The Existence Spesies of Passionflower (Turnera subulata J.E SM. and Turnera ulmifolia L.) on Palm Oil Plant (Elaeis guineensis J.) Against to The Diversity of Entomofag and Phytophage Insects

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The Existence Spesies of Passionflower (*Turnera subulata* J.E SM. and *Turnera ulmifolia* L.) on Palm Oil Plant (*Elaeis guineensis* J.) Against to The Diversity of Entomofag and Phytophage Insects

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Abstract

The research was purposed to inventory and identification types of entomofag and phytophage insects on Passionflower Plants in the area of PT. Tania Selatan part of Burnai Timur I . The area of research is ± 20 hectares, dominated by two species of Passionflower, there are Passionflower of Yellow Flower (*Turnera subulata* J.E SM.) and Passionflower of White Flower (*Turnera ulmifolia* L.). Entomofag and phytophage insects were collected using D-vaccum, and sweep net in every kind of Passionflower , started July until August 2017. The identification of entomofag and phytophage insects were done in the Laboratory of Postgraduate Sriwijaya University. The results of the study were 8 orders, 34 families and 48 species on *T. subulata* plants, and 9 orders, 26 families, 36 species on *T. ulmifolia* plants. The value of diversity index from entomofag and phytophage insects in T. subulata were 2.912 plant and the value of diversity index from entomofag and phytophage insects in *T. ulmifolia* plants were 2.603.

Keywords: Passionflower, Phytophage, Entomofag, Diversity Index,

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1. Introduction

The oil palm plantation sector (*Elaeis guineensis* J.) played an important role for national development, because it also can be the source of jobs field and as a source of foreign exchange. Palm oil is one species of tropical and annual plants. Palm oil came from West Africa. This plant thrives in many countries including Indonesia, Malaysia, Thailand, and Papua New Guinea. Palm oil began to be cultivated commercially in 1991. Andrian Hallet, a Belgian citizen, was the first person that pioneering the oil palm plantation business in Indonesia (Masykur, 2013). Palm oil plants has the advantage on production rather than other plants oil. 1 ha of palm oil can produce 5.000 kg crude oil or almost 6.000 liter of crude oil. As a comparisson, soybean plants and corn only able to produce around 172 to 440 liters per ha. The high productivity of palm oil plant and also long production period arround (22 years) make the production cost most cheaper (Suprainingsih, 2012).

Ecological conditions in oil palm plantations belong to the category of monoculture, there is only one dominant plant species. Monoculture conditions in oil palm plantations are an indication of poor ecology. Monoculture crops can lead to reduced biodiversity in the oil palm plantation ecosystem (Simanjuntak and Syarifudin, 2016). The low biodiversity in oil palm can lead to decreased productivity of oil palm due to insect pest insects (Sembel, 2010).

Pest attacks in Indonesia become the main problem in increasing the productivity of oil palm. Insect pests are generally from the class of phytophage or plant-eaters. Phytophage insects are plant-eating insects such as oil palm crops (Meilien and Nasamsir, 2016). Some of the phytophage insects that become the main pest in oil palm are the fire worm (*Setothosea asigna*), the caterpillar sac (*Mahasena corbatti*), and another caterpillar

(*Dasychira inclusa*) (Sinaga et al., 2011). The Attack from *Setothosea asigna* and *Mahasena corbatti* can cause economically disadvantageous, because it generally attack on the palm leaves. the leaves that have been attacked by caterpillars can causing disruption photosynthesis in oil palm, 2 years after the attack will make the productivity of oil palm become worse and the plant eventually died. therefore, it needs an effort to increase the biodiversity in oil palm plantation area.

Increasing the biodiversity can be done by increasing the population of parasitoids in oil palm plants. Increasing the parasitoids can be done through conservation by providing the feed and habitat for the parasitoid imago (Utami et al., 2014). the plants which is containing pollen can be use as feed providers and also be the habitat of natural enemy populations (parasitoids and predators). Polen can be use as food sources, shelter, and breeding place before the main host or prey come into the planting area (Tyas et al., 2016).

