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JURNAL SYNTAX TRANSFORMATION

ROLE OF PREDATION AND ABUNDANCE OF BIOLOGICAL CONTROL AGENTS (ORDO HEMIPTERA, FAMILY REDUVIIDAE) AT SUBANG PALM OIL PLANTATION EXPERIMEN

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Abstract:
The Hemiptere Order of the Family Reduviidae has an important role in an ecosystem, namely as a natural enemy (predator) of insects, the hemiptera group itself and other arthropods. This study aims to determine the role of predation and the abundance of natural enemies in the order Hemiptera family reduviidae on oil palm plantations. This study and research was carried out in the area of a productive oil palm plantation in the village of Karapyak, Cintamekar Serangpanjang, Subang, Jawa Barat. This research is an exploratory research conducted from September 2022 to mid-December 2022. Sampling was carried out using the letter 'S' transect method with hand picking assisted by fishing nets. Identification was carried out in the laboratory of the Kampus Politeknik Kelapa Sawit Citra Widya Edukasi, Cibuntu, Cibitung, Bekasi. Data is presented in the form of tables and plot design drawings in the field, as well as sample images of sample species in the field. The abundance of species of the order Hemiptera Family Reduviidae was analyzed using the Shannon-Wiener Index and evenness was calculated according to the Pielou formula, the role of natural enemies was determined based on the behavior description and mouth type of the order Hemiptera Family Reduviidae. The results of the study obtained 37 individuals consisting of 7 genera. The diversity index (H') of the fauna of the order Hemiptera family Reduviidae on oil palm plantations of producing plants is 0.59 which is classified as in the low category. The evenness index (E') of the fauna of the order Hemiptera family Reduviidae on oil palm plantations of productive plants is 0.39 which is classified as depressed evenness.

Keywords: Biological Control Agents, Order Hemiptera, Family Reduviidae, Oil Palm.

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INTRODUCTION

Sustainable natural resources and sustainable palm oil is the most important resource in a tropical area like our country. The oil palm plantation agribusiness industry contributes greatly to regional development as an important source of alleviating the level of the economy through cultivation and processing of its downstream sector (Sudrajat, 2020). According to (Purba & Sipayung, 2018), from this area, Indonesia is capable of producing 42,883,631 tons of palm oil/year. Such a large level of oil palm production has been produced by oil palm plantations from agro-industrial companies, state plantations and smallholder plantations.

The extent of the existing oil palm plantation area is able to represent as a whole several existing types of ecosystems, especially the ecosystem of perennial and perennial plantations. Indonesia as a strategic place for the cultivation of oil palm plants has a wealth of biodiversity that ranks 2nd in the world after Brazil. (Najib, 2014), most of the diversity in Indonesia is dominated by insects when compared to other animals.

Disturbing insects that exist in the oil palm plantation area are cosmopolitan fauna that greatly suppresses FFB production in various ecosystems. Insects dominate terrestrial ecosystems because of their high adaptability. The high diversity and adaptability of the hemiptera order to environmental changes makes it beneficial for how the types and populations of the Hemiptera order of the Reduviidae family can adapt and thrive in oil palm plantation areas.

The order hemiptera of the reduviidae family influences the occurrence of balance in ecosystems, so it is often very important to pay attention and examine its essential role as a balancer of population levels in an ecosystem. This matter emphasized by (Price et al., 2011) who stated that the fauna group of the order Hemiptera of the reduviidae family, besides their role in maintaining the balance of the ecosystem, also acts as a biological agent. Aside from being a counterweight to other organisms, the order hemiptera group of the rediviidae family is also a component of biodiversity in the ecosystem chain of a plantation.

So far, there have not been many research studies on the faunal diversity of the order Hemiptera, the reduviidae family, in oil palm plantations. So it is very necessary to do research on the role of predation and the abundance of biological agents in the order Hamiptera family reduviidae in the Kebun Percobaab Politeknik Citra Widya Edukasi, Subang, Jawa Barat.

The objectives to be achieved in carrying out this research are: 1. To find out the fauna of the order Hemiptera family reduviidae found in oil palm plantations at the Kebun Percobaan Politeknik Kelapa Sawit Citra Widya Edukasi, Subang, Jawa Barat. 2. To determine the abundance of fauna of the order Hemiptera family reduviidae found in oil palm plantations at the Kebun Percobaan Politeknik Kelapa Sawit Citra Widya Edukasi, Subang, Jawa Barat. 3. To

determine the role of natural enemies of the order hemiptera fauna of the reduviidae family found in the Kebun Percobaan Politeknik Kelapa Sawit Citra Widya Edukasi, Subang, Jawa Barat.

