Diversity of insect pollinators on *Citrullus lanatus* thunb

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Abstract. The interaction between insect pollinator and crops is a mutualism association, in which plants provide feed for insects and plants to benefit in the pollination process. So that insect pollinators are the biological agents of fruit production. This study aims to analyze the diversity of pollinating insects, and to know their effectiveness in the watermelon production (*Citrullus lanatus* Thunb.). Observation of visiting insect community was conducted by scan sampling method. Visiting activity of insect pollinator were observed based on length of visit per flower and number of flowers visited per minute. The Result showed that 7 species of insects visitors, were pollinator of *Citrullus lanatus* flower i.e. *Amegilla* sp, *Ceratina* sp, *Lasioglossum* sp, *Nomia* sp, *Cerceris* sp, *Ischiodon scutellaris* and *Polistes stigma*. The highest abundance i.e. *Lasioglossum* sp (98 individuals) and *Ceratina* sp (81 individuals). The highest diversity of insect pollinators was found in the morning (07.00 - 10.00). The community similarity based Bray-Curtis similarity index was highest between 10.00 - 12.00 and 14.00 - 16.00 o'clock.

1. Introduction

Insects are the most important global pollinant group [1]. More than 80% of wild plant species and nearly 75% of cultivated plant species rely on insects, especially wild bees, for fruit and seed production [2]. Pollinating insects generally visit flowers due to attractant factor, ie flower shape, flower color, pollen, and nectar (as primary puller) and aroma (as secondary pull) and influenced by abiotic factor. Abiotic factors that affect them are temperature and humidity, and light intensity [3]. Generally wind velocity affects flying activity on some insects [4]. Insects pollinators also play a role in environmental improvement. The diversity of insect species that visit plant flowers is related to available resources, number of flowers, plant spacing, and foraging distance, especially pollen and nectar. For insects, pollen is used as a source of protein, while nectar is a source of sugar that...
is needed for life [5]. In addition to pollen and nectar, factors affecting pollinator insect diversity are flower morphology and abundance of flowers [6,7].

Watermelon has been cultivated since ancient times, in the 10th century watermelon (C. lanatus) introduced to China and today China is the most important producer and consumer of watermelon in the world [8]. Watermelon is a production plant, about 90 million tons of production per year in the world, so watermelon is a widely consumed fruit [9]. Successful production of watermelon plant is strongly influenced by various factors, one of which is pollinating insects. Pollination is a meeting of pollen with a pistil (stigma). About 2/3 species of flowering plants require insect pollination to produce optimal seed [10]. Animals pollinators are estimated to contribute in 15 to 30% of global food production, and are key to the success of agricultural productivity [11,7] and are important mediators of inter and intra-specific interactions between plants [12]. Insects that contribute to the pollination of plants are beetles, flies, bees, wasps, gonteng (order Hymenoptera), butterflies and moths [5].

Constraints in watermelon crops in Indonesia are low watermelon production due to at least watermelon varieties suitable to be developed in certain areas [13]. The presence of pollinating insects is very important in determining the quality of the fruit produced. However, information on the types of pollinating insects in watermelon plants still lacked. The research aims to analyze the diversity and abundance of pollinating insects in watermelon (Citrullus lanatus Thunb.).

2. Material and Method

2.1. The Study site
This research was conducted in this year, 2018. It was done in community farms located in Lamala district, Central Sulawesi. The identification of insects and data analysis were carried out at Biodiversity Laboratory of Department of Biology, Faculty of Mathematics and Natural Sciences, Tadulako University.

2.2. The Observation of Pollinating Insect Diversity
The diversity of pollinating insects were observed on four plots of flowering watermelon plants (2 caged plots and 2 open plots). The observations were conducted every 20 minutes from 07.00 to 16.00 pm. The insect pollinators were observed by a scan sampling method that records the behavior of more than one individual previously determined.

2.3. Collection, Identification and Preservation of Specimen
All insect samples were collected by insect net. Small insects are preserved wet while large insects were preserved dry by using standard method based on [14]. The identification was done up to the genus and species levels referring to [15], [16] and [17].