Conservation techniques by planting T. subulataare part of the improvement in biodiversity of oil palm which refers to ISPO (Indonesia Sustainable Palm Oil) and RSPO (Roundtable and Sustainable Palm Oil). The implementation of ISPO is mandatory (obligation) and RSPO implementation is voluntary (Angelika, 2010). The implementation of ISPO and RSPO is very important, related to the regulation of the agriculture Minister No.19 / Permentan / OT / 140/3/2011 on the Guidelines for Sustainable Palm Oil Plantation in Indonesia. The implementation of ISPO and RSPO is able to increase the competitiveness of palm oil in the world market, because i'ts application can improve the environment and support life of the biodiversity (Panjaitan et al., 2014).

Passionflower (*T. subulata* and *T. ulmifolia*) are kinds of flowering plants that can be habitat for predators and parasitoids (Kurniawati and Martono, 2015). Flowering plants have ability to attract insects. This plant acts as a feed sources and can be use as a place to lay the egg. Flowering plants can attract the insect which is act as polinators and natural enemies. The presence of various types of insects are because of flowering plants led to the formation of a more stable ecosystem and the balance of ecosystem components (Yuliadhi and Sudiarta, 2012).

Flowering plants have a flower attraction, including the color and content. the flower's colour is an attraction for insects. Flowers also have many nectars and pollen contents that can be an attraction for insects (Sari dan Program 2015). Nectar and pollen are sources of carbohydrates, protein, fats, vitamin, essential minerals, it needed by insects for their growth, development, system repair and for hypopharyngeal development stimulation. (Agussalim et al.,2017). The pollen in flowering plants contains 16-30% protein, 1-7% starch, 0-15% free sugar, and 3-10% fat. Therefore, pollen can be used as a food for insect, especially larvae of the bees (Apidae), beetles, flies (Syrphidae and Anthomyiidae), Colembolla, some Orthopteroids and butterflies (Kurniawati and Martono, 2015).

Phytophage insects are kind of animal that interested in plants. they make plant as a place to lay eggs, shelters, as well as feed. Part of the plants that use as food by them include leaves, stalks, flowers, fruits, roots, liquids and honey. Almost 50% of all types of insects are plant-eaters, then the rest are insectivorous eaters. Phytophage insect is divided into two types, namely the outer eater and the inner eater of the plant. The insect that eat the outer part of the plant have chewing mouth type, generally eat the leaf's buds, stems, and almost all parts of the plant. These insects are commonly included in orthoptera, lepidoptera, and coleoptera orders. Whether, the insect which is eating inner plants generally eat by piercing, sucking, and buckling. These insects generally belong to the order lepidoptera, coleoptera and diptera. The order of diptera has the type of larvae which can pierce the parts of the plant (Hidayat, 2016).

Entomofag insects are kind of insectivorous animals including insects phytophage (plant-eating) (Jumar, 2000). Fitofag belong to insects that interested in plants, to be a food sources and shelter. Part of the plants that can be utilized by phytophage insects include leaves, stems, twigs, stems, flower nectar and plant fluids (Ledheng et al., 2016). Entomofag insects are divided into two groups, including predators and parasitoids. Predator insects can be use as a pest control efforts, although they are non-specific (may prey on other insects).

2. Materials and Method

This research has been done in oil palm plantations PT. South Tania and Postgraduate Laboratory of Sriwijaya University started from July to August 2017. The research was using purposive sampling method, and the research location was divided into 2 regions. special-

itation A Area, there are 3 *T. subulata* Plants, and 3 *T. ulmifolia* Plants., and B area there are 3 Turnera Plants, and 3 *T. ulmifolia* Plants.

Collection of phytophage and entomofag insects in each flower was using D-Vaccum Poulan PRO BVM200VS (Figure. 1) (swallow insects) and sweep net (insect net). Each trap was applying in the morning, afternoon and has been observed too. Sampling entomofag and phytophage insects from the trap device was performed 12 times for 6 weeks. The identification of entomofag and phytophage insects was identified by the basis of morphological features. Books used for identification include: (Kalshoven, 1981), (Stary & Scblinger, 1967), (Venkataraman, 2010), (Zahradnik et al., 1991), and (Anderson, 1998).

