Insects diversity in salak (Salacca zalacca Gaert.) plantation with differences altitude in North Sumatra, Indonesia

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Abstract. The aim of this study was to compare the composition, the distribution and the index of diversity of insects on salak (Salacca zalacca Gaert.) from October 2019 until December 2019 at two different altitudes, including 1200 meter above sea level (masl) in Kutambaru Village, Tiganderket District, Karo Regency and at 350 masl in Rumah Lengo Village, STM Hulu District, Deli Serdang Regency. The research was conducted by survey method with collection samples for 6 times using pit fall traps, light traps, yellow traps, and hand picking. The insects were identified at the Laboratory of Pests and Diseases, Faculty of Agriculture, University of Sumatera Utara. The results showed that the insects caught in the S.zalacca plantation area at 350 masl comprised of 10 orders, 20 families with a total population of 663 individuals, while the insects collected from the 1200 masl were 8 orders, 19 families and 367 individuals. The diversity index calculated are H’=2.03 in 350 masl and H’=2.35 in 1200 masl. The categorized into moderate diversity of insects which implication no quite differences scores of the composition and diversities of insects. The function status insects were categorized into pest, predator, parasitoid, pollinator, and decomposer.

1. Introduction

Indonesia is a tropical country that is rich in fruits, some of which are superior fruits whose taste and special smelly for many peoples. One of the priorities for research on superior fruit plants from Indonesia is salak. Salak is popular with the public, both eaten fresh, and processed into sweets and pickles [1]. As a fruit crop, it can grow and thrive in the lowlands to an altitude of more than 800 meters above sea level (masl), the supply of quality Salacca zalacca Gaert.or salak fruit is still very limited. Meanwhile, the demand for modern, processed and export markets continues to increase from year to year, so that the agribusiness opportunity for the salak fruit commodity has a pretty good prospect [2].

Agro-climate and pests’ infestations are factors limiting salak cultivation. Pests in Salak plantation include ticks, stem borer, various microfauna, mesofauna and macrofauna of animals. Pests that attack salak cultivation can reduce its production by up to 30% in the villages of Tanjungharjo, Wedi, and Kalianyar, Kapas District, Bojonegoro, East Java [3].

Insect pests are a limiting factor for crop production in Indonesia, both for food crops, horticulture and plantations. So that by studying the structure of the ecosystem such as the composition of plant types, pests, natural enemies, and other biotic groups, as well as dynamic interactions between biotic components, management strategies can be established that are able to maintain pest populations at a level that is not detrimental [4].
Based on this information data, the authors are interested to determine of diversity insects in salak plantation. The aim of study was to compare the composition, the distribution, and the index diversity of insects and pests that dominate the planting area on salak from October 2019 until December 2019 at two different altitudes, including 1200 masl in Kutambaru Village, Tiganderket District, Karo Regency and at 350 masl in Rumah Lengo Village, STM Hulu District, Deli Serdang Regency.

2. Materials and methods

This research was conducted in smallholder plantations located in Rumah Lengo Village, STM Hulu District, Deli Serdang Regency, North Sumatra with an altitude of 350 meters above sea level and in Kutambaru Village, Tiganderket District, Karo Regency, North Sumatra with an altitude of 1200 masl. The research method used was a survey method, which was to take insect samples from two salak plantations. The insects obtained at each catch were identified, counted, and analyzed in the Laboratory of Plant Pests and Diseases, Faculty of Agriculture, University of Sumatera Utara, Medan-Indonesia. This research was conducted from October 2019 to December 2019.

Sampling was carried out 6 times, at intervals of one week by catching insects in the salak plantations that have been fruitful. The insects were collected as many as possible. The samples for observation were adult insects (imago) from insects in the salak plantation. Insects were caught using a variety of traps, including light traps, pit fall traps, yellow traps and handpicking. This catching insects heading to the light source used by light trapping at once with 2x24 hour. Insects that live insects above the ground were collected by pit fall traps with intervals of one week. Then yellow traps and handpicking to catch the others insects with intervals of one week. The data of insect collection were analyzed from composition, distribution, index diversities and status function of insect in the salak plantation.

3. Results and discussion

The results showed that insects caught in salak plantations in the village of Rumah Sumbul, STM Hulu District, Deli Serdang Regency consisted of 10 orders, 20 families with a population of 663 individuals (Table 1). Meanwhile there were 8 orders, 19 families and 367 individuals of insects caught in the Kutambaru village, Tiganderket District, Karo Regency.

In figure 1, it can be seen that the most insects caught are in the salak plantation with an altitude of 350 masl. This assumes that the salak trees are covered by the 18 year old-oil palm trees that are cultivated surround the salak plantation. Moreover humidity also affects the salak plantation [5]. The development of insects in nature is influenced by two factors, including external factors and internal factors (temperature, humidity, light, and wind). The population of an insect at a time is the result of the combination of these two factors, consist of.

