Abundance and Diversity of Coccinellid Predators in Rice Field Ecosystem in Payakumbuh District, Indonesia

ABSTRACT

Aims: The study aimed to identify the study the abundance and biodiversity of Coccinellid predators in rice field Ecosystem in Payakumbuh District, Lima Puluh Kota Regency, West Sumatera, Indonesia.
Study design: Purposive random sampling
Place and Duration of Study: The research was conducted in rice field Payakumbuh District, Lima Puluh Kota Regency, West Sumatera and Laboratory of Pest, Faculty of Agriculture, Riau University, Pekanbaru, Indonesia from January to April 2022.
Methodology: Purposive random sampling was used in the research. Three rice field in Payakumbuh District was chosen as sampling location. Sweep net method was using to collect the coccinellid and the collected coccinellids were identified in Pest Laboratory, Faculty of Agriculture, Riau University, Pekanbaru, Indonesia. The data was analyzed by using Shannon-Winner diversity index to analyse biodiversity and evenness index
Results: Nine individuals of three species of coccinelid predator were found in rice field ecosystem in Payakumbuh district. The species were *Micraspis lineata* (20 individuals), *Menochilus sexmaculatus* (9 individuals) and *Coleophora bisselata* (1 individuals). The species diversity index (H') and species evenness index (E) were 0.73 and 0.66 respectively.
Conclusion: The diversity of coccinellid predator in rice field in Payakumbuh district was quite stable and more stable.

Keywords: Abundance, coccinellids, diversity, ecosystem, predator

1. INTRODUCTION

Rice (*Oriza sativa* L.) is main carbohydrate source for Indonesian people [1]. The demand of rice in Indonesia always increases year by year due to the population growth. In West Sumatera, Indonesia, Lima Puluh Kota regency is one of rice producer and Payakumbuh district is included as a part of them [2].

Regardless of production increasing effort, the pest attack is always the problem in rice cultivation, both of quality and quantity of rice. Several pests were reported as main rice pest such as brown planthopper (*Nilaparvata lugens*), stink bug (*Leptocorisa acuta*), green planthopper (*Nephotettix virescens*), stem borer (*Scirpophaga interculas*) and leafhopper (*Oxya* spp.) [3]. Brown planthopper, beside being a pest that can cause the serious damage, it also plays a role as grassy stunt virus vector [4][5].

An effective effort to control brown planthopper is Integrated pest management (IPT) application and one of IPT component is biological control [6]. Biological control by using natural enemies such as predator was effective to control pest population. Coccinellid predator is general natural enemy that found in agricultural ecosystem of Indonesia [7].

Coccinellidae is one of Coleoptera's family that consisted seven sub-families, Epilachninae, Coccinellinae, Chilocorinae, Coccidulinae, Ortaliinae, Scymninae, dan Sticholotidinae [8]. These sub-families were know is predator for small insect such as aphid, insect eggs etc [9]. The biodiversity of coccinellid is high, 5,000 species were estimated entire the world and Indonesia, 300 species were reported [10]. In rice field ecosystem, *Micraspis lineata* and *Coccinella* sp. were reported as predator for brown and green planthopper [11]. Coccinellid predator plays important role in rice field ecosystem in keeping the web food stability. The report of abundance and biodiversity of coccinellid predator in rice field ecosystem in Payakumbuh district is required to analyze the stability of this area ecosystem. The study aimed to study the abundance and diversity of coccinellid predator in rice field ecosystem in Payakumbuh district.

2. MATERIAL AND METHODS

The research was conducted in rice field in Payakumbuh district, Lima Puluh Kota regency, West Sumatera and Laboratory of Pest, Faculty of Agriculture, Riau University, Pekanbaru, Riau, Indonesia. The research was conducted from January to April 2022.

2.1 Method

Purposive random sampling was used as method to collect the coccinellid predator in rice field. The criteria for the location was rice plant in generative stage. The area of rice field was 200 m^2. Coccinellid predator collection was conducting by using sweep net.

According the criteria, three locations were chosen as sampling locations. In each location, $\pm$500 m transect line was made. In each transect, 10 plots was determined and space among plots $\pm$ was 50 m. The area of each plot was $\pm$200 m^2. The collection of coccinellid was conducted in 8.00-11.00 a.m for each location by using sweep net. The collection of coccinellid predator in each plot was conducted in diagonal line that was determined previously. The collected coccinellid was moved to bottle that was filled by 70% of alcohol.

The collected coccinellid predator was carried to laboratory to identify. The identification was conducted in laboratory of pest, Faculty of Agriculture, Riau University, Pekanbaru, Indonesia. The coccinellid predator was identified by using the identification key in www.Waterbugkey.vcsu.edu. [12] The species determination was conducted according morphological different.

2.2 Parameter and data analysis

The parameters were richness and abundance of coccinellid predator. The richness and abundance could be obtained by calculating number of total species and number of individual of coccinellid predator in each locations.

