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Abundance of corn planthopper (*Stenocranus pacificus*) (Hemiptera: Delphacidae) and the potential natural enemies in West Sumatra, Indonesia

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Abstract. *Nelly N, Syahrawati M, Hamid H. 2017. Abundance of corn planthopper (*Stenocranus pacificus*) (Hemiptera: Delphacidae) and the potential natural enemies in West Sumatra, Indonesia. Biodiversitas 18: 696-700.* A study about the abundance of corn planthopper *Stenocranus pacificus* and diversity of it's potential natural enemies in West Sumatra, Indonesia was conducted from July until October 2016 in Pasaman Barat, Limapuluh Kota and Tanah Datar. The method was purposive random technique sampling. Sampling *Stenocranus pacificus* Kirkaldy (Hemiptera: Delphacidae) and it's potential natural enemies were collected by using a modified d-vac vacuum. The Identification was done based on morphological differences between species. The result showed that corn planthopper was found in all study location, as well as natural enemies could be found in the vegetative and generative phase of corn. The distribution pattern of corn planthopper, *S. pacificus* generally was aggregated, except on the vegetative phase in Pasaman Barat that classified as uniform. The natural enemies that found consist of two class (Insects and Arachnids) and three ordo (Hymenoptera, Coleoptera and Araneae). Diversity index (H) of natural enemies in Pasaman Barat is higher than Tanah Datar and Limapuluh Kota district. Evenness index at all study locations showed low value (E<1).

Keywords: Corn, planthopper, diversity, natural enemies

INTRODUCTION

Corn has long been a staple food in several regions in Indonesia, such as Madura, Nusa Tenggara and Gorontalo because it contains dietary fiber with a low glycemic index compared to rice, so that the corn has been recommended for diabetics (Suarni 2009). Furthermore, the corn is also the main ingredient of animal feed and industry needs (Suarni and Yasin 2011).

Planthopper that attacked corn was *Peregrinus maidis* (Hemiptera: Delphacidae), limited the increase of corn production (Sudjak 2013). It was reported as a serious pest in Hawaii because transmitting the corn mosaic virus (rao virus and tenui virus) and causing "*hopperburn*" (Nault and Knoke 1981; Takara and Nishida 1983), *P. maidis* was attacking the corn from most of the humid tropical and subtropical regions of the world including Africa, India, Malaysia, Taiwan, Indonesia, Australia (Metcalf, 1943) and China (Tsai et al. 1986), but for this study showed that the corn planthopper in West Sumatra, Indonesia, was *Stenocranus pacificus* Kirkaldy (Hemiptera: Delphacidae).

Stenocranus was a pest invasive on corn in the Philippines, firstly inserted into the genus *Sogatella*, but the insect eventually was confirmed as *S. pacificus* (Cayabyab et al. 2009). Dumayo et al. (2007) reported, there was white waxy substance in the abdomen of female, which was absent in male. Then, Cayabyab et al. (2009) informed that the nymph and adult of *S. pacificus* attacked the corn by sucking plant sap from young leaves and leaf sheaths which could lead to stunted plant growth. The formation of a droplet of honeydew on leaves caused galls along veins and underneath leaf surface that resulted in the loss of plant vigor and stunting.

Many arthropods were classified as natural enemies of *S. pacificus* in the Philippines, namely Coccinellidae, Araneae, Dermaptera, Diptera (Syrphidae), Odonata, Neuroptera, Hemiptera (*Cyrtorhinus lividipennis*), and Strepsiptera (Dumayo et al. 2007). Nowadays, there are few reports of *Stenocranus* distribution and its natural enemies in Indonesia. This study aimed to know about the distribution pattern of *Stenocranus* and its potential natural enemies in the field, especially in West Sumatra, Indonesia.

MATERIALS AND METHODS

Study sites

The study was conducted in West Sumatra during July to September 2016, at three locations; Pasaman Barat, Limapuluh Kota, and Tanah Datar (Figure 1). The corn planthopper and its potential natural enemies were identified and counted in Laboratory of Insect Bioecology, Department of Plant Protection, Faculty of Agriculture, Universitas Andalas, Padang, West Sumatra, Indonesia.

