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Diversity of Bees and Wasp (Hymenoptera) in Cowpea (*Vigna sinensis* L.) in Agricultural Area at Martapura District, Banjar Regency, South Kalimantan

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Abstract

Bees and wasp are belong to insect which helpful for plant pollination, produces honey and wax, also can eliminate pests, one of which is in cowpea plants. This study aims to analyse the diversity of bees and wasp in cowpea (*Vigna sinensis* L.) agricultural area at Martapura District, Banjar Regency, South Kalimantan. The insect collection was carried out in the villages of Bincau, Labuan Tabu and Indra Sari using sweep net during the day and light trap at night. The result showed there are 464 individuas of from 19 species bees and wasp which distributed in three study location, namely Bincau Village (163 individuals and 17 species), Indra Sari Village (105 individuals and 14 species), and Labuan Tabu Village (196 individuals and 19 species). The highest divesity index was found in Labuan Tabu Village (H'= 1.297), while the lowest was Indra Sari village (H'= 0.587).

INTRODUCTION

Hymenoptera or bees and wasp order are one of main pollinator for agricultural plants (Widhiono, 2015). Bees and wasp are belong to insect which is useful for plant pollination, produces honey and wax, and also eliminate plant-disturbing insects (pests) (Pedigo & Rice, 2006). The Hymenoptera order is divided into two sub-orders, namely the Symphyta and Apocrita (Pedigo & Rice, 2006; Nurhikmah, 2020). Suborder Symphyta is leaf insect that less calssified as pests for plants. Suborder Apocrita is largely a parasitoid type (Kalshoven, 1981). The Hymenoptera order is found in various types of plants, one of which is cowpea.

Cowpea (*Vigna sinensis* L.) has been cultivated by Indonesians for a long time. Cowpea is originally come from India and Africa. Later spread its planting to the regions of Tropical Asia to Indonesia (Ashari, 2006). Cowpea have varieties such as *lanjaran* beans (Java), *turus* beans (Pasundan), *taukok* (Chinese), *sitao* (Philippines), *eel* beans (Malaysia), *paythenki*, *yardlong* bean and *asparagus* bean. This plant is easy to grow in various types of land, both paddy fields and *tegalan* even home yards (Allifah *et al.*, 2020). Cowpeas are annual shrubs, which tend to climbing and twisting to its prop. The leaves are composed of three strands, while the flowers are butterfly-like light blue color, the pods are green with a length of about 10 - 80 cm (Sunarjono, 2011).

Recently, farmer usually used pesticides to eliminated pest (Allifah, 2020). Unfortunatelly, application of pesticides do not only affected to pest but also pollinators such as bees and wasp (Bahagiawati, 2001) in cowpeas plantation at Martapura Distict. Hence, it is necessary to study the diversity of bees and wasp in cowpeas (*Vigna sinensis* L.) plantation in Martapura District, South Kalimantan.

MATERIALS AND METHODS

The study was conducted on cowpea farms (*Vigna sinensis* L.) in Bincau Village (B), Indra Sari Village (IS), and Labuan Tabu Village (LT), Martapura District, Banjar Regency, South Kalimantan (Figure 1).

The collection of bees and wasp was done for four weeks by two methods, namely sweep net during the day and 10 light trap at night for six hour of observation. Collected insects were preserved using papilot paper (dry preserved) and 70% ethanol (wet preserved).

The bees and wasp insect speciments were identified in the Laboratory of Entomology, Faculty of Biology, Universitas Gadjah Mada. Identification of specimen based on Borror *et al.,* (1994), Baker (2002), Michener (2007), Smith (2012), and Trianto & Purwanto (2020). In this study, measurements of temperatur was carried out on three different observation location. Evironmental temperature was estimated by using termometer.