The most dominant insects in the salak plantation with an altitude of 1200 masl were order Coleoptera from Curculionidae family, which are pollinators (Figure 1). Therefore, the differences in land design that are far different, on the planted area of 1200 masl planting is done by planting 8 female plants and inserting 1 male plant, while male plants are planted far from the area of female plants, so that pollination is done by man-made. Insect-plant interactions have a beneficial effect on plants to help pollination. Pollination with insects makes a significant contribution to agricultural production [6] in the agricultural sector, pollination with insects is one of the keys to the success of agricultural production, which depends on or increases with the visit of the insect pollinators [7].

The results of insect distribution also showed that three families, such as Pentatomidae (229), Braconidae (139) and Tephritidae (122) were abundances than other insect recorded from the salak plantation (Fig 1). It is assumed that the habitat, availability of source food and environmental supported the growth of three families. According to write the author’s family name followed by numbering reference in paranthesis [8,9], the population density of Nodoenemis sp. (Family Curculionidae), one of the pollinator insects of salak, is significantly influenced by the development of flower bloom, which is influenced by temperature, humidity and the eruption of Merapi in Yogyakarta, Indonesia.
Table 1. The composition and diversity of insects in the salak plantation (350 masl and 1200 masl).

| Order       | Family            | 350 masl | Observation | 1200 masl | Observation |
|-------------|-------------------|----------|-------------|-----------|-------------|
|             |                   | 1 2 3   4 5 6 | Total       | 1 2 3   4 5 6 | Total       |
| Blatodae    | Blattellidae      | 1 0 1 2 1 1 1 | 6 2 0 2 2 1 1 8 |                                     |
| Coleoptera  | Crysolomelidae    | 3 0 0 0 0 0 2 5 | 5 0 0 0 0 0 0 0 |                                     |
|             | Curculionidae     | 4 0 1 0 2 1 8 | 10 17 31 18 17 14 107 |                                     |
|             | Elateridae        | 0 0 0 0 0 0 2 1 1 0 | 1 1 1 6 |                                     |
|             | lampyridae        | 0 0 4 1 0 0 5 1 2 1 | 0 3 0 7 |                                     |
|             | Leiodidae         | 0 0 0 0 0 0 1 2 | 0 1 1 1 6 |                                     |
|             | Scarabaeidae      | 0 0 0 0 0 0 1 1 0 | 3 0 0 5 |                                     |
| Dermaptera  | Forficulidae      | 2 0 1 1 3 1 1 8 | 0 0 0 0 0 0 0 0 |                                     |
| Diptera     | Tephritidae       | 57 27 10 19 7 2 122 2 | 3 6 3 6 3 23 |                                     |
|             | Tipulidae         | 2 0 1 2 0 1 6 2 3 | 0 1 3 10 |                                     |
| Hemiptera   | Pentatomidae      | 45 46 40 39 32 27 229 0 | 0 0 0 0 0 0 |                                     |
| Hymenoptera | Braconidae        | 43 8 8 26 48 6 139 10 | 3 12 7 9 7 48 |                                     |
|             | Diapriidae        | 0 0 0 0 0 0 5 0 15 25 55 |                                     |
|             | Eulophidae        | 0 0 23 0 0 0 23 | 0 0 0 0 0 0 |                                     |
|             | Formicidae        | 1 6 2 2 5 7 23 14 7 4 4 3 5 37 |                                     |
|             | Heloridae         | 0 0 1 0 0 4 5 0 | 0 7 0 7 |                                     |
|             | Ichneumidae       | 0 1 0 1 0 0 2 1 0 2 2 0 1 6 |                                     |
|             | Tiphidae          | 5 8 5 0 4 2 24 | 0 0 0 0 4 2 6 |                                     |
|             | Vespidae          | 0 3 1 0 3 0 7 3 1 2 4 1 2 13 |                                     |
| Isoptera    | Termitidae        | 0 1 2 0 2 1 6 3 1 0 2 0 3 9 |                                     |
| Lepidoptera | Cossidae          | 1 1 0 2 0 2 6 1 2 0 1 0 1 5 |                                     |
|             | Noctuidae         | 1 3 0 1 0 3 8 2 1 1 | 1 0 1 6 |                                     |
| Odonata     | Libellulidae      | 1 1 0 2 0 1 5 | 0 0 0 0 0 0 |                                     |
| Orthoptera  | Gryllidae         | 3 3 4 5 7 4 26 | 0 0 0 0 0 0 |                                     |
|             | Gryllotalpidae    | 0 0 0 0 0 0 1 1 0 | 0 1 0 3 |                                     |
| Total       |                   | 169 108 104 103 114 65 663 56 | 50 62 66 65 68 367 |                                     |

Figure 1. Distribution of families insects from salak plantation in difference altitude.