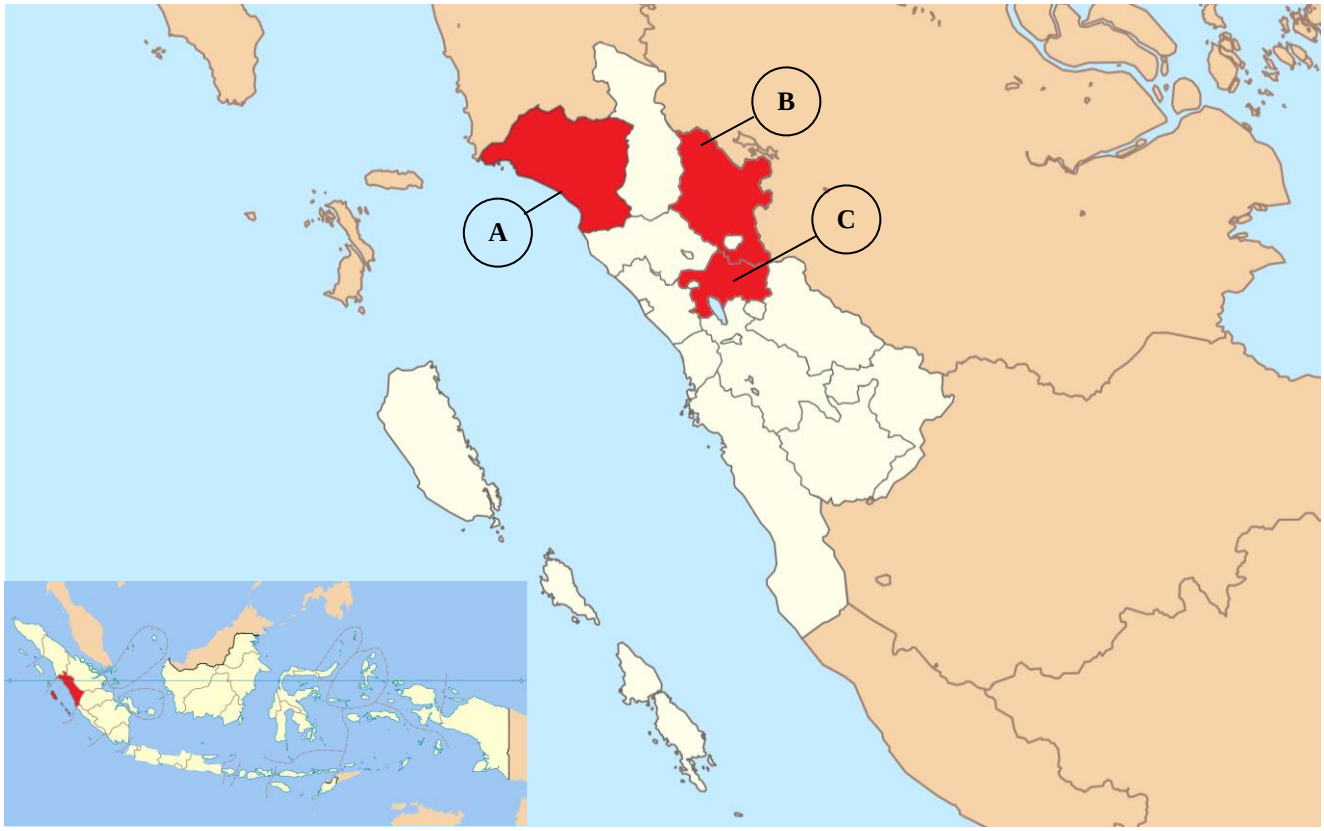

Figure 1. Study sites in West Sumatra, Indonesia. A. Pasaman Barat, B. Limapuluh Kota, C. Tanah Datar

Collecting the corn planthopper and it's natural enemies

There were two fields of corn cultivation in vegetative phase and two other fields on generative phase for collecting the corn planthopper and its potential natural enemies; each field had a measurement of 400 m^2. They were collected from 10 samples (clump) randomly from each field by using D-vac vacuum modified. All collections were put into a bag containing chloroform 95%, then, transferred into the bottle that already contained alcohol 70%. The identifying, counting and grouping were done based various reference, namely: Kalshoven (1981), Reissig et al. (1985), Wilson and Claridge (1991), Goulet and Huber (1993), Heinrichs (1994), Barrion and Litsinger (1995), Amir (2002), Triplehorn and Johnson (2005), and Heong and Hardy (2009).

