AGRITROPICA Journal of Agricultural Sciences

Content is available at:
https://ejournal.unib.ac.id/jagritropica
ISSN: (Print) 2621-217X, (Online) 2621-699X
Agritropica. J. Agr. Sci. 8 (1): 33-42 May 2025

Diversity of Land Arthropods in Community Oil Palm Plantations in the Coastal Area of Bengkulu

Ariffatchur Fauzi[1], Agustin Zarkani[1], Djamilah[1], Deri Gustian[1], Ilmi Hamidi[1], Rihan ifebri[2], and Turko Prastio[1]

[1]Department of Plant Protection, Faculty of Agriculture, University of Bengkulu, Indonesia
[2]Department of Agribusiness, Faculty of Agriculture, University of Bengkulu, Bengkulu, Indonesia
Corresponding Author: Ariffatchurfauzi@unib.ac.id
Article info: Submitted: 2025-04-16, Accepted: 2025-06-10, Publish: 2025-07-15

ABSTRAK: Bengkulu is one of the provinces located on the island of Sumatra, boasting a significant agricultural sector. One of the leading agrarian commodities in Bengkulu Province is oil palm. Oil palm in Bengkulu is planted in coastal areas. One of the key factors supporting oil palm fruit production is a healthy soil arthropod ecosystem. Soil arthropods play an essential role in the oil palm plantation ecosystem. As organisms that live in the soil, these animals help maintain soil and plant health, improving soil structure and nutrient availability for oil palm plants. This study aims to obtain initial data on the diversity of soil arthropods and their roles in smallholder oil palm plantations on the coast of Bengkulu. This study began with sampling oil palm plantations around the coast of Bengkulu. The areas that will be used as study locations include Sungai Suci, Danau Gedang, and Pekik Nyaring. Arthropod sampling was carried out by installing pitfall traps in both areas, which were determined diagonally in a 200 m² area, with 20 pitfall trap units per location. Arthropod species were identified based on morphology, and the type and number of populations were recorded. The Shannon-Wiener diversity index, dominance index, and evenness index measure analysis of biodiversity data. The results of the study showed that in the majority, the diversity of soil arthropods in the three sampling areas was moderate, the dominance of arthropod types was low to moderate, and evenness was moderate to high.

Keywords: Arthropod, ecosystem, palm oil, environment, coast

Reference to this paper should be made as follows:
Fauzi, A., Zarkani, A., Djamilah, Gustian, D., Hamidi, I., Ifebri, R., and Prastio, T. (2025). Diversity of Land Arthropods in Community Oil Palm Plantations in the Coastal Area of Bengkulu. Agritropica. J. Agr. Sci. 8 (1): 33-42. Doi: https://doi.org/10.31186/J.agritropica.8.1.33-42.

INTRODUCTION

Bengkulu is one of the provinces located on the island of Sumatra, boasting a significant agricultural sector. One of the leading plantation commodities in Bengkulu Province is oil palm. According to the BPS in 2021, oil palm production in Bengkulu in 2020 was 234.83 thousand tons. Oil palm is generally planted in lowland areas; in Bengkulu, several oil palm plantations owned by the community are located in coastal areas.

Oil palm is one of the plantation commodities that plays a significant role in Indonesia's economic activities due to its ability to produce vegetable oil, which is widely used by the industrial sector. Its properties are resistant to oxidation with high pressure, and its ability to dissolve chemicals that are insoluble in other solvents, as well as its high coating power, making palm oil usable for various purposes, including cooking oil, industrial oil, and fuel (biodiesel) (GAPKI, 2014).