2.4. Data Analysis
The data of the diversity of pollinating insects and their abundance analyzed were included Shannon-Wiener diversity index (H'), Evenness index (E) and Bray-Curtis similarity index using PAST version 2.17c (http://folk.uio.no/ohammer/past).

3. Results and Discussion
The number of individual watermelon visitor insects obtained at the research site were 252 individuals, belonging to 5 families and 7 species (table 1). The highest number of individuals
were collected in the morning (196 individuals), followed by the afternoon (34 individuals), and by noon (22 individuals). This was because the watermelon flowers were open in the morning and begin to close during the day. Male flowers on the watermelon began to open at 07.15 and closed at 13.00 pm, while the female flowers began to open at 07.20 am and began to close at 12.00 [18]. Two species were found with high abundance, namely Lasioglossum sp (98 individuals) and Ceratina sp. (81 individuals). The abundance of Lasioglossum sp and Ceratina sp species were related to the suitability of body size of the species to the size of the flowers of watermelon plants. The results of [18] in the watermelon plants in Kenya reveal that there were three species of wild bees, such as Lasioglossum (Ctenonomia) scobe, Lasioglossum (Ctenonomia) sp. and Lasioglossum (Ipomalictus) nairobeans who become pollinators. These wild pollinators also utilized the soil condition under the watermelon plant for their nest. The Lasioglossum species is an eusocial insect that has the ability to visit various types of flowers [19]. In addition to Lasioglossum sp., Ceratina sp bees also have a high abundance. Ceratina sp. bees have a small body size with a size of 8-10 mm [20]. With these body sizes, these bees will not be difficult to pick up the nectar located at the base of the flower.

Table 1. Number of species and individual insects visitors of watermelon flowers

| Family/species | Number of individual | Total |
|----------------|----------------------|-------|
|                | Morning | Noon | Afternoon |       |
| Apidae         |          |      |           |       |
| Amegilla sp.   | 8        | 2    | 4         | 14    |
| Ceratina sp.   | 66       | 6    | 9         | 81    |
| Halictidae     |          |      |           |       |
| Lasioglossum sp.| 72      | 10   | 16        | 98    |
| Nomia sp.      | 37       | 2    | 2         | 41    |
| Crabronidae    |          |      |           |       |
| Cerceris sp.   | 4        | 0    | 2         | 6     |
| Syrphidae      |          |      |           |       |
| Ischiodon scutellaris | 6    | 0    | 0         | 6     |
| Vespidae       |          |      |           |       |
| Polistes stigma| 3        | 2    | 1         | 6     |

| Number of individual | 196 | 22 | 34 | 252 |
| Number of species    | 7   | 5  | 6  |
| Diversity Index (H') | 1.43| 1.36| 1.39 |
| Evenness Index (E)   | 0.59| 0.78| 0.67 |

Based on observation time, the highest index of diversity was in the morning, it occurred because the full flower blooms emit the most powerful floral scent in the morning. Changes in the number of individual from morning, noon, until the afternoon most likely also were caused by the blooming time of interest is quite short (around 7:00 to 10:00). The highest insect diversity in the morning was also reported by [7] in cai sin (Brassica rapa), the peak of the visit occurred at 08.30 and 09.30. The morphology of watermelon flowers are bright yellow, as well as the availability of nectar and pollen can attract the insect pollinator [21].
Figure 1. Dendrogram community similarity of watermelon visitor insects based on Bray-Curtis matrix using pair-group average method

Based on the dendogram formed, there are two groups of insect communities namely morning and afternoon-noon (figure 1). There is a resemblance of the watermelon visitor community between day and afternoon (75%). The resemblance of the visitor community of watermelon flowers related to the composition and abundance of individuals found at that time. Based on the time, the condition of the flowers during the day began to wither, as well as in the afternoon. This caused a similarity in the number of insect individuals visiting at that time. The abundance of insects in a habitat is determined by the diversity and the abundance of feed and other resources available in the habitat [22].

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