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Exploration of macrofauna in Coffee plants

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Abstract. *Coffea sp.* is one of the superior commodities in North Sumatra Province. Soil insects in coffee plantations play a role as a decoder of organic matter, which produces humus as a nutrient for plants. In addition, soil insects can also be used as an indicator of soil fertility. This study aims to identify the types of macrofauna found in immature plants and mature plantsof coffee plantations. The study was conducted in June 2018 until it was completed in two villages in Sipirok using the descriptive method. The results showed that the most common macrofauna found in the mature plants area, consisting of orders Hymenoptera, Orthoptera and Coleoptera, Oligochaeta While in the immature plants area there are only insects from the Order of Hymenoptera and Orthoptera, Dermaptera, Araneae, Oligochaeta.

1. Introduction

Coffee plants are a mainstay commodity of North Sumatra province in addition to other plantation commodities such as oil palm, cocoa and rubber. The land for growing Arabica coffee in North Sumatra Province is located on a stretch of plateau ranging from 1000-1650 m above sea level [1]. Coffee is also an economic enterprise that provides employment opportunities and also as a source of income. In its development, coffee exports increase every year, the demand for coffee products is very high in the international market [2].

The southern Mandailing area is very suitable for coffee plantations. coffee from this region in the Dutch era was quite well known in the international market, commonly called "Kopi Mandily". In the Mandailing area, the area of community coffee plantations in the area was 3,768.60 Ha with coffee production in 2013 which was 1,737, 51 tons, which was divided into two types of coffee varieties, namely robusta and arabica. The area of the people's Arabica coffee plantations in Mandailing is 2,410, 80 Ha with an area for producing crops of 1,069 Ha and for immature plants of 1,078 Ha [3,4].

Soil has a variety of properties, which consist of physical, chemical, and biological properties. The difference between the three properties affects the ability of the land. The biological nature of land has an important role in increasing land productivity because of the widespread expansion of poorly managed agricultural land that is not based on the environment and the limited availability of inorganic fertilizer resources. Various types of microbes and soil fauna have been known to have potential as biological fertilizers and various soil biological attributes began to be widely used as indicators of soil quality and health. Soil insects are insects that live on the ground, both those that live in the soil and those that live on the ground. Insects in a community play a role as a decoder of organic materials, which results in the form of topsoil which later becomes useful as a nutrient for plants . In addition, soil insects can also be used as an indicator of soil fertility.

The most important role of soil insects in the ecosystem is as a breaker of organic material available for green plants. Plant nutrients derived from various plant residues will go through a decomposition process so that humus is formed as a source of soil nutrients. In addition, several types

of soil insects can be used as indicators of soil fertility [5]. In general, the revamping process takes place as follows: first of all a large breaker or macrofauna weakens the substance of the habitat that has died, then this material will pass through the intestine and eventually produce faeces. Stool can also be consumed first by macrofauna with the help of specific enzymes found in the digestive tract. Decomposition will be more perfect if the excretion of this fauna is destroyed by decomposing organic-eating insects, helping to transform decaying substances into simpler substances. Many types of insects that part or all of their lives are in the soil. The land gives insects a settlement or nest, defense and often food [6].

The role of soil insects as decomposers is very useful in the process of existing food webs, the results of which are used by plants. The decomposer groups that are often found are orders of Coleoptera, Diptera and isopterans [7]. The types of soil insects found in a place are influenced by environmental factors, both biotic factors and abiotic factors. Abiotic factors include soil, water, temperature, light, and atmosphere. While biotic factors include plants and animals in the environment. The purpose of this study was to determine the type of soil macrofauna found in immature and mature coffee plants.

2. Materials and Method

This research was conducted in May 2018 until it was finished in the coffee farming area in Sipirok. Insect identification was carried out at the Laboratory of Pest, Faculty of Agriculture, University of North Sumatra and LIPI Cibinong. Soil analysis is carried out at Socfindo Laboratory. The tools and materials used in this study were Soil Sampler size (25x25x30) cm, hoe, Thermohygrometer, scissors, meter, bottle, magnifying glass, tweezers, 70% alcohol, microscope, camera.

This research is a descriptive quantitative method. Methods of observation or sampling directly from the location of research or exploration. Direct site review for the research to be carried out, in two producing coffee plantations and immature coffee plants. Method of sampling using a 25 m line, with a distance of 5 m between each point. This line is made as much as 3. Then soil sampling is made at points determined with a size of 25 x 25 and into 30cm. Then the excavated soil is put into plastic, and the insects obtained are put into bottles containing alcohol to last as a collection.

Identification of insect morphology was carried out under a microscope and then matched with insect identification books [8]. Soil analysis includes: Soil Temperature, Soil Moisture, direct sunlight intensity measured in the research area. While the water content is measured in the laboratory. Analysis of soil chemical properties was carried out by carrying soil samples from the research site to the laboratory then measuring the pH, measured the organic content, type of soil.