In addition to economic benefits, oil palm plantations are a source of germplasm for soil fauna habitats. Soil fauna, including soil arthropods, play an essential role in the ecosystem of oil palm plantations. As organisms that live in the soil, these animals help maintain soil and plant health, improving soil structure and nutrient availability for oil palm plants. In addition, soil fauna also helps improve soil structure and nutrient availability for oil palm plants. Jeffery et al. (2010) stated that soil serves as a habitat for bacteria, fungi, and various types of fauna, including arthropods, earthworms, and nematodes, which play special ecosystem functions. Oil palm plantations cannot be separated from the presence of insects in the plantation area; several factors, such as air, temperature, pH, humidity, and light intensity, influence the presence and activity of insects. Several types of soil fauna, such as earthworms, cockroaches, and decomposing insects, help decompose organic matter and convert it into a form that plants can more easily digest. This process enhances the availability of nutrients for oil palm plants while also improving soil structure, thereby increasing water storage capacity and enhancing water infiltration in the soil. Setiawan and Maulana, in 2019, stated that arthropods can live in soil and water and can help absorb groundwater through their activities during their lives. The presence of arthropods in an ecosystem is influenced by both abiotic and biotic factors (Sembiring, 2020).

Soil fauna can also help increase the productivity and quality of oil palm seeds. Several types of soil fauna, such as wood borers and termites, help break down organic matter buried in the soil and release the nutrients contained therein. Additionally, various types of soil fauna, including earthworms and decomposing insects, can enhance the number of microorganisms in the soil that facilitate the decomposition of organic matter. Decomposition in the ecosystem will be slow if soil arthropods cannot fill the niche (Gesriantuti et al. 2016). Organic matter around oil palms is food and shelter for arthropods.

Soil arthropods in oil palm plants have various vital roles in maintaining plant health and productivity, including as predators and decomposers. Several types of soil arthropods, such as ground beetles (Carabidae) and ground spiders (Gnaphosidae), are natural predators that can eat pests on oil palms. In addition, several types of soil arthropods, such as earthworms (Lumbricidae) and decomposing insects (Isoptera), are natural decomposers that aid in the decomposition of plant remains and enhance soil structure.

Several types of soil arthropods can also be used as indicators of soil fertility. Semiun and Stefanus (2016) stated that soil arthropods are part of soil biodiversity and play a crucial role in enhancing the physical, chemical, and biological properties of the soil. The role of soil arthropods in the ecosystem is that they are pollinators, decomposers, predators (biological controllers), parasitoids (biological controllers), and bioindicators for the ecosystem. The same statement was made by Haneda et al. in 2023; insect diversity is believed to be used as one of the bioindicators of an ecosystem's condition.

Exploring the diversity and abundance of arthropods is necessary to monitor the condition of an ecosystem in a particular area.

RESEARCH METHODS

Sampling Location

This research was conducted in three community oil palm plantations in the coastal area of Bengkulu Beach. The study locations used include Sungai Suci, Danau Gedang, and Pekik Nyaring. The sampling locations are oil palm plantations owned by the community in the coastal area of Bengkulu.

Research Data Resources

The primary data source for this research is the data collected directly. Primary data is research data obtained from direct data collection. Data was obtained by installing pitfall traps in the coffee plantation area with a diagonal sampling pattern. In one sample area measuring 200 m2, 20 pitfall trap units were installed.

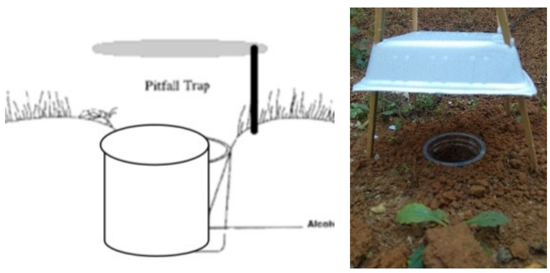

Figure 1. Pitfall trap used for sampling

Pitfall traps, made of plastic cups with a diameter of 5 cm and a height of 15 cm, are planted in the soil at a depth of 15 cm. In the area around the pitfall hole, the ground's surface is made so that there is no gap between the surface of the pitfall trap and the ground. The pitfall trap hole is filled with soapy water, so that if an insect enters the pitfall trap, it cannot escape. To prevent rainwater from entering the pitfall trap, the top of the pitfall trap is fitted with stretched plastic. Furthermore, after the pitfall trap has been installed for 3 days and 24 hours, it is dismantled. The sample is placed in a plastic container containing 70% alcohol. Furthermore, the sample is taken to the laboratory to be identified based on morphology, and then counted and recorded according to order, family, and genus.