Data analysis

Corn planthopper distribution

Data were tabulated in Excel program to get the value of population and mean per clump from each location. The distribution pattern was determined by calculating the standard deviation that was compared with the mean. If SD = mean, the planthopper distribution was random, SD > mean, the planthopper distribution was aggregated, and if SD < mean, the planthopper distribution was uniform.

Diversity index of natural enemies

Diversity index of natural enemies was calculated by using Shannon-Wiener index (Krebs 1999):

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

H" = Index of diversity
pi = number of individual per species/ total species

RESULTS AND DISCUSSION

The abundance and distribution of corn planthopper

The corn planthopper, *Stenocranus pacificus*, was found on all study location, as well as phases of corn (Figure 1 and Table 1). The record of *S. pacificus* during the collection indicated that phases of corn and location of cultivation played an important role on *S. pacificus* abundance but did not tend to effect on distribution pattern. *S. pacificus* abundance tended to be higher in vegetative phase than generative. The highest abundance of *S. pacificus* on vegetative phase was found in Tanah Datar (15 individual/clump), whereas the lowest was found in Limapuluh Kota (0.25 individual/clump). The highest abundance on generative phase was found in Pasaman Barat (2.50 individual/clump), whereas the lowest was found in Tanah Datar. Distribution pattern generally was aggregated, except on the vegetative phase in Pasaman Barat that classified as uniform (Table 1).

Figure 1. *Stenocranus pacificus*, the corn planthopper that was found in West Sumatra, Indonesia (*left*: nymph, *right*: adult - female)

The potential natural enemies of corn planthopper

The record of potential natural enemies indicated that phases of the corn and location of cultivation also played an important role in diversity and abundance of them. In general, there were 19 families of arthropods which potentially as natural enemies of *S. pacificus*. Ten families were classified as a predator, while nine families were classified as a parasitoid. From 10 predators that found, five of them included in the Order Araneae (spiders), while the others included in the Order Coleoptera, Dermaptera, Hymenoptera, and Mantidae. Meanwhile, all of the parasitoids came from the Order of Hymenoptera, two families (Ichneumonidae and Scelionidae) were only found on vegetative phase, and four families (Braconidae, Elasmidae, Mymaridae, Pteromalidae) were only found on generative (Table 2 and 3).

In the vegetative phase, 14 families of arthropods were found as potential natural enemies, which was dominated by Formicidae (ants) and occupied 78.42% of the total natural enemies that be found in the field. Meanwhile, Anthicidae and Coccinellidae are two families of Coleoptera which had a higher population compared to other natural enemies. The highest Formicidae was found in Limapuluh Kota (37.79%), while the highest Anthicidae and Coccinellidae were found in Tanah Datar (5.17% and 2.74% respectively) (Table 2).

In the generative phase, 18 families of arthropods were found as natural enemies, also dominated by Formicidae (ants), which occupied 38.15% of total natural enemies. Meanwhile, Coccinellidae and Cucujidae are two families of Coleoptera which had a higher population compared to other natural enemies. The highest Formicidae was found in Tanah Datar (30.25%), whereas the highest Cucujidae and Coccinellidae were found in Pasaman Barat (12.81% and 8.45% respectively) (Table 3).

The diversity index of natural enemies generally ranged from 1.09 (low) to 2.55 (medium). The highest diversity index was found in Pasaman Barat (2.55), but the highest evenness index was found in Limapuluh Kota (0.84) (Table 4).

Discussion

The result of the study showed that corn planthopper, *Stenocranus pacificus*, was found on all study location. It showed that *S. pacificus* had widespread in West Sumatra. Heong and Hardy (2009) stated that *S. pacificus* have distribution in Fiji Island, Western Caroline Island, Palau, and the Philippines. The phases of corn and location of cultivation played an important role on *S. pacificus* abundance, natural enemies diversity and it's abundance. *S. pacificus* abundance tended to be higher in vegetative phase than generative, on the contrary, the diversity and abundance of natural enemies tended to be higher in generative phase (Table 1 and 2).The high abundance of *S. pacificus* in vegetative phase is closely related to foraging behavior of the insect belonging piercing-sucking type. According to Havlin et al. (2005), the ability of the insect to take the food from the host will depend on the strict level of the stem. The younger the plant, the easier the corn planthopper to suck needed nutrients. Diversity and abundance of natural enemies tended to be higher in generative phase. A similar phenomenon has been reported in other studies such as Hadi et al. (2013) who studied diversity and abundance of rice stem borer in Central Java. They found the highest diversity of rice stem borer during rice generative phase until ripen and decline in line with the age of rice. Species diversity index in vegetative phase was below 2, while during generative phase until ripening increased above 2. Insect population abundance declined, in the end, vegetative phase and increased at the beginning of reproductive phase until ripen phase.

