Assessment of insect diversity and community structure in the sugarcane plantation in Jambi Province

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Abstract. Sugarcane can be cultivated in diverse agroecosystems, so it has the potential attack of different pest. The study on the biodiversity of insects in sugarcane plantations at different altitudes has the objective to study the insect community structures that are useful in making decisions in integrated pest control. The study was conducted on sugarcane plantations in the highlands and lowlands areas, i.e Kerinci and Muaro Jambi Regency. The insect sample was identified to morphospecies level. The results showed that the altitude did not affect the diversity of insects in the sugarcane agrosystem, nevertheless the altitude affected the abundance of pests attacked. Interestingly, Sesamia was only found attack the sugarcane in the highlands area. Ants (Hymenoptera) causing hollow stems of plants. The intensity of attacks in the highlands ranges 36 - 76%, while in the lowlands 28 - 40% rate of cell division resulting in bacterial colonization and motility approaching the fungal pathogen.

1. Introduction
Along with the continuous increase in population and increase in people's welfare, national sugar consumption also increased to 3.3 million tons, consisting of 2.5 million tons of sugar consumption and 0.8 million tons for the needs of the food and beverage industry. Based on the projected Data Center for Agriculture and Information Systems Agricultural consumption in 2017 is projected to reach 5.07 million tons while production is only 2.47 million tons. As a result, sugar moved across a deficit of 2.6 million tons. To meet domestic sugar needs and stabilize domestic prices, the government must import sugar from abroad every year [1].

The problem which until now often occurs is low sugarcane production and low sugarcane yield [2]. The biggest obstacle to sugarcane in Indonesia is pests. The decline in sugar production due to pest attacks can reach 20% per year [3]. Losses that reduce pests and diseases are quite high, about 10% decrease in sugar production. Even if a shoot borer occurs in the 5 months before cutting can reduce sugar production by 52–73%. There are 43 types of pests (insects and non-insects) that attack sugarcane. However, the pests that are often found in sugarcane plantations in Indonesia are shoot borer, stem borer, white fur lice, and grub [4].

Insect diversity is often the basis for developing technologies that support the application of pesticides by utilizing the ecosystem services provided by insects. Insects give explicit approval to sugarcane that reaches other approved species.

Integrated pest or disease control component, using agricultural methods, use of biological agents, use of pesticides and monitoring of pests or diseases [4]. Jambi Province does not yet have data that mentions...
the development and types of pests that attack sugarcane, therefore this research is expected to provide information on various pests that attack sugarcane in Jambi Province, through conversion between low and high sugarcane mills in Jambi Province.

2. Materials and Methods
The field research was conducted on February to March 2018, in several districts in Jambi Province. The sample village upon the highlands was in Sungai Asam Village, Kayu Aro Barat District and Siulak Village, Hamparan Sungai Bemas District, Kerinci Regency. The sample village upon the lowland was in Tangkit Village, Batanghari Regency and Sungai Gelam District, Muaro Jambi Regency. Insects identification was done in Laboratory of Batanghari University.

The studies in which location were presented with survey items deliberately constructed (purposive sampling method) in the indicators that they exist in the area object to be researched. The object referred to is of sugar-cane plantations that is upon the highland and lowland in Jambi Province that infested by pests. The location of the sampling method of divided into four, two a highland in Sungai Asam Village, Siulak Village, the lowland is in Muaro Bulian and Tangkit Village.

The sample collection was done by set a trap to know population insects that are pests is somewhere location. A yellow trap made of plastic measuring 20x20 cm given the pole and glue. Traps were installed for the next one week. A pitfall trap to evaluate an insect that strike the rooting cane, made of plastic glass with a diameter of 13 cm contained a 70% alcohol solution and a soapy liquid deposited 10 cm deep in the soil [5]. Trapped insects were taken for identification. Identification of insects refers to Naumann et al. [6].

The results of the identification was entry in the form of a species of insects in excel. The number of species (the riches species) in the form of a curve accumulation of the species have evolved to each location with different heights displayed to surmise the whole species of insects using EstimateS software version 9.1.0 [7-8].

Factors influencing the diversity of insects analyzed using analysis of variance (ANOVA). The presentation of graphic to put more detailed information about the number of species, diversity index and the evenness dominance on two different heights use box-plot.

Further tests to find out the structure of the community the bugs on the height of land that is different is by test ANOSIM (analysis of similarity) performed to gain value statistics a differences coefficient.

Sorensen index calculated to know an insect that community structure with him there is for a height of land next shows in the form of ordination non metric multidimensional scaling (NMDS) by using multidimensional analysis scaling (MDS) [9]. Plantation company that holds was structural similarity is usually located close to each other. Analysis was done with uses software R-Statistic [10].

To describe the similarity of its arrangement and relations of an insect to which there are in plants cane juice in the different heights used a Diagram Venn. Of a circle which is overlap between used to describe the number of species of which have point of similarity between the groups that are put on display, while the difference has been described out in portions of a circle which wasn’t overlap. A Diagram Venn are draw up so as by processing the species strokes of the fly on for making interactive websites [11].