Collected Samples are counted by the number of species (S), individual abundance (N) and displayed in tables and figures. The index calculated to determine the diversity of the Hymenoptera insect, includes the Shannon-Wienner diversity index (Magurran, 2004), Shannon-Evenness and Simpson's dominance (Singh *et al.,* 2013). The formulas of each index are:

Shannon-Wiener's Index

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

Information:
H' : Shannon-Wiener diversity Index
pi : ni/N
ni : Number of individual of ith species
N : Total number of individuals caught

Shannon-Evenness's Index

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

Information:
E : Shannon-Evenness index
Hi : Shannon-Wiener Diversity Index
S : Total of species

Simpson's Dominansi Index

$$D = \sum (pi)^2 \longrightarrow pi = ni.ni/N$$

Information:
D : Dominance Index
pi : Proportion of total samples based on ith species
ni : Number of individual of ith species
N : Total number of individuals caught

RESULT AND DISCUSSION

Generaly, environmental temperature in cowpea farms in Martapura District is ranged from 27-30^{o}C, i.e., in Bincau Village (28-29^{o}C), Indra Sari Village (27-30°C), and Labuan Tabu Village (27-29^{o}C) (Figure 2).

Fig 1. Sampling point of bees and wasp in Martapura District. B: Bincau Village, IS: Indra Sari Village, and LT: Labuan Tabu Village

Obtanined temperature is in range 27-30^{o}C, whis is the normal temperature needed for insects develoment. These temperature are highly potential for consevations and cultivation of insects (Allifah *et al.*, 2020) in Martapura district. The range of temperature in this study are similar to Dibisono *et al.,* (2017) which at range 26-31^{o}C is accpetable for insect life cycle. The same result also describe by Aminah (2011), that the observation in PPTN VII Cikasungka Bogor were showed the highest of insect visiteted are happened at 27-32°C.

According to Jumar (2000), the effective temperature for insect survival are minimum temperature of 15°C, an optimum temperature of 25°C, and a maximum temperature of 45°C. Furthermore, Tautz (2008) also explained that bees, could have normal activities around 18 - 35^{o}C of temperature with the ideal temperature of 26°C, while conditions above and below mentioned temperature begin to be disrupted. Abrol (1991) reported that *Apis dorsata* are more active in collecting nectar at around 24.5 - 34.5°C of temperature.

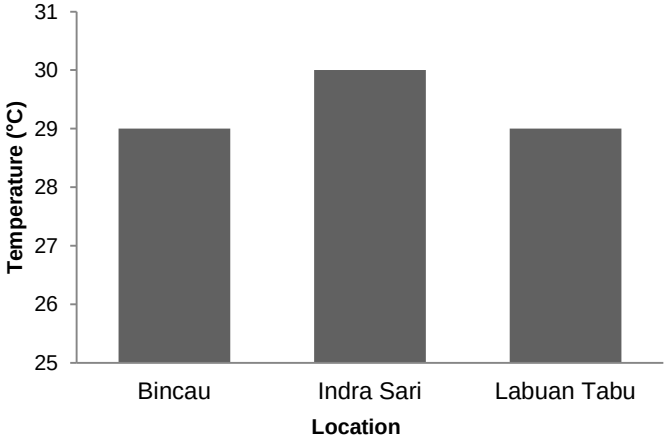

Fig. 2. Environmental temperature (°C) in cowpeas farm study sites

The Hymenoptera insects found in this study consisted of 464 individuals, 6 Families and 19 Species, which is Apidae (9 species), Colletidae (1 species), Halictidae (3 species), Megachilidae (2 species), Scoliidae (1 species), and Vespidae (3 species). According to the number of individuals found, three species are dominant, referred from the number of individuals and the number of observations location, the species mentioned are *Tetragonula laeviceps* (87 individuals) (3 locations), *Heterotrigona itama* (71 individuals) (3 location), and *Apis cerana* (54 individuals) (3 locations). Meanwhile, there are species with small numbers which consisting of *Ropallidia romandi* (3 individuals) (2 locations), *Ceratina negrolateralis* (3 individuals) (2 locations), and *Hylaeus modestus* (4 individuals) (2 locations) (Table 1).

The differences between number of individuals and species of bees and wasp found in cowpeas farm at three villages can be seen in Figure 3. Based on the Shannon-Wiener diversity index (H') shows that the cowpeas farms in Labuan Tabu Village have the highest diversity index (H' = 1.297), while the lowest (H' = 0.857) was found in Indra Sari Village. A similar trend is also shown in the Shannon-Evenness index (E) which shows the difference between two locations. Simpson's index also highest in Labuan Tabu (0.015) (D) (Table 2).