Data analysis

Analysis of data on the number and types of arthropods determined the diversity index using the formula:

$$Pi = ni/N ......(1)$$

Once the Pi value is obtained, it will be calculated further using the formula:

$$H' = - \Sigma\ (pi)\ (\log pi) .... (2)$$

In condition:
H' = Diversity species index
S = Species number
Pi = Proportion of the number of samples of species i
N = Total number of sample individuals
ni = Number of individuals of type i

The values from the diversity index calculation match the indices in Table 1.

Table 1. Diversity Index Category

H index value	Cathegory
H<1	Low Diversity
1<H<3	Moderate Diversity
>3	High Diversity

Then, the dominance index value is calculated by Odum using the 1966 formula:

$$C = \sum (Pi)^2 ....(3)$$

The results of the calculation of the dominance index value are then matched with the dominance index category (Table 2)

Table 2. Domination Index Category:

Domination index value	Category
0-0.50	Low domination
0.51-0.75	Moderate domination
>0.75	High domination

Next, the calculation of the evenness index value (Maggurran, 1988) using the formula

$$E = H' / \ln S ....(4)$$

information:
E = Evenness value
H ' = Diversity index value
S = Total type of arthropod

The value of the evenness index calculation is then matched with the evenness index table (table 3).

Table 3. Evenness index value

Evennes index	Category
0 < E < 0.4	Low evenness
0.4 < E < 0.6	moderate eveness
0.6 < E < 1.0	high eveness

RESULT AND DISCUSSION

Oil palm plantations have few types of plants and food resources, so the initial assumption is that the ecosystem does not support the composition and structure of animal communities. Arthropods obtained in the study were 15 orders, namely Orthoptera, Myriapoda, Hemiptera, Blattodea, Hymenoptera, Diptera, Coleoptera, Mollusca, Arachnida, Hemiptera, Lepidoptera, Protura, Isopoda, Spirostrepsida, Scolopendromorpha. Figures 1, 2, and 3 show the distribution of orders obtained from the three sample areas; all three graphs show that the Hymenoptera order is the most commonly found order from the three sampling locations. The life support capacity of the ecosystem influences the number of arthropod species in an ecosystem. Figure 3 and Tables 5, 6, and 7 show the orders of soil arthropods in the Gedang Lake sample area. The graphs and tables show that Hymenoptera of the Formicidae family are the most common arthropods found in Gedang Lake, followed by isopods of the Armadilidae family.

Figure 4, Figure 5, and tables 8, 9, 10, 11, 12, and 13 show that soil arthropods at Pasar Pedati have something similar to the samples at Danau Gedang, namely the Hymenoptera order: Formicidae is the most commonly found in the Pasar Pedati and Pekik Nyaring areas. These results align with research by Dewi et al. in 2020, where the study showed that Formicidae is the most common family found in several habitats.

Table 4. Sample land condition

Variable	Danau Gedang			Pekik Nyaring			Pasar Pedati		
	1	2	3	1	2	3	1	2	3
Soil Temperature (°C)	29	28	28	29	30	30	30	29	29
pH	4.5	5	6.5	6.5	6.5	5	6.5	6	7
Heights (meters above sea level)	11	11	10	10	10	11	17	18	14