METHODS

The process of carrying out this research was carried out for 3.5 months, from May to mid-September 2021. The implementation and sampling stages were carried out at the kebun percobaan Politeknik Kelapa Sawit Citra Widya Edukasi, Subang, Jawa Barat. Then the samples were taken and analyzed at the Laboratory of the Kampus Politeknik Kelapa Sawit Citra Widya Edukas.

Table 1. The Tools Used and Their Functions

No	Tool	Function
1.	Camera	Documentation
2.	Stationary	Take note of the samples you get
3.	Roll meters	To measure
4.	Flashlight	To lure the arrival of insects
5.	Plastic bowl	As a container for trapping insects
6.	Insect bottle	For a place to store insects to keep them intact
7.	Loupe	For insect observation in the laboratory
8.	Spoit	Syringe
9.	Tweezers	For pinching insects
10.	Chip plastic	To save the sample obtained
11.	Envelope	For storing wet unusual samples
12.	Drop pipette	To pipette the solution
13.	Yellow paper	As bait for attracting insects

Table 2. Materials Used and Their Functions

No	Ingredients	Function
1.	Alcohol 70%	To preserve the sample
2	Lesson identification book Insect introduction (Borror at *al.*, 1996)	To identify insect samples found

Research Implementation

This research is an exploratory study to look at the diversity and role of natural enemies of the order Hemiptera family reduviidae found in the area of the Politeknik Kelapa Sawit Citra Widya Edukasi, Subang, Jawa Barat. The variables in this study were the diversity and evenness

of the fauna of the order hemiptera of the reduviidae family at the Politeknik Kelapa Sawit Citra Widya Edukasi, Subang, Jawa Barat.

Research Implementation

To make it easier for researchers to determine the place of the location observation, then the determination of the location of research is based on various considerations such as time, distance and cost. The main consideration is the sustainability and sustainability of the technical management of cultivation in the oil palm plantation in the Subang experimental garden, West Java. This garden has been cultivated in a sustainable manner since 2012. Based on this, the research location was made using a letter 'S' transect method with a length of 300 m and a width of 100 m. In the form of the letter 'S' transect, 5 plots in the form of an equilateral quadrangle are installed with a length of 20 m each side. Each plot has 5 circular object sampling areas with a diameter of 7 m.

Sampling of the fauna of the order Hemiptera of the reduviidae family was carried out by taking samples of objects that comply with biological requirements in areas that are included in the research plot area that has been determined in the Politeknik Kelapa Sawit Citra Widya Edukasi Subang. The collection of fauna samples of the order hemiptera family reduviidae was carried out using the hand picking method assisted by insect nets. The layout/scheme for placement of the letter 'S' sampling plot transect (300 m long and 100 m wide) and the installation of the plot are in the form of an equilateral quadrangle with a length of 20 m each side as shown in Figure 1.

