was low because the spreading of insects was not spread evenly. Disseminating value was about zero to one. If the value is near to zero, it means distribution of insects in ecosystem does not spread evenly, but if it near to one, it means more disseminated (Elkie et al. 1999).

The highest variety of species was found in petsai, it was 43 species. It was because in petsai was found fixtitious hosts for parasitoid larvae. Planting system that was used by farmer in petsai was an emerging factor of fixtitious host. The lowest variety species was found in cabbage, it was 36. It was caused by disturbing on ecosystem in each planting seasons, agronomy activities, and harvest. The heavy disturbing showed low species and short food net. So only a little species can adapting and it influence to species amount of parasitoid larvae (Landis and Haas 1992; Marino and Landis 2000).

CONCLUSIONS

Diversity parasitoid larvae in West Sumatra in several Brassicaceae species are heterogenic. The highest diversity was found in sawi, it was 3.64. The highest disseminating species was found in sawi, it was 0.15. Petsai was the highest in variety of parasitoid larvae species, it was 43. Parasitoid larvae Lepidoptera which found in some species of Brassicaceae in West Sumatra were 566 individual and 83 species in 9 families. The most parasitoid larvae in field were family Tachinidae. Parasitation rate of parasitoid larvae in three of Lepidoptera was low. The most pests from Lepidoptera in Brassicaceae are *Crocidolomia pavonana* with parasitoid larvae from Ichneumonidae and Tachinidae family. Average parasitation for both of them were 0.56% and 0.53%, respectively. *Spodoptera litura* was parasited by larvae Braconidae, Tachinidae, and Encyrtidae with average parasitation rate were 0.65%, 1.07%, and 1.26%, consecutively. *Plutella xylostella* was parasited by parasitoid larvae Ichneumonidae and Braconidae with average parasitation rate were 18.77% and 6.53%, respectively.

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