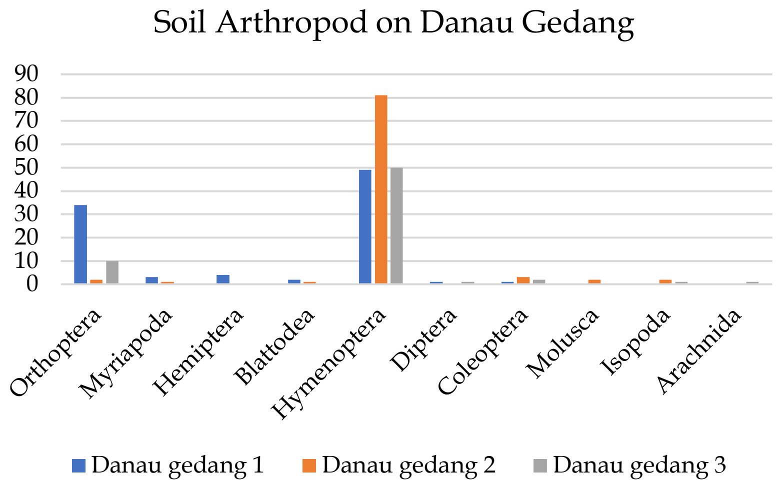

Figure 2. Order of arthropod samples obtained from the Danau Gedang sample location

Table 5. Arthropods obtained from Gedang Lake; sample location point 1

Ordo	Family	Genus	N
Orthoptera	*Acrididae*		4
Orthoptera	*Gryllidae*		30
Myriapoda			
Hemiptera	*Reduuvidae*	*Sycanus*	3
Blatodea	*Blattidae*		2
Hymenoptera	*Formicidae*	*Camponotus*	49
Arachnida 3			
Hemiptera	*Anthocoridae*	*Orius*	1
Hymenoptera	*Formicidae*	*Lasius*	30
Diptera1			1
Coleoptera	*Chrysomellidae*	*Lamprosema*	1
			127

Table 6. Arthropods obtained from Gedang Lake, sample location point 2

Ordo	Family	Genus	N
Orthoptera	*Gryllidae*	*Teleogryllus*	2
Myriapoda			1
Blatodea1			1
Mollusca 1			1
Mollusca 2			1
Hymenoptera	*Formicidae*	*Solenopsis*	61
Hymenoptera	*Formicidae*	*Camponotus*	20
Isopoda	*Armadilidae*		2
Coleoptera	*Nitidulidae*		3
			92

Table 7. Arthropods obtained from Gedang Lake, sample location point 3

Ordo	Genus	Family	N
Arachnida 4	*Gryllidae*		1
Isopoda			1
Orthoptera	*Gryllidae*		10
Diptera1			1
Coleoptera	*Scarabidae*		2
Hymenoptera	*Formicidae*	*Solenopsis*	50
			65

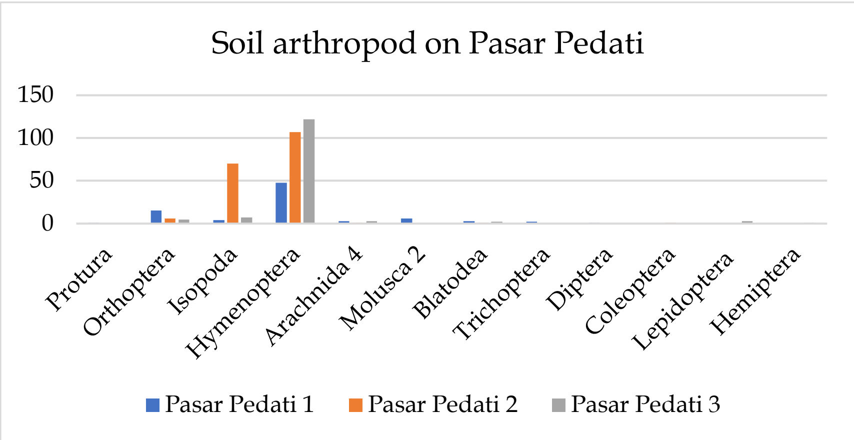

Figure 3. Soil arthropod orders obtained at the Pasar Pedati

Table 8. Arthropods obtained from Pasar Pedati; sample location point 1

Ordo	Family	Spesies	N
Protura			1
Orthoptera	*Gryllidae*		15
Isopoda	*Armadilidae*		4
Hymenoptera	*Formicidae*	Camponotus	48
Arachnida 4			3
Molusca 2			6
Blatodea	*Blattidae*		3
Trichoptera			2
Diptera	*Asilidae*		1
			83