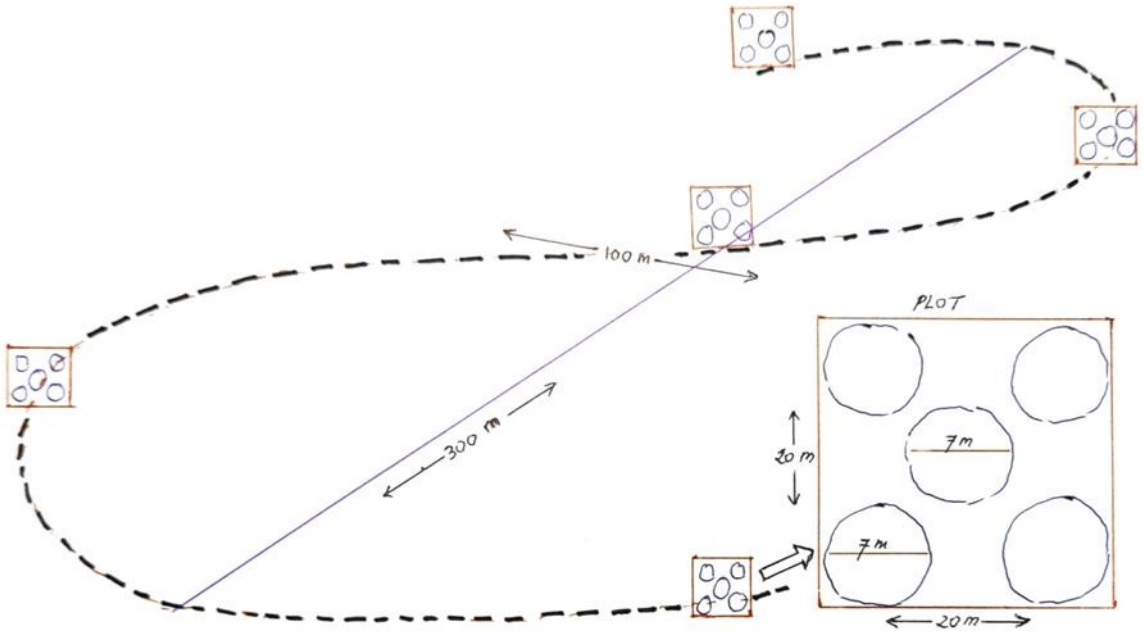

Figure 1. Layout / placement scheme of 5 sampling plot units on the large letter 'S' transect plot (300 m long and 100 m wide)

Identification of Samples of the Order Hemiptera of the Family Reduviidae

Sampling identification is based on morphological characteristics which are usually physical characteristics of the order hemiptera of the reduviidae family having two body segments which include:

a. The front part of the body is called the head (caput)
b. The middle segment is called the thorax.
c. The back is called the abdomen.

Samples that were found in the field and fulfilled the requirements were then grouped according to the sampling location and preserved with 60% alcohol, then brought to the campus laboratory to be determined and identified by observing the outer shape (morphology).

Determination was carried out using a microscope, loupe and the help of a flashlight. Identification was carried out using the sixth edition of the book Introduction to Insect Studies (Borror et al., 1996).

Data analysis

Data from the types of the order Hemiptera family rediviidae that have been obtained, then analyzed qualitatively and descriptively and displayed in the form of graphs, tables and photos. While the data from the number of species of the order Hemiptera family rediviidae obtained, then analyzed based on the Shannon-Wiener index diversity parameter (1994), in (Pelawi, 2009) with the formula:

$H = - \Sigma pi \log pi$; with: $pi = ni/N$

H = diversity index Shannon-Weaver

Pi = number of types (ni/N)

ni = important value index of one species or the number of individuals of one species.

N = the number of important value indices of all types or the number of individuals of all types

Assessment criteria based on species diversity :

$H' \leq 1$, : low diversity

$1 < H' \leq 3$, : moderate diversity

$H' > 3$, : High diversity

Diversity includes 2 main things, namely variations in the number of species and the number of individuals of each species in an area. If the number of species and the variation in the number of individuals of each species is relatively small, it means that there is an ecosystem imbalance caused by disturbance or pressure (Jumar, 2000). According to (Pelawi, 2009), A

community is said to have high species diversity if the community is composed of many species with the same or nearly the same abundance of species.

Conversely, if the community is composed of very few species and if only a few species are dominant, the species diversity is low. High diversity indicates that a community has high complexity because the community also has high species interactions. So that in a community that has high species diversity there will be species interactions involving energy transfer (food webs), predation, competition, and the division of niches which are theoretically more complex.

Evenness index (E) is determined by the following formula (Barbour et al., 1987):

E = H / (LogS)
E = Evenness Index (Eveness)
H = species diversity index
S = Number of species

This index describes the average distribution of individuals from the species of organisms that make up the community.

Assessment criteria based on species diversity:
E' < 0,50 : The community is in a state of stress.
0,50 < E' ≤ 0,75 : The community is in an unstable condition.
0,75 < E' ≤ 1,00 : The community is in a stable condition.

RESULTS AND DISCUSSION

A. Fauna Ordo Hemiptera Family Reduviidae

The fauna diversity community of the order Hemiptera family Reduviidae in a particular habitat is closely related to environmental factors and also to agro-ecosystems (Tindall, 2004). In addition, the hemiptera order of the reduviidae family is a natural enemy that acts as a predator which has a function related to controlling insect populations, especially other lepidoptera groups and regulation therein. (Yuliadhi & Pudjianto, 2015) stated that the order Hemiptera family reduviidae has a role in stabilizing the ecosystem, including in the ecosystem of a monoculture plantation such as an oil palm plantation. Differences in the type of land in a plantation will shape the vegetation structure and ecological functions which are of course specific and can affect the community structure of the abundance of the order Hemiptera, family Reduviidae.