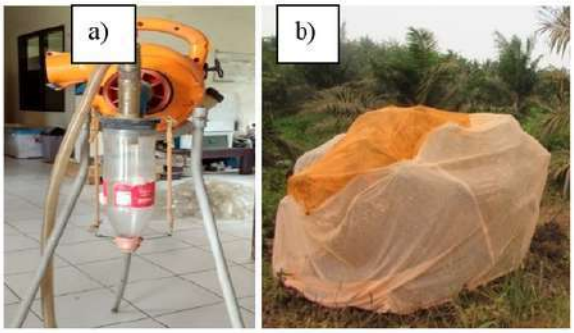

Figure 1. Insect collection tool (a) device D- Vaccum (b) sweep net'

The obtained data of Entomofag and phytophage insects are shown in tabular form. it has been used for determine the number of entomofag and phytophage insects. The data obtained has been also used for find out the index of diversity from entomofag and phytophage insects at *Passionflower* plants.

The species diversity index (Shannon Index) (Magurran, 1998), calculated by the formula:

$$H' = -\sum pi \ln pi$$

Description:

H'	= index of species diversity
p*i*	= *ni*/N
n*i*	= number individual species-i
N	= total number of individuals

The index of species dominance, calculated by Simpson formula (Indriyanto 2010),:

$$D = \sum \left(\frac{ni}{N}\right)^2$$

Description:

D	= species dominance
n*i*	= the number of individual species-i
N	= total number of individuals

Criteria value of dominance index:

D < 0,5 = No species domintes other species or stable structural community

D > 0,5 = There are species dominating other species or unstable structural community

The index of species dominance,calculated by the formula (Odum, 1998)

$$e = \frac{H'}{H\ max}$$

Description:

e	= the evenness index
H'	= the index of species diversity
H max	= the index of maximum diversity (ln S)
S	= number of species

Criteria value of fairness index:

E < 0,5 = The similarity between species is low, means the individual wealth owned by each species is very much different

E > 0,5 = The similarity between species is relatively equal or the number of each species is equal.

3. Results And Discussion

1. Number of Entomofag Species and Insects Fitofag found in Turnera subulata cultivation.

The result of this study shows Passionflower plants that had been planted around palm trees can affect the presence of entomofag species and phytophages. The results also showed that entomofag species and phytophage found in yellow flower of Passionflower plants (T. subulata), classified into 8 orders, and 34 families and 47 species totally as much 319 insects (table 1) shows that the entomofag species that have been found inthe Turnera subulata plant is around 12 species and the phytophages

have 35 species.

Table 1. Number of Entomofag Species and phytophage that have been found in *Turnera subulata*.

No.	Order	Family	Genus/ species	*Turnera subulata*
1	Araneae	Oxyopidae	*Oxyopes javanus*	2**
		Salticidae	*Paraphidippus aurantius*	1**
		Thomisidae	*Misumonoides formisipes*	2**
2	Coleoptera	Chrymsommelidae	*Chrysochus auratus*	2*
		Coccinellidae	*Epilachna* sp	7**
			Harmonia testudinaria	6*
			Harmonia octomaculata	3**
			Melanochillus sp	4*
		Curculionidae	*Orchestes testaceus*	1*
		Endomychidae	*Mycetina cyanipennis*	2*
		Scarabaeidae	*Protetia fusca*	1*
3	Diptera	Calliphoridae	*Crymsomya* sp	3*
		Limoniidae	*Eugnophomyia luctosa*	2*
		Micropezidea	*Rainieria antennaepes*	2*
		Platystomatidae	*Europsia* sp	2*
		Tubanidae	*Tabanus* sp	3*
		Syrphidae	*Helophillus pendulus*	25**
		Tephritidae	*Bactocera cucurbitae*	3*
4	Hemiptera	Achantosomatidae	*Plautia affinis*	4*
		Alydidae	*Leptocorisa oratorius*	2*
		Arradidae	*Mezira membranaceae*	1*
		Auchenorryncha	*Bothgoria ferruginea*	4*
		Corridae	*Homoecellus marginellus*	12*
		Flatidae	*Ricaniidae planthopper*	4*
			Siphanta eberhardi	5*
		Pentatomidae	*Eochanthecona furcelatia*	2**
			Sciocoris homalonatus	2*
		Phyrrhocoridae	*Dsydercus cingulatus*	4*
		Rophalidae	*Corizus hyoscyami*	1*
5	Hymenoptera	Apidae	*Andrena nubecula*	29*
			Apis dorsata	71*
			Xhylocopa apidae	2*
			Xhylacopa latreille	2*
		Formicidae	*Comfonotus* sp	64*
			Dolichiderus thoracicus	6**
			Odontoponera sp	49*
		Halictidae	*Sphcodes davisii*	3**
		Vespidae	*Ancistrocerus* sp	9*
		Eupelmidae	*Eupelmus urozomus*	4**
		Incheumonoidae	*Eurycryptus unicolor*	1**
			Virgicnheumon digrasmus	4**
6	Lepidoptera	Articiidae	*Amata polymita*	1*
		Nhympahilidae	*Junonia orytha*	1*
			Neptis hylas	4*
7	Mantodea	Mantidae	*Hymenopus coronatus*	7*
8	Orthoptera	Accricidae	*Chlorochia prasina*	1*
			Leopard grasshopper	1*
			Valanga nigricornis	1*
Number of individuals				372
Entomofags				12
Phytopages				35
Number of species in *Passionflower*				47

