**Original article**

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

Manap Trianto* and Fajri Marisa

Department of Tropical Biology, Faculty of Biology, Gadjah Mada University, Jl. Bulaksumur, Yogyakarta 55281, Indonesia

**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 diversity 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 classified 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), laukok (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 District. 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. Environmental 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-Wiener diversity index (Magurran, 2004), Shannon-Evenness and Simpson's dominance (Singh et al., 2013). The formulas of each index are:

\[
H' = -\sum p_i \ln p_i
\]

Shannon-Wiener’s Index
Information:
\(H'\) : Shannon-Wiener diversity Index
\(p_i\) : \(n_i/N\)
\(n_i\) : Number of individual of ith species
\(N\) : Total number of individuals caught

\[
E = \frac{H'}{\ln S}
\]

Shannon-Evenness’s Index
Information:
\(E\) : Shannon-Evenness index
\(H_i\) : Shannon-Wiener Diversity Index
\(S\) : Total of species

\[
D = \sum (p_i)^2 \rightarrow p_i = \frac{n_i.n_i}{N}
\]

Simpson’s Dominanssi Index
Information:
\(D\) : Dominance Index
\(p_i\) : Proportion of total samples based on ith species
\(n_i\) : Number of individual of ith species
\(N\) : Total number of individuals caught

RESULT AND DISCUSSION

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

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{Fig1.png}
\caption{Sampling point of bees and wasp in Martapura District. B: Bincau Village, IS: Indra Sari Village, and LT: Labuan Tabu Village}
\end{figure}

Obatined temperature is in range 27-30°C, whis is the normal temperature needed for insects development. These temperature are highly potential for conservations 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°C is acceptabel 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 visited 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°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.

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).

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

**Table 1.** Family and species of Hymenoptera insect collected

<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Location</th>
<th>Total Individuals</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apidae</td>
<td><em>Amegilla cingulate</em></td>
<td>B 6</td>
<td>10</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td><em>A. zonata</em></td>
<td>IS 4</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td><em>Apis cerana</em></td>
<td>LT 19</td>
<td>20</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td><em>Ceratina negrolateralis</em></td>
<td>LT 1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><em>Heterotrigona itama</em></td>
<td>B 29</td>
<td>18</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td><em>Tetragonula laeviceps</em></td>
<td>LT 32</td>
<td>20</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td><em>Xylocopa caeruleus</em></td>
<td>LT 10</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td><em>X. confusa</em></td>
<td>LT 6</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td><em>X. latipes</em></td>
<td>LT 0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Megachilidae</td>
<td><em>Megachile centuncularis</em></td>
<td>LT 10</td>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td><em>M. relative</em></td>
<td>LT 9</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Halictidae</td>
<td><em>Augochlora sp.</em></td>
<td>LT 5</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td><em>Lassioslosum malachurum</em></td>
<td>LT 7</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td><em>Nomia melanderi</em></td>
<td>LT 11</td>
<td>11</td>
<td>14</td>
</tr>
<tr>
<td>Colletidae</td>
<td><em>Hylaeus modestus</em></td>
<td>LT 1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Vespidae</td>
<td><em>Delta comparniforme</em></td>
<td>LT 8</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td><em>Ropallidia fasciata</em></td>
<td>LT 2</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td><em>R. romandi</em></td>
<td>LT 0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Scoliidae</td>
<td><em>Campsomeris plumipes</em></td>
<td>LT 3</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total of individuals</strong></td>
<td></td>
<td>163</td>
<td>105</td>
<td>196</td>
</tr>
<tr>
<td><strong>Total of species</strong></td>
<td></td>
<td>17</td>
<td>14</td>
<td>19</td>
</tr>
</tbody>
</table>

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 W writen et al., (2012) and Nursal (2008), also 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. Wintfree 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

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Location</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bincan</td>
<td>Indra Sari</td>
</tr>
<tr>
<td>Individual</td>
<td>163</td>
<td>105</td>
</tr>
<tr>
<td>Percentage (%)</td>
<td>35.13</td>
<td>22.63</td>
</tr>
<tr>
<td>Species</td>
<td>17</td>
<td>14</td>
</tr>
<tr>
<td>Shannon-Wiener index (H)</td>
<td>1.253</td>
<td>0.857</td>
</tr>
<tr>
<td>Dominansi Simpson (D)</td>
<td>0.013</td>
<td>0.006</td>
</tr>
<tr>
<td>Shannon Evennes</td>
<td>0.610</td>
<td>0.373</td>
</tr>
</tbody>
</table>

Bascially, insect is required two major things for living, specifically 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 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 Syamsuwardi (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).

REFERENCES