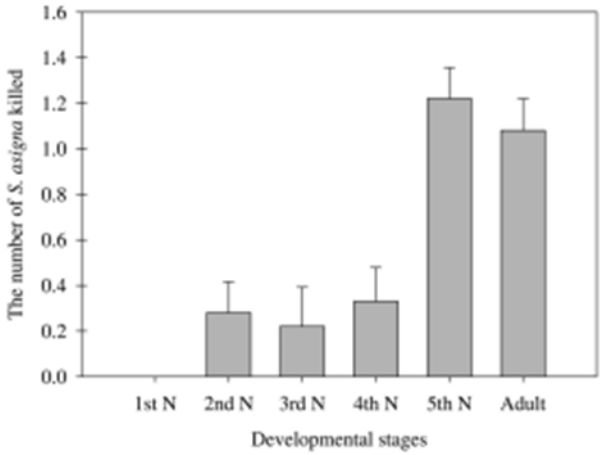

Fig 2. Mean (± S.D.) number of S. asigna larvae killed in 24 h by nymphs (N) and adults of S. Annulicornis (Sahid & Natawigena, 2018)

The abundance of fauna of the order Hemiptera of the reduviidae family is often used as an indicator of ecosystem stability because it acts as a natural enemy (predator) for arthropod groups and their presence is related to the structure and composition of vegetation in a certain area and the level of damage to the ecosystem. The aims of the study were (1) to determine the fauna of the order Hemiptera family reduviidae found on oil palm plantations at the kebun percobaan Politeknik Kelapa Sawit Citra Widya Edukasi, Subang, Jawa Barat, (2) to determine the fauna diversity of the order hemiptera family reduviidae found on kebun percobaan Politeknik Kelapa Sawit Citra Widya Edukasi, Subang, Jawa Barat, and (3) to find out the role of biological control agents in the order hemiptera fauna of the reduviidae family found in perkebunan kelapa sawit kebun percobaan Politeknik Kelapa Sawit Citra Widya Edukasi, Subang, Jawa Barat.

Fauna of the order Hemiptera family reduviidae found in the kebun percobaan Politeknik Kelapa Sawit Citra Widya Edukasi, Subang, Jawa Barat will go through a search process in a predetermined sample area, then be explored and identified. The results of exploration and identification of several species of the Araneae order in the experimental garden area of the Citra Widya Edukasi Oil Palm Polytechnic, Subang, West Java, resulted in 37 individuals belonging to 7 genera, namely: Rhinocoris, Cosmolestes, Zelus, Arilus, Sycanus, Rhiginia dan Apiomerus.

Types of fauna of the order Hemiptera family reduviidae based on the role of biological control agents as predators found in the kebun percobaan Politeknik Kelapa Sawit Citra Widya Edukasi, Subang, Jawa Barat were then taken and put in plastic bags. The results of the identification of the types of the order hemiptera family reduviidae based on their role as predators found in the Citra Widya Edukasi Oil Palm Polytechnic experimental garden which were found can be seen in Table 3.

Table 3. Number of Genuses and Individuals Ordo Hemiptera Famili Reduviidae Based on the Role of Predators (Biological Control Agents) at Kebun Percobaan Politeknik Kelapa Sawit Citra Widya Edukasi, Subang, Jawa Barat.

No	Category; Ordo Hemiptera			Role Ecology	Amount Individual (Ni)	Role Natural enemies (100%)
	Family	Genus	Spesies			
1	Reduviidae	*Rhinocoris*	*fuscipes*	Predator	2	5,405
2	Reduviidae	*Cosmolestes*	*picticeps*	Predator	10	27,027
3	Reduviidae	*Zelus*	*renardii*	Predator	1	2,702
4	Reduviidae	*Arilus*	*cristatus*	Predator	2	5,405
5	Reduviidae	*Sycanus*	*annulicornis*	Predator	17	45,946
6	Reduviidae	*Rhiginia*	*cruciata*	Predator	3	8,108
7	Reduviidae	*Apiomerus*	*crassipes*	Predator	2	5,405
Jumlah Total					37	100

B. Diversity Index (H') and Evenness (E)

The results of the calculation of the index of diversity and evenness of the order hemiptera of the reduviidae family found in the kebun percobaan Politeknik Kelapa Sawit Citra Widya Edukasi, Subang, Jawa Barat are in Table 4.