3. Results and Discussion
The number of species of obtained of a whole plot cane consisting of 37 species included in the order Table 1. Based on land height, diversity insects in the highlands of as many as 34 species and 31 species in the lowlands. Diversity insects found in plants cane the highlands of higher compared to diversity insects in the lowlands. The height of the land does not affect the number of species of insects (ANOVA, F1,4 = 2.376; P = 0.198), the diversity index Shannon-Wiener (ANOVA, F1,4 = 1.851; P = 0.245 ), Evenness of Index to plant cane ( ANOVA, F1,4 = 0.273; P = 0.629) but effect on insects (ANOVA, dominance F1,4 = 9.676; P = 0.0358). The number of species insects collected described in the form of function an increase in the sample collection (a species accumulation curves) (Fig. 1).
Table 1. Diversity insects in plant cane in the highlands and lowlands.

| Land         | Species | Percentage |
|--------------|---------|------------|
| Lowland      |         |            |
| Tangkit      | 24      | 64.86%     |
| Muara Bulian | 24      | 64.86%     |
| Highland     |         |            |
| Sungai Asam  | 10      | 27.03%     |
| Sungai Asam Lereng | 14 | 37.84% |
| Sungai Asam Rendah | 23 | 62.16% |
| Sungai Bermas | 21      | 75.68%     |
| Total        | 37      | 100%       |

Figure 1. A curve in the species of plant cane (a) lowland and (b) highland.

With 24 times the sample insects in plants to cane in the lowlands asimtute in the highlands of, and reached the insects not all 24 times. Only the insects in the lowland (Sungai Asam Village) reached 24 times from asimtute. The structure of the community insect species described resemblance between the height of the land (Table 2). The resemblance of 75% highest species in Sungai Asam dan Sungai Asam Lereng. The resemblance of the species was lowest in Muara Bulian and Sungai Asam Rendah 19.1%.
Differences of composition species at the height of the plains that different can be compared with using analysis in common (ANOSIM) Bray-Curtis according to the common ground that produces NMDS dimension to display the difference the structure of the community insects in sugarcane pertanaman at different heights (Fig. 2). The analysis shows that the different NMDS type heights do not affect the diversity of insects in sugarcane (ANOSIM Statistic; R = -0.3929, P = 1).

Table 2. Sorensen index resemblance to insects in lowland and highland.

| Region          | Tangkit | Muara Bulian | Sungai Asam Rendah | Sungai Asam | Sungai Asam Lereng |
|-----------------|---------|--------------|---------------------|-------------|-------------------|
| Muara Bulian    | 29.1    |              |                     |             |                   |
| Sungai Asam Rendah | 40.4  | 19.1         |                     |             |                   |
| Sungai Asam     | 58.2    | 58.8         | 57.6                |             |                   |
| Sungai Asam Lereng | 47.3  | 36.8         | 45.9                | 75.0        |                   |
| Sungai Bernas   | 24.4    | 28.9         | 40.9                | 54.8        | 54.3              |

Figure 2. NMDS from the structure of the community gather to insects according to the Bray-Curtis Dissimilarity Index of the sugarcane.

The intensity of attacks on sugarcane in the highlands and lowlands showed difference. In the highlands, the average attack intensity is 61.33% or ranges from 52-76%. In the lowlands, attacks range from 28% to 40%. Pests in the lowlands are dominated by ants (Hymenoptera) which are the main pests that cause perforated plant stems. In the highlands the type of pest that attacks sugarcane is a pest of the type of Sesamia inferens (Jambon Borer). Stem borer (S. inferens) is the main pest that attacks sugarcane plants, causing plants to die in shoots. And also found the larvae of ants at the base of the sugarcane roots.
The results from Capinera’s research, the height of the place affects the differences in temperature, humidity, and wind that affect the spread of insects [12]. Furthermore, Rahayu stated that altitude of the place is closely related to air temperature which plays an important role and is often a limiting factor because it affects the speed of the metabolic processes and life of insects in various aspects including insect feeding activities, and their development [13].

As many as 28 species of insects were found lowland and highland. These common elements were Acrididae 01, Acrididae 02, Acrididae 03, Anoplolepis 01, Calliphoridae 02, Camponotus 01, Camponotus 02, Carrhotus sannio, Cecidomyidae 02, Cecidomyidae 03, Coleoptera 01, Coleoptera 02, Coleoptera 03, Coleoptera 05, Coleoptera 06, Coleoptera 08, Culicidae 01, Culicidae 02, Diatraecophaga striatalis, Hemiptera 01, Hemiptera 02, Muscidae 01, Myrmicinae 02, Oxyopes javanus, Pardosa pseudoannulata, Polyrhachis 01, Tephritidae 01, and Tipulidae 01. As many as 3 elements included exclusively in Lowland were Coleoptera 07, Coleoptera 09, and Maripissa magister. Then 6 elements included exclusively in Highland were Crematogaster 01, Hemiptera 03, Lepidoptera 01, Myrmicinae 01, Oxyopes salticus, and Tetragnatha maxillosa (Fig. 3).

4. Conclusion
The insect diversity in each plantation plot in the highlands and lows is not significantly different. More specific analysis needs to be developed to be able to find out the potential use of insects as a terrestrial indicator species and the utilization of insect ecosystem services for pest control in sugarcane plantations. Changes in the environment can also be easily done at low costs.

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