Diversity and abundance of insect pollinator on *dimocarpus longan* L. in Sawitsari research station, Sleman, Yogyakarta

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Abstract. Kelengkeng Super Sleman (KSS) is a new variety of Dimocarpus longan L. developed at Sawitsari Research Station, Sleman, Yogyakarta. As the key of agroecosystems, insects play an important role in aiding the process of pollination of flowers. The research was aimed to study the diversity and pollination effectivity of insect pollinators on Kelengkeng Super Sleman (*Dimocarpus longan* L.) in Sawitsari Research Station, Sleman, Yogyakarta. The purposive sampling method including active and passive was used to explore the diversity of insect pollinators. Observation was conducted on three ranges of time, morning (08.00 to 09.00 am), noon (11.00 am to 12.00 pm), and evening (03.00 to 05.00 pm). The result showed that 19 families identified and 21 families unidentified from active and passive methods with Calliphoridae and Formicidae had the highest flower-visiting activity in the morning, noon, and evening. Besides that, uncovered panicles successfully pollinated with an average of 114 flowers, while covered panicles only 43 flowers. In conclusion, both Calliphoridae and Formicidae were the most KSS pollinators and the flower cover hinders the pollination process.

1. Introduction

Longan (*Dimocarpus longan* L.) is a subtropical fruit that belongs to the family of Sapindaceae closely related to Lychee and Rambutan. It is the second leading fruit in Sapindaceae after lychee which has high economic value especially in Thailand and Asia-pacific region. It originally comes from mountainous areas of Northern Burma, Northeast, and Southern China [1, 2]. The term “Longan” is derived from the Chinese word “Longan” or “Long-yan” or “Lungnan”. In a different country, Longan has several names such as “longan” known as in Indonesia and Malaysia, Myanmar as kyet mouk; Cambodia as mien; Laos as lam nai and nam nai; Vietnam as nhan; French as Longanier, Oeil de Dragon [1]. Longan fruits are either consumed as fresh, canned products, or dried fruit. The fruit in canned products has a good taste when compared to similar fruits, namely rambutan, and lychee. Apart from having a good taste, there are several other advantages of this fruit including containing antioxidant and anticancer compounds in the pericarp of the fruit [3].

Longan cultivated in Indonesia has several types of varieties including Pingpong and Diamond River from Vietnam, while for the Itoh variety from Thailand and Malaysia. There are also several local varieties that have been cultivated such as longan Batu, Kopyor, and Lumut. Kelengkeng Batu produces large fruit with small seeds [4]. Longan cultivation covers various regions in Indonesia including Ambarawa, Magelang, Temanggung, Wonogiri, and several areas in East Java. The results of this new cultivation also show that longan can be cultivated in lowlands such as in Selarong, Bantul
Regency. In other locations, longan cultivation in lowland areas has also been successfully carried out, as in the area of Sleman Regency which became known as Super Sleman Longan. This fruit is a new local longan variety developed by the people of Sleman (Yusuf S. Sulaiman, S.I.P) which was developed in the Sleman and surrounding areas. Kelengkeng Super Sleman (KSS) has advantages that are not inferior to the Itoh variety, namely thick flesh, relatively small seeds, and not runny. In addition, the main advantage of this variety is that it has a shorter early age, which is to produce fruit at the age of 2 years (6 months faster than Itoh's longan variety from Thailand) [5].

The increase in population followed by public awareness of health causes the fulfillment of the need for the fruit to be high in the market. The fulfillment of high consumption of fruits which is not matched by production capacity causes the import of fruits domestically to be carried out. Last year, to be precise, 2019 showed that there were several types of fruit imported quite large, including 71.46 thousand tonnes of longan fruit [6]. Reflecting on the years 2012-2013, the import of longan fruit itself also experienced a rapid increase of 91,000 tons, which indicates that there is a large market need for longan fruit [5]. There is a large need for longan fruit every year, of course, encouraging awareness for Indonesia to be able to meet the needs of local longan fruit. The development of local longan fruit has the potential to shift the dominance of imported fruit. This opportunity has started to be put into practice by H. Isto Suwarno where he began to develop the Itoh variety of longan fruit from Thailand which is very suitable for cultivation in the lowlands and the fertilization process can be programmed [7].