Table 4. Diversity Index (H') and Evenness (E') Type Ordo Hemiptera Family Reduviidae at Kebun Percobaan Politeknik Kelapa Sawit Citra Widya Edukasi, Subang, Jawa Barat

No	Ordo Hemiptera		Amount Individual (Ni)	Pi	lnPi	PiLn Pi	H'	E'
	Family	Genus						
1	Reduviidae	*Rhinocoris*	2	0,009	4,11	0,04	0,59	0,39
2	Reduviidae	*Cosmolestes*	10	0,029	3,52	0,11		
3	Reduviidae	*Zelus*	1	0,005	4,11	0,04		
4	Reduviidae	*Arilus*	2	0,009	4,11	0,04		
5	Reduviidae	*Sycanus*	17	0,038	2,61	0,28		
6	Reduviidae	*Rhiginia*	3	0,016	4,11	0,04		
7	Reduviidae	*Apiomerus*	2	0,009	4,11	0,04		
			37			0,59		

Table 4 shows that the diversity index (H') type ordo hemiptera family reduviidae at Kebun Percobaan Politeknik Kelapa Sawit Citra Widya Edukasi, Subang, Jawa Barat is 0,59. This shows that the criteria for species diversity of ordo hemiptera family reduviidae at kebun kelapa sawit included in the low category (H´ ≤ 1). The three criteria for species

diversity index values are, if H' < 1 means diversity is low, if H' = 1-3 means that the diversity is moderate, if H` > 3 means diversity is high (Pelawi, 2009).

Diversity index on kebun percobaan Politeknik Kelapa Sawit Citra Widya Edukasi, Subang, Jawa Barat included in the low category, this is because kebun percobaan Politeknik Kelapa Sawit Citra Widya Edukasi, Subang, Jawa Barat is a plantation ecosystem where the oil palm plantation community includes a monoculture cultivation system. Along with the routine maintenance of the experimental garden area, it certainly affects the formation of colonies fauna ordo hemiptera family reduviidae.

This is supported by (Buchori, 2014) statement, which states that natural ecosystems have high diversity compared to oil palm plantation ecosystems. The diversity index tends to be high in older communities and tends to be low in communities where there are frequent human activities and clearing of cultivation areas.

Of the 7 genera found, each genus has a varying number. These varying numbers cause the value of the genus diversity index to also vary. The diversity index will increase along with the increase in the evenness of the abundance of species. From an ecological point of view, the number of species in a community is important because species diversity appears to increase when the community is stable and undisturbed.

Species diversity is a characteristic level in a community based on its biological organization, which can be used to describe the structure of the community (Tarumingkeng, 2009). A community is said to have high diversity if the community is composed of many species with the same and almost the same abundance of species. Conversely, if a community is composed of a few species and if only a few species are dominant, the species diversity is low.

Result of evenness index calculation (E') type ordo hemiptera family reduviidae at Kebun Percobaan Politeknik Kelapa Sawit Citra Widya Edukasi, Subang, Jawa Barat as big 0,39, this shows that the level of evenness of several genera in the oil palm plantations is classified as even under depressed conditions. According to (Pelawi, 2009), three criteria for the environmental community based on the value of evenness, namely when E' < 0,50 then the community is in a state of stress. When 0,50 < E' ≤ 0,75 then the community is in an unstable condition while 0,75 < E' ≤ 1,00 then the community is in a stable condition. Evenness index value (E') can describe the stability of a community. The smaller the value E' or close to zero, the more unequal the distribution of organisms in the community that is dominated by certain types and vice versa the greater the value E' or close to one, then the organisms in the community will spread evenly.

Figure 3. Cosmolestes eggs. (Source : Google, 2023)

C. The Role of Biological Control Agencies

In the order Hemiptera, which plays an ecological role as a biological control agent, it can become a natural enemy of insect pests, one of which comes from the reduviidae family (Shanker et al., 2016). Zelus renardii is a common species found in oil palm plantations. This species is a natural enemy of oil palm pests. Pests that usually fall prey to the group of fire caterpillars. This type of caterpillar is commonly found in the undergrowth of oil palm plantations. The general characteristics of this species are that the body is dominated by brown, the abdomen which merges with the thorax looks small and the female imago has a brighter color than the male imago (Yaherwandi & Diratika, 2020). Reduviidae is a member of the order hemiptera in which all members act as natural enemies, especially as predatory insects. Reduviidae are polyphagous insects that can prey on more than 1 species of prey.