Information: *Phytopages, **Entomofag

The results showed that the presence of entomofag species and phytophage insects in *T. subulata* plants was influenced by yellow color in the plant flower. The yellow color of the *T. subulata* flower (Fig. 1) is a visual factor that attracted the fitofag insects. According Sunarno (2011) there are three visual characteristics of plants that cause a plant selected by insects to lay eggs or as a food sources including; the size, shape and quality of plant colours. Based on Salarupa's research et al., (2016) yellow color in plants are able to invite entomofag species and phytophages.

Figure 1. *Turnera subulata*

The result showed that the presence of entomofag at *Passionflower* plant is influenced by the existence of phytophage that act as a prey. Entomofag finds phytopage insects using chemical sensors that respond to smells. Entomofag insects know the presence of a fitofag insect based on the phytophages's smell. based on Herlinda's research (2006), type of entomofag parasitoid and predators can find prey or host because the smell that smells on the host or prey.

2. Number of Entomofag and Phytophage that have been found in *Turnera ulmifolia* plantation.

The result showed that entomofag and phytophage insects that have been found in the yellow *Passionflower* plants (*T. subulata*) are classified into 9 orders, and 26 families and 36 species with 223 tails (Table 2). In (Table 1) show that the entomofag found in *T. subulata* plants as much 13 species and the phytophage insects have 23 species.

Tabel 2. Number of Entomofag Species and phytophage that have been found in *Turnera ulmifolia*

No.	Ordo	Famili	Genus/ spesies	*Turnera ulmifolia*	
1	Araneae	Oxyopidae	*Oxyopes javanus*		1**
		Salticidae	*Paraphidippus aurantius*		1**
		Thomisidae	*Misumonoides formisipes*		2**
2	Coleoptera	Coccinellidae	*Melanochillus* sp		2*
		Curculionidae	*Orchestes testaceus*		1*
		Endomychidae	*Mycetina cyanipennis*		1*
		Scarabaeidae	*Protetia fusca*		5*
3	Diptera	Calliphoridae	*Crymsonya* sp		3*
		Limoniidae	*Eugnophomyia luctosa*		1*
		Muscidae	*Musca sarbens*		3*
		Micropezidea	*Rainieria antennaepes*		2*
		Tubanidae	*Tabanus* sp		2*
		Syrphidae	*Helophillus pendulus*	10**	
			Eudorylas sp		1*
4	Hemiptera	Achantosomatidae	*Plautia affinis*		3*
		Auchenorryncha	*Bothgoria ferruginea*		4*
		Corridae	*Homoecellus marginellus*		3**
		Flatidae	*Ricaniidae planthopper*		2*
		Pentatomidae	*Eochanthecona furcelatta*		1**
		Phyrrhocoridae	*Dsydercus cingulatus*		1**
		Reduviidae	*Sycanus versicolor*		2**
5	Hymenoptera	Apidae	*Andrena nubecula*		20*
			Apis dorsata		50*
			Xhylacopa latreille	1*	
		Formicidae	*Comfonotus* sp		47*
			Dolichiderus thoracicus		7**
			Odontoponera sp		28*
		Vespidae	*Ancistrocerus* sp		7**
		Eupelmidae	*Eupelmus urozomus*		3**
6	Lepidoptera	Articiidae	*Amata polymita*	1*	
7	Mantodea	Mantidae	*Hymenopus coronatus*		1**
8	Odonata	Libellulidae	*Bracythemis contaminata*		2**
9	Orthoptera	Accricidae	*Chlorochia prasina*	2*	
			Leopard grasshopper	1*	
			Melanoplus differentialis		2*
Total of individals					223
Entomofags					13
Phytophages					23
Number of species					36