Table 1. Family and species of Hymenoptera insect collected

Family	Species	Location			Total Individuals	Percentage (%)
		B	IS	LT		
Apidae	*Amegilla cingulate*	6	2	10	18	3.88
	A. zonata	4	4	5	13	2.80
	Apis cerana	19	15	20	54	11.64
	Ceratina negrolateralis	1	0	2	3	0.65
	Heterotrigona itama	29	18	24	71	15.30
	Tetragonula laeviceps	32	20	35	87	18.75
	Xylocopa caeruleus	10	4	12	26	5.60
	X. confusa	6	0	6	12	2.59
	X. latipes	0	0	5	5	1.08
Megachilidae	*Megachile centuncularis*	10	8	14	32	6.90
	M. relative	9	7	7	23	4.96
Halictidae	*Augochlora* sp.	5	2	5	12	2.59
	Lassioglosum malachurum	7	2	4	13	2.80
	Nomia melanderi	11	11	14	36	7.76
Colletidae	*Hylaeus modestus*	1	0	3	4	0.86
Vespidae	*Delta comparniforme*	8	9	11	28	6.03
	Ropallidia fasciata	2	1	6	9	1.94
	R. romandi	0	0	3	3	0.65
Scoliidae	*Campsomeris plumipes*	3	2	10	15	3.23
Total of individuals		**163**	**105**	**196**	**464**	**100**
Total of species		**17**	**14**	**19**	**19**	

Notes: B= Bincau Village, IS= Indra Sari Village, and LT= Labuan Tabu Village

There are three types of dominant bees and wasp in this study which are T. laeviceps, H. itama, and A. cerana. This research is appropriate with Widhiono and Sudiana (2015), that the most commonly types of insect found in cowpeas plantation are Trigona sp. dan Apis cerana. Naturally, these three kind of insect have many roles, for example as a pollinator (Riyanto, 2007). According to Wratten *et al*., (2012) and Nursal (2014), described that the high level of bees and wasp diversity as pollinator could be impact by flower color, amount of flower and the environmental conditions themselves such as temperature factors. Winfree *et al*., (2008) also described that the presence of flowers is affected on density stability of population also improve the value of insect diversity.

Table 2. Diversity of Hymenoptera insects

Criteria	Location			Total
	Bincau	Indra Sari	Labuan Tabu	
∑ Individual	163	105	196	464
Relative (%)	35.13	22.63	42.24	100
∑ Species	17	14	19	
Shannon-Wienner index (H')	1.253	0.857	1.297	
Dominansi Simpson (D)	0.013	0.006	0.015	
Shannon Evennes	0.610	0.373	0.637	

Bassicaly, insect is required two major things for living, spesificaly place for nesting and source of food such as the presence of nectar and pollen (Kremen & Ricketts, 2000). According to Riyanto (2007) ecologically Hymenoptera insects can be useful for other animals and plants, because they have has an important role in the food chain, which is utilized as predators and pollinators to reduce pests and support the development of plants on plantations. The interaction between pollinator and flowering plants especially for cowpea is mutualism symbiosis. In these interactions the plants provide a food source which is pollen and nectar as well as a place of reproduction, while the plants get benefit from pollination. The association of mutualism between insects and plants varies between species. Plants that associating with insects have a positive effect, especially for cross pollination. Whereas, insects is beneficially by plants because its provided a food source in the form of pollen and nectar (Schoonhven, 1998).

According to Syamsuardi (2013) the diversity of insects related to the abundance of plant resources, mainly pollen and nectar. Insect used pollen as a source of protein, while nectar as a source of sugar that is needed for their life. The combination of sugars in nectar determines the diversity of insects. Aside from pollen and nectar, flower morphology also influenced the diversity of visitor insects. Insect diversity also influenced by environmental factors such as temperature, humidity and light intensity. Species diversity can be used to express structure of community, because diversity is granted stability and related to central ecological thinking, which is about the balance of a system. Increasingly the number of species, showed a greater the diversity (Leksono, 2007).

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