The distribution pattern of *S. pacificus* generally was the group, except on the vegetative phase in Pasaman Barat that classified as uniform. These results indicate that the differences in location could affect the distribution patterns of insect. Sedaratian et al. (2010) were concluded that soybean varieties affect the population density and spatial distribution of *Thrips tabaci*. Roiz et al. (2015) results also suggest that for mosquitoes, hydroperiod, inundation surface and NDVI (Normalized Difference Vegetation Index) are strongly related to the spatial distribution of mosquitoes

The results obtained showed that the Formicidae (ant)was natural enemies the greatest abundance, both in the phase of vegetative and generative. It could happen because the ant can form colonies and able to live in various conditions. Franks (2009) stated that ants are now extremely successful ecologically. They dominate, at their size scale, many terrestrial ecosystems from latitudes north of the boreal tree line to such southern climes as Tierra del Fuego, Chile. In certain tropical forests the contribution of ants to the biomass is spectacular. In Brazilian rain forests, for example, the biomass of ants has been estimated as approximately four times greater than the biomass of all of the vertebrates combined. The Study of Pérez-Bote and Romero (2012) showed that soil fauna was numerically dominated by Formicidae (26.60%), Coleoptera (19.77%), and Aranae (16.76%)

Table 1. Population (individual/clump) and distribution pattern of corn planthopper on vegetative and generative phase in West Sumatra, Indonesia

Phase of corn	Districts	Corn planthopper (mean)	Standard Deviation (SD)	Distribution pattern
Vegetative	Pasaman Barat	4.45	2.82	Uniform
	Limapuluh Kota	0.25	0.54	Aggregated
	Tanah Datar	15.00	23.69	Aggregated
Generative	Pasaman Barat	2.50	3.59	Aggregated
	Limapuluh Kota	1.70	2.57	Aggregated
	Tanah Datar	0.70	1.10	Aggregated

Note: Distribution pattern of corn planthopper; mean = SD, random; mean < SD, aggregated; mean> SD, uniform

Table 2. The abundance of potential natural enemies of corn planthopper on vegetative phase in West Sumatra, Indonesia

Class	Ordo	Family	Number of species	District						Total	
				Pasaman Barat		Limapuluh Kota		Tanah Datar			
				Ind	%	Ind	%	Ind	%	Ind	%
Arachnida	Araneae	Linyphiidae	1	4	1.22	1	0.3	0	0	5	1.52
Arachnida	Araneae	Lycosidae	2	7	2.13	1	0.3	0	0	8	2.43
Arachnida	Araneae	Oxyopidae	1	1	0.3	0	0	0	0	1	0.3
Arachnida	Araneae	Salticidae	1	7	2.13	1	0.3	0	0	8	2.43
Arachnida	Araneae	Tetragnathidae	1	2	0.61	0	0	0	0	2	0.61
Insecta	Coleoptera	Anthicidae	1	1	0.3	0	0	17	5.17	18	5.47
Insecta	Coleoptera	Coccinellidae	4	2	0.61	2	0.61	9	2.74	13	3.95
Insecta	Dermaptera	Forficulidae	1	0	0	1	0.3	0	0	1	0.3
Insecta	Hymenoptera	Chalcididae	1	1	0.3	0	0	5	1.52	6	1.82
Insecta	Hymenoptera	Eulophidae	1	1	0.3	0	0	0	0	1	0.3
Insecta	Hymenoptera	Eupelmidae	1	1	0.3	0	0	0	0	1	0.3
Insecta	Hymenoptera	Formicidae	2	15	4.56	123	37.39	120	36.47	258	78.42
Insecta	Hymenoptera	Ichneumonidae	1	0	0	1	0.3	0	0	1	0.3
Insecta	Hymenoptera	Scelionidae	2	0	0	0	0	6	1.82	6	1.82
		Total	20	42	12.77	130	39.51	157	47.72	329	100