Table 9. Arthropods obtained from Pasar Pedati, sample location point 2

Ordo	Family	Spesies	N
Arachnida 5			1
Blatodea	*Blattidae*		1
Orthoptera	*Gryllidae*		6
Coleoptera	*Curculionidae*		1
Isopoda	*Armadilidae*		70
Hymenoptera	*Formicidae*	*Solenopsis*	43
Hymenoptera	*Formicidae*	*Oecophylla*	64
			186

Table 10. Arthropods obtained from Pasar Pedati, sample location point 3

Ordo	Family	Genus	N
Blatodea	*Blattidae*		2
Arachnida 3			3
Lepidoptera 2			3
Isopoda	*Armadilidae*		7
Orthoptera	*Gryllidae*		3
Orthoptera	*Gryllotalpidae*		2
Hemiptera	*Reduuvidae*	*Sycanus*	1
Lepidoptera 3			1
Hymenoptera	*Formicidae*	*Solenopsis*	111
Hymenoptera	*Formicidae*	*Oecophylla*	11
Hemiptera	*Pyrrhocoridae*		1
			145

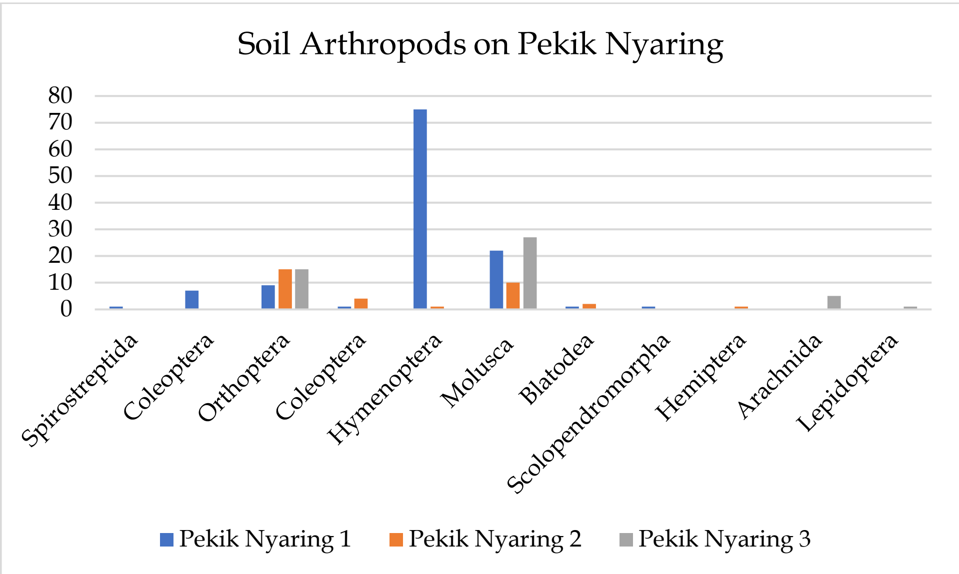

Figure 4. Soil arthropod orders obtained at Pekik Nyaring

Table 11. Arthropods obtained from the Pekik Nyaring sample location point 1

Ordo	Family	Genus	N
Spirostreptida			1
Coleoptera	*Carabidae*	*Pherosophus*	7
Orthoptera	*Gryllidae*		9
Coleoptera	*Histeridae*		1
Hymenoptera	*Formicidae*	*Oecophylla*	75
Mollusca 2			22
Blatodea	*Blattidae*		1
Scolopendromorpha	*Cicadidae*		1
			117