3. Results and Discussions

Based on observations made on coffee plants, it can be seen that there are 3 insect orders with 6 genera (Table 1). Each genus has a different number. The most genus trapped is *Oecophylla* 20 individu (ind.), *Anoplolepis* 16 ind., *Gryllus* 9 ind., *Loxoblemus* 6 ind., *Gryllotalpa* 5 ind., *Pontoscolex* 3 ind., and *Alphitobius* 2 ind. Whereas in coffee plants that produce there are differences in insect orders and the number of insects trapped. There are 4 orders, 4 families and 5 genera.

The most common genus is *Oecophylla* 23 ind., *Anoplolepis* 11 ind., *Gryllus* 7 ind., *Macrotermes* 6 ind., *Pontoscolex* 5 ind., *Calosoma* 3 ind., *Pardosa* 2 ind., and *Vostax* 2 ind. The environmental conditions when collecting data are in the morning from 06.00 to 09.00 in the morning. This is done so that ground insects are still around the coffee plant and have not moved far because the hot weather causes insects to move. The difference in macrofauna diversity in occurs because of differences in the age of coffee plants that have produced and produced, this difference also affects the amount of organic fertilizers and materials that have been applied so that the fertility and organic matter content in the soil is different and the temperature environment in different plants, because the shrubs of coffee plants that produce and do not produce also affect the micro-temperature and the presence of macrofauna as a breeding ground and looking for food.

Table 1. Result of macrofauna survey on coffee plants

	Order	**Family**	**Genus**
	Coleoptera	Carabidae	*Alphitobius*
	Orthoptera	Gryllidae	*Gryllus*
Immature plants		Gryllidae	*Loxoblemus*
		Gryllotalpidae	*Gryllotalpa*
	Hymenoptera	Formicidae	*Oecophylla*
		Formicidae	*Anoplolepis*
	Oligochaeta	Glossoscolecidae	*Pontoscolex*
	Isoptera	Termitidae	*Macrotermes*
	Coleoptera	Carabidae	*Calosoma*
	Hymenoptera	Formicidae	*Oecophylla*
Mature plants		Formicidae	*Anoplolepis*
	Dermaptera	Labiidae	*Vostax*
	Orthoptera	Gryllidae	*Gryllus*
	Araneae	Lycosidae	*Pardosa*

Figure 1. Documentation of macrofauna survey

This is in accordance with previous study that the factors that influence the presence of soil insects are the soil structure influences movement and penetration, soil moisture and nutrient content affect the development in the life cycle, soil temperature affects egg laying, light and air conditioning affect its activities [6,9]. While the diversity of soil insects in each place is different, as mentioned by [10] low diversity is found in communities with extreme environments, such as dry areas, poor land, and high mountains. While high diversity is found in areas with optimum environmental communities, for example fertile areas, rich soils, and mountainous areas.

4. Conclusions
There are differences of macrofauna diversity in coffee plants between mature and immature types. Macrofauna diversity is found more diverse in mature coffee plants. There are 4 orders, 7 families in immature Plant and 7 orders, 8 families in mature coffee plants.

References

[1]   Sari. M. 2014. Identifikasi Serangga Dekomposer Permukaan Tanah Hutan Tropis Dataran Rendah. FKIP. Universitas Lancang Kuning.

[2]   Bustami B R dan Hidayat P. 2013. Analisis Daya Saing Produk Ekspor Provinsi Sumatera Utara. *J. Eko. Keu* 1(2), Januari 2013.

[3]   BPS. 2014. Madina dalam Angka. Badan Pusat Statistik Kabupaten Mandailing Natal.

[4]   Matondang. D, T.sabrina, H.Guchi. 2015. Evaluasi Sifat Biologi Tanah Kopi Arabika Pada Beberapa Kecamatan di Kabupaten Mandailing Natal. Fakultas Pertanian. USU. Medan.

[5]   Sari. M. 2014. Identifikasi Serangga Dekomposer Permukaan Tanah Hutan Tropis Dataran Rendah. FKIP. Universitas Lancang Kuning.

[6]   Rahmawaty.2000. Keanekaragaman Serangga Tanah dan Perannya pada Komunitas *Rhizopora* spp. Dan Komunitas *Ceriops tagal* Di Taman Nasional Rawa Aopa Watumohai, Sulawesi Tenggara. Tesis program pascasarjana IPB. Bogor.

[7]   Odum, E.P. 1998, Dasar-dasar Ekologi. Alih Bahasa : Samingan, T dan B. Srigandono. Edisi Ketiga Universitas Gadjah Mada Press, Yogyakarta, 824 hlm

[8]   Borror, D.J., Triplehorn, C.A., and Johnson, N.F. 1992. Pengenalan Pelajaran Serangga. Edisi Keenam. Diterjemahkan oleh:Partosoedjono, S. dan Brotowidjoyo, M.D. Yogyakarta : Gadjah Mada University Press.

[9]   Szujecki, A. 1987. Ecology of Forest Insect. PWNPolish Scientific Publisher. Warszawa.

[10]   Situmorang T S. 2013. Kopi *Sigarar Utang* dari Sumatera Utara.Balai Besar Perbenihan dan Proteksi Tanaman Perkebunan (BBPPTP). Medan.