The order hemiptera group of the reduviidae family are capable predators suppress insect pest populations on various types of plants such as crops oil palm and other cultivated crops. This family is a predator that preys on the larvae that destroy plant leaves, especially the oil palm leaf-eating caterpillar (UPDKS). For example R. fuscipes from the reduviidae family can prey on armyworm pests. This biological control agent has a very quiet and sluggish performance compared to ladybugs that suck plant fluids.

Many times the predator R. fuscipes stops, then takes a stance waiting for its prey to pass, like the praying mantis which is endowed with modified front legs to catch and prey (Sahid et.al, 2018). When the prey is close enough to it, the front legs of R. fuscipes are extended forward as fast as lightning, and the prey is already in its grip. After the prey is gripped, the predator R. fuscipes will jab needle (stylet) into the body of the prey slowly on a soft spot between its body segments (Farehan et al., 2013).

Table 5. The Development duration of Sycanus sichuanensis Hsiao

Stage	Development Duration (Days)		
	minimum	maximum	average
Egg	13	16	15.37
1 st-instar	12	16	12.84
2 nd-instar	12	22	15.43
3 rd-instar	18	35	22.69
4 th-instar	46	66	56.25
5 th-instar	102	172	145.78

(Source: (Liu et al., 2012))

Another species, one example of the reduviidae family, is Sycanus annulicornis, which is still classified in the order hemiptera, the reduviidae family. S. annulicornis is one of the potential predator groups in the field. (Jamjanya et al., 2014) stated that this predator has the ability to live in various agro-ecosystems, both in food crop, vegetable and plantation agro-ecosystems with a wide range of prey, especially from the Order Lepidoptera.

S. annulicornis predators lay eggs in groups forming elongated egg packets. The eggs are oblong-shaped, brown in color, and are laid in packages arranged in several rows. The eggs are coated with a liquid which functions to glue the eggs to form egg packages, besides that this liquid also functions to glue the egg packages to the surface. The coating also functions to protect the eggs from attack by bullies and other natural enemies (Sahid & Natawigena, 2018).

Instar 1 Instar 2 Instar 3 Instar 4 Instar 5

Fig 4. Nimphs Sycanus annulicornis instar 1 until instar 5

(Source: (Sahid & Natawigena, 2018))

D. Utilization of Biological Control Agents Is Part of Integrated Pest Management

The concept of sustainability and sustainability provides a policy that the use of chemicals is dangerous enough to control the risks of chemical applications in oil palm

plantation areas and can potentially also be a threat to biodiversity. Therefore, many plantation companies are starting to engage in environmentally friendly development methods and approaches to integrate pest monitoring and control through an Integrated Pest Management (IPM) practical approach.

Figure 5. Since hatching nymphs Sycanus annulicornis already actively looking for prey
(Source: Doc. Personal (2022)

If a prey has been accepted by a predator, then the predator will continue to eat the prey as a means to support the growth and development and reproduction of the predator, but if the prey is not suitable then the reaction will be different for each predator, 1) the predator immediately regurgitates the prey, 2) the predator instantly dies due to the poison content in the prey, 3) the predator remains alive but with very slow growth and development, and if it manages to reach an imago, its life span will be short and have very low fecundity and fertility (Ambrose et al., 2007).

The IPM system implemented combines natural control, biological control, and technical (biological and chemical) control (Maredia et al., 2003). Technical control as a last resort is carried out when natural and biological control is no longer able to significantly suppress pest populations. Natural and biological control utilizes natural enemies (predators, parasitoids, and entomopathogens) which are able to suppress pest populations naturally and reduce the risk of environmental damage due to the use of pesticides (Buchori, 2014).

CONCLUSION

Based on the results of research conducted on oil palm plantations at the Citra Widya Edukasi Palm Oil Polytechnic, Subang, West Java, it can be concluded that the total number of individuals belonging to the order Hemiptera family reduviidae was found to be 37 individuals in 7 genera, namely: Rhinocoris, Cosmolestes, Zelus, Arilus, Sycanus, Rhiginia and Apiomerus. The diversity index (H') of the fauna of the order hemiptera family reduviidae in plantation areas producing oil palm plantations is 0.59 which is classified as low diversity, while the

evenness index (E') of the fauna of the order hemiptera family reduviidae in plantation areas producing oil palm plantations is 0.39 which is classified as depressed evenness. Based on the role of natural enemies, the fauna of the order Hemiptera family reduviidae in plantation areas producing oil palm plantations are predators.

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