In the process of forming the fruit of the longan plant here, it will be assisted by natural insects that are in charge of flower pollination for later fruit formation. Pollination is the process of transferring pollen from the anther to the stigma (stigma) so that it helps flowers to develop into seeds in the reproduction process, which in this process can be helped by the presence of pollinators or environmental factors. There are several agents that can play a role in the pollination process such as wind, water, insects, birds, and bats. However, the majority is dominated by insect agents in the pollination process which will then have an impact on biodiversity [8]. There are several types of insects such as bees, butterflies, moths, beetles, wasp, and flies are reported as pollinators of plants. Bees are pollinator insects that play an important role in the pollination process compared to other types. With the presence of pollinators an ecosystem can maintain its sustainability and health, increase plant productivity and increase the diversity of existing plants [9].

It is reported that pollinating insects can play a role in increasing the number of yields, such as by increasing the number of pods, weight of seeds per plant, and seed germination of plants Brassica rapa [10]. Pollinator insects have an important role in the process of forming longan fruit. The absence of pollinator insects will cause a drastic reduction in the fruit formation process. The absence of research on insect pollinators for the Sleman Super Longan variety is the main objective of this research. Therefore, this study aimed to investigate diversity of abundance of insect pollinators in Kelengkeng Super Sleman (Dimocarpus longan L.) in Sawitsari Research Station, Sleman, Yogyakarta.

2. Methodology

2.1 Sampling and Insect Processing

This research was conducted in Sawitsari Research Station of the Faculty of Biology UGM for 3 weeks from January 12th, 2020 to January 26th, 2020. The sampling point was determined purposively so that it could represent all trees in the field [11]. Three trees were selected, each representing repetition and several flower panicles on each tree were covered up by net. Sampling was carried out using active sampling and passive sampling. Active sampling is done by directly observing insects and counting them, then capturing one individual as a species voucher. Passive sampling is done by installing sticky traps at several points on each tree from the start of active sampling to completion.

The specimens obtained in the sticky trap are then collected and stored in conical tubes containing 90% alcohol. Sampling was divided into 3 time ranges, namely morning, afternoon, and evening. Morning sampling was conducted at 08.00 to 09.00, afternoon sampling was conducted at 11.00 to
12.00, while afternoon sampling was conducted at 15.00 to 17.00 [12]. The preservation was carried out a day after sampling at the Entomology Laboratory, Faculty of Biology, UGM. The insects were preserved dry and identified using the inaturalist.org website.

2.2 Data Analysis

Collected data was analyzed using the relative abundance index (RAI) and Simpson’s index of dominance (D) by using Microsoft Office Excel 365. Relative abundance index can be calculated based on formula [13]:

$$\text{RAI} = \frac{A_i}{N} \times 100$$

In which $A_i$ represents the number of individuals in a family and $N$ represents the total number of individuals. Simpson’s index of dominance (D) can be calculated by [14]:

$$D = \Sigma (n_i/N)^2 \text{ or } D = \Sigma (p_i)^2$$

In which $n_i$ represents the number of individuals in a family, $N$ represents the total number of individuals, and $p_i$ represents the portion of each family.

3. Result and Discussion

3.1 Description of Study Area

Sawitsari Research Station is agricultural land created to support various research activities including the cultivation of Super Sleman Longan plants and plant cultivation such as mango, durian, striated peanuts, and chilies as well as research on bees and the conservation of orchids and other horticultural crops. Kelengkeng Super Sleman (KSS) Plant currently dominates the existing plants on the land in addition to the plants around the land. In all study areas, air temperature, relative humidity, and wind velocity during observations consecutively were 24°C - 33°C, 61% - 82%, and 6 km/h - 22 km/h.

![Figure 1. Family abundance and dominance of KSS insect pollinator on Sawitsari (*=obtained from active sampling; **=obtained from passive sampling)](image)

3.2 Diversity of Insect Pollinator

Observations for this research use 2 different sampling methods, active sampling and passive sampling using sticky traps. This study found 699 individual’s insect pollinators from the active sampling method and 278 individuals coming from the passive method. All of the pollinator insect belongs to
three Orders including Diptera, Lepidoptera and Hymenoptera also 38 famlias such as Calliphoridae, Dolichopodidae, Erebidae, Flatidae, Formicidae, Lauaxaniidae, Libellulidae, Lycenidae, Muscidae, Nymphalidiae, Papilionidae, Pieridae, Sarcophagidae, Scarabaeidae, Scoliidae, Sphecidae, Stratiomyidae, Syrphidae, and Vespidae.