The types of insect pests based on status function showed that insects in the salak plantation with an altitude of 350 masl were more diverse than insects found in the altitude 1200 masl. The status function of insects consists of pest, predator, parasitoid, pollinator, and decomposer groups. Then,
assumed the composition and distribution of insects were quite diverse are strongly influenced by various abiotic factors, one of which is climate, this factor affects insects directly or indirectly, especially the orientation of insects when looking for food, and causes changes in insect physiology in anticipation of adverse climatic conditions. Climate has a direct effect on birth and mortality rates, indirectly, climate affects insect abundance [10,11].

Table 2. Status function of insects caught on land at altitudes of 350 masl and 1200 masl

| Order       | Family       | Altitude 350 masl | Altitude 1200 masl | Status     |
|-------------|--------------|-------------------|-------------------|------------|
| Blatodae    | Blatellidae  | 6                 | 8                 | Pest       |
| Coleoptera  | Crysomelidae | 5                 | 0                 | Pest       |
|             | Curculionidae| 8                 | 107               | pollinator |
|             | Elateridae   | 0                 | 6                 | Pest       |
|             | Lampyridae   | 5                 | 7                 | Predater   |
|             | Leiididae    | 0                 | 6                 | Pest       |
|             | Scarabaeidae | 0                 | 5                 | Pest       |
| Dermaptera  | Forficulidae | 8                 | 0                 | Predator   |
| Diptera     | Tephiritidae | 122               | 23                | Pest       |
|             | Tipulidae    | 6                 | 10                | Parasitoids|
| Hemiptera   | Pentatomidae | 229               | 0                 | Pest       |
| Hymenoptera | Braconidae   | 139               | 48                | Parasitoids|
|             | Diapriidae   | 0                 | 55                | Parasitoids|
|             | Eulophidae   | 23                | 0                 | Parasitoids|
|             | Formicidae   | 23                | 37                | Predater   |
|             | Heloridae    | 5                 | 7                 | Parasitoids|
|             | Ichneumidae  | 2                 | 6                 | Parasitoids|
|             | Tippiidae    | 24                | 6                 | Parasitoids|
|             | Vespidae     | 7                 | 13                | Parasitoids|
| Isoptera    | Termittidae  | 6                 | 9                 | Decomposer |
| Lepidoptera | Cossidae     | 6                 | 5                 | Pest       |
|             | Noctuidae    | 8                 | 6                 | Pest       |
| Odonata     | Libellulidae | 5                 | 0                 | Predator   |
| Orthoptera  | Gryllidae    | 26                | 0                 | Pest       |
|             | Gryllotalpida| 0                 | 3                 | Pest       |
| **Total**   |              | **663**           | **367**           |            |
| **Index Diversity (H')** | **2.03** | **2.35**           |            |            |
| **Index Evenness (E)**     | **0.63** | **0.73**           |            |            |

In the Table 2 showed the diversity and evenness insect species in salak plantation at 350 masl is H'=2.03 and E'=0.63, is similar to 1200 masl is H'=2.35 and E'=0.73, which indicates the diversity and evenness of insect species in this area supported by environmental factors causes the score is high (E'>0.6). This fact is in accordance with write the author’s name here [12] who state that the evenness value (E) ranges between 0 and 1, which means that if the evenness value gets closer to 1, it describes a state where all species are quite abundant.

The cause of the high evenness of insect species in the salak plantations with an altitude of 350 masl and 1200 masl was recorded no family type dominates in the sites. This is in accordance with [13] which states that the evenness value will tend to be high if the number of populations in a family does not dominate the population of other families, otherwise evenness tends to be low if a family has a population that dominates the number of other populations.
4. Conclusions
The insects caught in the salak plantation at 350 masl consisted of 10 orders, 20 families with a total population of 663 individuals. While the insects found in the salak plantation at 1200 masl were recorded 367 individuals, 19 families and 8 orders. Diversity index in salak plantation is $E'= 2.03$ (350 masl) and at 1200 masl is 2.35, which shows moderate diversity with implication the environmental factors effected to composition, distribution and diversities of insects. The evenness index of insects in salak plantations at 350 masl of $E= 0.63$, then $E= 0.73$ into 1200 masl. The indication used of $E$ mean getting similar score to 1, then described a situation where all species are quite abundant. The function status insects is categorized into pest, predator, parasitoid, pollinator, and decomposer group of insects, which it is specifically useful for studying the visiting behavior of pollinator and parasitoid insects in salak cultivation.

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