Table 12. Arthropods obtained from the Pekik Nyaring sample location point 2

Ordo	Family	Genus	N
Orthoptera	*Gryllidae*		15
Hemiptera	*Reduuvidae*	*Sycanus*	1
Coleoptera	*Carabidae*		
Coleoptera	*Scarabidae*		
Hymenoptera	*Formicidae*	*Oecophylla*	1
Blatodea	*Blattidae*		2
Mollusca 1			
			33

Table 13. Arthropods obtained from the Pekik Nyaring sample location point 3

Ordo		Genus	N
Mollusca 2			27
Orthoptera	*Gryllidae*		15
Arachnida 1			1
Coleoptera	*Carabidae*	*Pherosophus*	19
Arachnida 2			4
Lepidoptera 1			1
			67

Table 14. Results of calculating the critical value index at the three sample locations

Index value / Location	Danau Gedang			Pekik Nyaring			Pasar Pedati		
	1	2	3	1	2	3	1	2	3
Diversity Index	moderate	moderate	Low	moderate	moderate	moderate	moderate	moderate	moderate
Dominatio n index	Low	Low	moderate	Low	Low	Low	Low	Low	moderate
Evenness index	High	moderate	moderate	moderate	High	High	High	High	moderate

Arthropod Role in the Environment

Soil surface arthropods are an important part of the soil ecosystem, playing a role in decomposition, aeration, and nutrient cycling. The diversity and composition of soil arthropods can be used to assess an ecosystem's condition or as an indicator. If an ecosystem has high biodiversity, it can.

The existence of an organism depends on the presence of other organisms and the resources in the ecosystem. This is related to the role of organisms in the food web. The role of organisms in the ecosystem can be divided into carnivores, detritivores, and herbivores. The role of living organisms in maintaining the ecosystem is based on decomposition and nutrient cycling (Ramadhan et al., 2023). The process of decomposition and nutrient cycling improves and maintains the soil's biological, chemical, and physical properties; however, cultivation activities can affect the role of soil organisms in the ecosystem (Ramadhan et al., 2023).

Most commonly found in this study, the Formicidae family acted as detritivores, or organisms that consume organic matter, on the oil palm land used as the research location. The important role of Formicidae is as a bioindicator of change. As a component of the ecosystem, the Formicidae family acts as a predator, herbivore, detritivore, soil fertilizer, and waste decomposer.

Ants are widely distributed in various habitats due to their high environmental tolerance. However, they are not yet able to serve as an indicator of whether the habitat conditions are still favorable or not. The soil arthropods in this study that act as detritivores include Armadilidae, Gryllidae, Scarabaeidae, and Blattidae. The herbivorous insects found in this study are Cicadellidae, the order Lepidoptera, Gryllotalpidae, and Mollusca. In this study, the arthropods that act as carnivores are Arachnida, the family Reduviidae, and Histeridae.

Importance Index Values at the Three Sampling Locations

Analysis of species diversity is a fundamental concept in measuring the diversity of a community (Ramadhan, 2023). Diversity analysis is the simplest way to describe biological richness. The diversity of soil organisms contributes significantly to maintaining the ecosystem.

The Shannon-Wiener diversity index (H') of soil arthropods at the three sampling locations in the coastal area of Bengkulu showed that the three sampling locations had moderate diversity ($1 < X < 3$), except for the Gedang Lake 3 location, which had a low diversity index value. Moderate species diversity indicates that the number of individuals is not diverse. The general interpretation of the species diversity index is that the higher the index value, the higher the species diversity in the area. The value of species diversity is a community-level characteristic based on its biological organization, which can express community structure (Ramadhan et al., 2023).