Figure 1 shows from this study there are 38 families obtained by active sampling methods and passive sampling. The various relative abundances shown indicate that the abundance of KSS pollinator families is mostly carried out by only a few families. Members of the Calliphoridae family such as Chrysomya megacephala are an abundant and dominant group of pollinators in KSS. Several other family groups such as Formicidae also show a lot of pollination in KSS. Calliphoridae has a relative abundance index about 66.7% and Simpson’s dominance index about 0.45.

The abundance of Calliphoridae members indicates that members of this family dominate as flower visitors, as do members of the family Formicidae. The existence of Calliphoridae and Formicidae as visitors to this flower has the potential to act as pollinators. In several other crops such as apple and vegetable plantations, the families Calliphoridae and Formicidae are insects which are also found as pollinators [15, 16, 17]. In this study, there were found as many as 40 types of insects as potential pollinators. The diversity of this species is influenced by several factors both from food sources such as floral nectar and extra floral nectar [15]. The abundance of flowers in Sawitsari Research Station garden allows many types of pollinators to be present.

The second figure shows a comparison index of the relative abundance and index of dominance derived from active and passive sampling methods. From the picture above, it can be seen that in the active method there are at least 3 groups with the highest relative abundance index and the most index of dominance, there are Calliphoridae, Formicidae, and Diptera 3. As for the passive sampling method, the top 3 families with the highest relative abundance index and index of dominance are Calliphoridae, Lauaxaniidae, and Diptera 3. Chrysomya megacephala is a member of the family Calliphoridae with the highest abundance both by using active and passive sampling.

Active sampling was conducted with direct observation and counting of insects perching on the flowers, while passive sampling was carried out by installing several sticky traps on each tree. From active sampling, it was found that Calliphoridae is the most dominant family perching on good flowers on Tree 1, Tree 2, and Tree 3. Meanwhile, from passive sampling, Calliphoridae is also the dominant
family. This is because the color of the longan flower and the color of the sticky trap are almost the same so that it effectively attracts many flies to land. The longan flowers and sticky trap used have a yellowish color which can attract more flies than other colors [18].

3.3 Pollinator Insects’ Activities During a Day
In the third picture, the results show that the activity of pollinating insects during the day with the division of three different time periods including morning, afternoon, and evening. The observations indicated that the activity of pollinating insects in the morning was dominated by the Calliphoridae family of 207 individuals followed by Formicidae with 42 individuals. During the daytime observations, 119 pollinating insects were dominated by the same family, namely Calliphoridae. The results of observations carried out in the afternoon showed that the activity of pollinating insects was dominated by 193 individuals of Calliphoridae, followed by Formicidae with 36 individuals. Of the three-time periods observed, it showed that Calliphoridae was the most dominant family, followed by the Formicidae family.

![Insects activity during the day based on its number](image)

3.4 Flowers Pollination Success Rate
Pollinator insects have a close correlation in the process of pollinating flowers into seeds. This is evidenced by the result of formation of the ovules with a cover and without a cover. Uncovered
panicles successfully pollinated with an average of 114 flowers, while covered panicles only 43 flowers.

![Pollination Success Rate](image)

**Figure 4.** Success rate of pollination on the covered and uncovered flowers

The fourth figure shows the comparison between the flowers that were successfully polished from the covered and uncovered panicle treatment. The results obtained indicate that without cover flower panicles have a higher success rate than covered flower panicles. The flowering process that was successfully carried out on uncovered flower panicles was 114.64, while on the covered flower the number of pollinated flowers was 43.58.

The results obtained in the fourth figure indicate that plants with covered flowers have a much lower pollination success rate than plants with flowers without cover. The existence of a cover will certainly greatly inhibit the participation of pollinating insects to land on flowers and carry pollen to other flowers. The factor that causes the flowers with the cover treatment can still undergo the pollination process is the presence of another factor in the form of wind that can carry pollen from one flower to another.

4. Conclusion

The diversity of insect pollinators in the Super Sleman longan (KSS) is quite diverse. Calliphoridae and Formicidae have the highest abundance and dominance indexes. Both are abundant and dominant so that they become pollinators for the Sleman Super Longan (KSS) flower. Flower cover hinders the insect from directly accessing the flowers.

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