Notes: Ind = individual/clump; % = number of individual/clump that was divided by the total (329) and multiplied by 100

Table 3. The abundance of potential natural enemies of corn planthopper on generative phase in West Sumatra, Indonesia

Class	Ordo	Family	Number of species	District						Total	
				Pasaman Barat		Limapuluh Kota		Tanah Datar			
				Ind	%	Ind	%	Ind	%	Ind	%
Arachnida	Araneae	Linyphiidae	2	23	6.27	1	0.27	4	1.09	28	7.63
Arachnida	Araneae	Lycosidae	1	5	1.36	2	0.54	2	0.54	9	2.45
Arachnida	Araneae	Oxyopidae	1	5	1.36	0	0	0	0	5	1.36
Arachnida	Araneae	Salticidae	1	23	6.27	0	0	0	0	23	6.27
Arachnida	Araneae	Tetragnathidae	1	5	1.36	0	0	0	0	5	1.36
Insecta	Coleoptera	Anthicidae	1	6	1.63	0	0	1	0.27	7	1.91
Insecta	Coleoptera	Coccinellidae	5	47	12.81	10	2.72	19	5.18	76	20.71
Insecta	Coleoptera	Cucujidae	1	31	8.45	0	0	3	0.82	34	9.26
Insecta	Dermaptera	Forficulidae	2	12	3.27	0	0	0	0	12	3.27
Insecta	Hymenoptera	Braconidae	1	0	0	1	0.27	2	0.54	3	0.82
Insecta	Hymenoptera	Chalcididae	1	1	0.27	0	0	0	0	1	0.27
Insecta	Hymenoptera	Elasmidae	1	0	0	0	0	1	0.27	1	0.27
Insecta	Hymenoptera	Eulophidae	2	0	0	0	0	14	3.81	14	3.81
Insecta	Hymenoptera	Eupelmidae	1	0	0	0	0	4	1.09	4	1.09
Insecta	Hymenoptera	Formicidae	3	19	5.18	10	2.72	111	30.25	140	38.15
Insecta	Hymenoptera	Mymaridae	1	0	0	2	0.54	1	0.27	3	0.82
Insecta	Hymenoptera	Pteromalidae	1	0	0	0	0	1	0.27	1	0.27
Insecta	Orthoptera	Mantidae	1	0	0	0	0	1	0.27	1	0.27
		Total	26	177	48.23	26	7.08	164	44.69	367	100

Notes: Ind = individual/clump; % = number of individual/clump that was divided by the total (329) and multiplied by 100

Table 4. Diversity of potential natural enemies of corn planthopper in West Sumatra, Indonesia

District	Diversity index (H')	Evenness index (E)
Pasaman Barat	2.55	0.44
Limapuluh Kota	1.09	0.84
Tanah Datar	1.35	0.47

The highest diversity index of natural enemies was found in Pasaman Barat, but the highest evenness index was found in Limapuluh Kota. The result indicated that the location is influencing diversity index of insect. It could happen because the different locations will have different vegetation patterns. Chima et al. (2006) found in fragmented habitats of the University of Port Harcourt, Nigeria, alpha diversity was highest in the Biodiversity Conservation Area, followed by residential area and arable farmland respectively, while monoculture plantation ofmm *Hevea brasiliensis* had the lowest diversity. Effendy et al. (2013) also found that the edge of the rice crops and land in the surrounding areas had a close relationship. The land could be a bridge between the predatory arthropods paddy crop in the next season. Evenness index at all study locations showed low value (E<1), despite the highest index values obtained in Limapuluh Kota. This is due to the dominant species at each location. The Formicidae had high abundance in all locations resulting diversity index is low. High levels of dominance in an ecosystem showed high densities in certain species compared to other species. It will affect the level of evenness of species in an ecosystem (Effendy et al. 2013).

The corn planthopper was found in all study location, as well as natural enemies could be found in the vegetative and generative phase of corn. The distribution pattern of corn planthopper, *Stenocranus pacificus* generally was aggregated, except on the vegetative phase in Pasaman Barat that classified as uniform. The natural enemies that found consist of two class (Insects and Arachnids) and three orders (Hymenoptera, Coleoptera, and Araneae). Diversity index (H) of natural enemies in Pasaman Barat is higher than Tanah Datar and Limapuluh Kota district. Evenness index at all study locations showed low value (E<1).

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