Information: * Fitofag Insect, **Entomofag

Table 2 show that entomofag and phytophage in-

sects are commonly found in *T. ulmifolia* plants, the type of Hymenoptera from *Apis dorsata* or bee (Figure 2) are kind of phytophage that most founded in *T. ulmifolia* plants. the bees generally aims to meet the feed (pollen and nectar). According to Wulandari et al., (2016) active bees take pollen and nectar in flowering plants which have a role to improve the quality and quantity of these plant product. Increasing the quality and quantity of flower production can make this plant being a good living habitat for insects that act as natural enemies.

Figure 2. Apis dorsata feed on nectar on *Turnera ulmifolia* plant

The results showed that entomofag presence the *Passionflower* plant influenced by phytopage. The entomofag species of the Thomisidae family, of the type *Misumonoides formisipes* or spiders are kinds of entomofag that act as prey on *Passionflower* (Fig. 3). According to Maramis (2014) Spider is an important predator in controlling phytopage as pest, especially in agricultural areas and plantations.

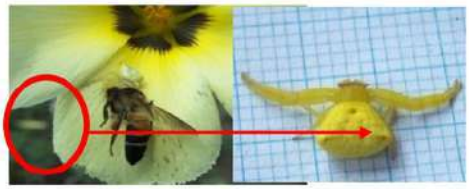

Figure 3. Misumonoides formisipes prey on Apis dorsata

3. Index of diversity, dominance and evenness of entomofag and phytophage insects at *Turnera subulata* and *Turnera ulmifolia* crops.

The results showed that entomofag and phytophage insects on *Turnera subulata* plants had higher values of diversity index than *Turnera ulmifolia* in oil palm plantation areas (Table 3).

Table 3. Index of diversity, dominance and evenness of entomofag and phytophage insects present in *Passionflower* plant

Community characteristics	Treatment	
	Turnera subulata	*Turnera ulmifolia*
Total individuals (∑)	372	223
Index of diversity (H')	2.912	2.603
Index of dominance (D)	0.091	0.125
Index of evenness (E)	0.752	0.738

The results showed that the index of diversity of entomofag species and phytophag insects on *T. subulata* plants was higher than *T.ulmifolia*. The diversity index of *T. subulata* has a value of 2.912 which is higher than T. ulmifolia with 2.603 diversity index value. Siregar et al.,(2014) Revealed that the diversity index useful to determinate the species richness the higher diversity leads to better species richness in the community. Table 3 show that *T. subulata* has the highnest species richness of both entomofag and fitofag. This highest value attributed to the higher yellow contained in the flower of T. subulata.

The result show dominance index of entomofag and fitofag in *T. subulata* and *T. ulmifolia* is 0.091 and 0.125, resvectively. The value D is less than 0.5 (D<0.5). It means that theare are no dominant species appears, on the community is in a stable condition (Hidayat et al., 2016). The stable condition can be seen from a high amount of fitofag followed by entomofag as its natural enemy.

The result reveal that the evenness indexs of fitofag and entomofag in *T. subulata* and *T. ulmifolia* is 0.725 and 0.738, resvectively . in the other words, E value is more than 0.5 (E>0.5). It means that the total eveness species or total individual of each species is nearly similar. The higher eveness value lead to higher diversity. This phenomenon makes the ecosystem becomes more stable (Odum, 1998). Thus, all of the species has a high probability to maintain is sustainability.

4. Conclusion

1. Entomofag and Phytophage in *T. subulata* planted around palm trees belong to 8 orders, and 34 families and 48 species totally as much 372 insects.
2. Entomofag and Insect Fitofag in *T. ulmifolia* plant is planted around palm trees belonging to 9 orders, and 26 families and 36 species with 223 insects.
3. The abilty to retain the community of entomofag and phytophages insects in *T. subulata* is better than *T.*

ulmifolia, its is prove by the high species diversity index value, *T. subulata* having index value as much 2.912 and followed by *T. ulmifolia* as much 2.603.

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