The diversity of coccinellid predator could be measured by using Shannon-Wienner's diversity index [13].

$$H' = - \Sigma Pi \ln Pi$$
$$Pi = n/N$$

Note :
H' : Shannon-Wienner's diversity index
Pi : Individual number certain species in community
ln : Natural logarithm

n : Individual abundance of certain species
N : Total individual number of all species

The species evenness is proportion of each species in a community. The evenness could be measured by using Shannon-Wienner's evenness index [13].

$$E = H'/\ln S$$

Note :
E : Evenness index of species
H' : Shannon-Wienner's diversity index
ln : Natural logarithm
S : Total number of species

Table 1. Criteria of Shannon-Wienner's index

Diversity index (H')	Community structure condition	Category
> 2.41	Very stable	Excellent
< 2.41	More stable	Good
1.21-1.8	Stable	Medium
0.61-1.2	Quite stable	Poor
< 0.6	Unstable	Worst
Evenness index (E)	**Distribution condition type of community structure**	**Category**
> 0.81	Very stable	Excellent
0.61-0.80	More stable	Good
0.41-0.60	Stable	Medium
0.21-0.40	Quite stable	Poor
< 0.21	Unstable	Worst

Source : Krebs (1999) [13].

3. RESULTS AND DISCUSSION

3.1 Coccinellid predator abundance

Micraspis lineata was the dominant species found in rice field ecosystem in Payakumbuh district (20 individual)(Figure 1), followed by *Menochilus sexmaculatus* (9 individual)(Figure 2) and *Coleophora bisselata* (1 individual)(Figure 3).

The abundance of insect was affected by reproduction activity that supported by appropriate environmental condition and food source. In tropical area, the abundance and reproduction activity was significantly affected by season [14][15]. The season influenced the food source availability and insect survival that directly affected the abundance [16]. *M. lineata* was reported as dominant species in rice field ecosystem due to this species was a main predator of brown planthopper, a main pest of rice plant. The other result also reported that this species was also the dominant species found in rice field in low and highland of West Sumatera [17].

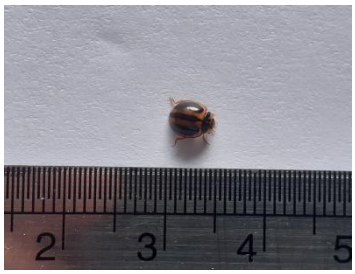

Figure 1. ***M. lineata***

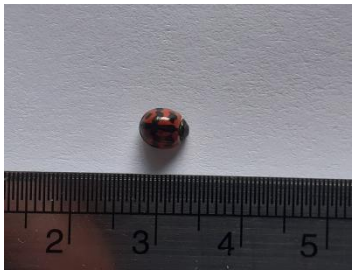

Figure 2. ***M. sexmaculatus***

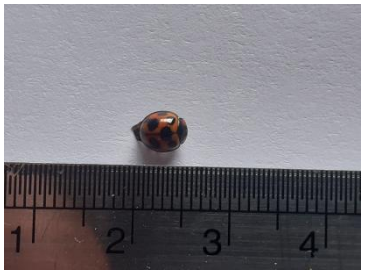

Figure 3. ***C. bisselata***

3.2 Diversity of coccinellid predator

Nine individuals of three species of coccinellid predator were found in rice field ecosystem in Payakumbuh district (Table 2). The variation of coccinellid predator found in this area due to the rice field was surrounded by other plants such as maize, chilli and yard-long bean.This condition allowed the *M. sexmaculatus* and *C. bisselata*, non-main coccinellid predator in rice field were found. A previous result also reported that these species were found in rice field ecosystem beside *M. lineata* in West Sumatera [17]. This result indicated that *M. sexmaculatus* and *C. bisselata* were also potential to be predator for rice plant pest.

Table 2. Diversity and evenness index of coccinellid predator in rice field ecosystem in Payakumbuh district

Parameter	Payakumbuh district	Criteria
Number of individual	9	
Number of species	3	
Species diversity index (H')	0.73	Quite stable
Species evenness index (E)	0.66	More stable

The diversity index of coccinellid predator in this area were Quite stable (0.73) and the evenness index was more stable (0.66)(Table 2). The diversity of species was affected by environmental gradient such as altitude and habitat structure [18]. In tropical rice field ecosystem, the insect species in was not correlated to altitude, but other vegetation around rice field [19]. The increasing of agricultural ecosystem diversity could increase natural enemy diversity and finally it could decrease the damage caused by pest [20]. Type and quality of vegetation, spacial structure and relation between vegetation in a landscape could affect the biodiversity and ecosystem function [21]. A previous result reported that the diversity index of coccinellid predator in rice field ecosystem low land was low [17]. This condition was caused by the single plant, rice was only planted in this area. A single plant caused the there was no variation of coccinellid predator in the ecosystem. This condition caused the an insect became a dominant species and finally it caused the diversity index of coccinellid in this ecosystem was low [22].

According the evenness index, the coccinellid predator of rice field ecosystem in Payakumbuh district could maintain the food chain in this area. This was supported by there was no significant symptom in rice plant caused by rice plant pest even there was no brown planthopper found in the rice plant. The evenness index inclined toward zero if a community was dominated by a species [13].

4. CONCLUSION

Nine individuals of three species of coccinelid predator were found in rice field ecosystem in Payakumbuh district. The species were *Micraspis lineata* (20 individuals), *Menochilus sexmaculatus* (9 individuals) and *Coleophora bisselata* (1 individuals). The species diversity index (H') and species evenness index (E) were 0.73 and 0.66 respectively. According the species diversity and evenness index, the diversity of coccinellid predator in rice field in Payakumbuh district was quite stable and more stable.

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