Diversity tends to be low if the ecosystem is physically controlled (there are strong physical and chemical limiting factors). Fitriani, in 2016, stated that agricultural land strongly influences insect diversity. High arthropod diversity allows the food web process to run. If the diversity of arthropods in a soil is low, the ecosystem is unstable and unbalanced. The more complex the food chain, the higher the diversity index value in an ecosystem. In ecosystems with high abundance and diversity of soil arthropods, there are complex interactions of food webs that can support ecosystem stability (Semiun & Stanis, 2016). Generally, a stable ecosystem contains highly diverse complex organisms (Odum, 1971).

The level of diversity of soil arthropods is influenced by several factors, including the level of lighting, temperature, organic matter (food), and other life-supporting factors. The dominance index value shows that the presence of the dominance index value (ID) is inversely proportional to the diversity index value (H ') and the species evenness index (E). The dominance index values at the three sampling locations indicate that Danau Gedang 1, Danau Gedang 2, Pekik nyaring 1, Pekik nyaring 2, Pekik nyaring 3, Pasar Pedati 1, and Pasar Pedati 2 are included in the low category; In contrast, Danau Gedang 3, and Pasar Pedati 3 are included in the medium category. A low dominance index value indicates low dominance of one type of arthropod or no dominance in the ecosystem. The results of the calculation of the evenness index at the three locations indicate the medium category at the locations of Danau Gedang 2, Danau Gedang 3, Pekik nyaring 1, and Pasar Pedati 3; while at the locations of Danau Gedang 1, Pekik nyaring 2, Pekik nyaring 3, Pasar Pedati 1, Pasar Pedati 2 are included in the high category. The evenness index measures the relative distribution of the abundance of organism types in a habitat. Higher evenness index values indicate a more even distribution of species abundance, which can be considered a sign of the evenness of an ecosystem or community.

The difference between the species diversity index (Shannon-Weiner), dominance index, and evenness is that the species diversity index measures the diversity of species in a habitat by considering the abundance and diversity of species. The evenness index measures the extent to which the abundance of individual species in a habitat is even or uneven. At the same time, the dominance index measures the dominance of one or more species in a community or an ecosystem. (Ramadhan et al., 2023).

CONCLUSION

The three sampling locations revealed the presence of soil arthropods that play distinct roles in the ecosystem, indicating that these locations support the life of soil arthropods. The life support capacity at the three oil palm locations in the coastal area of Bengkulu is sufficient to support the life of soil arthropods. In contrast, the ecosystem in Danau Gedang has a more diverse array of arthropods compared to other ecosystems.

REFERENCES

Adisoemarto, S. 1998. Kemungkinan Penggunaan Serangga Sebagai Indikator Pengelolaan Keanekaragaman Hayati. Biota. Vol. III. (1): 25 – 33

Anshori, MF. 2014. Analisis keragaman morfologi koleksi tanaman kopi arabika dan robusta Balai Penelitian Tanaman Industri dan Penyegar Sukabumi.[Skripsi]. Bogor (ID): Institut Pertanian Bogor.

Aradi K. 2008. Analisis daya dukung lahan dan karakteristik petani dalam pengembangan kopi arabika organik di Kabupaten Aceh Tengah [Tesis]. Banda Aceh (ID): Universitas Syiah Kuala.

Barnes, BV. Burk, JH. Shirley ,RD dan Stephen, HS. 1997. Forest Ecology. 4 Edition. John Wiley and Sons Inc. New York. 349-588.

Fitriani. 2016. Keanekaragaman Arthropoda Pada Ekosistem Tanaman Padi Dengan Aplikasi Pestisida. Agrovital. No. 1 Vol 1.

Gesriantuti N, Trantiati R, Badrun Y. 2016. Keanekaragaman serangga permukaan tanah padalahan gambut bekas kebakaran dan hutan lindung diDesa Kasang Padang, Kecamatan Bonaidarussalam,Kabupaten Rokan Hulu, Provinsi Riau. Photon: JurnalSain dan Kesehatan. 7(01):147–155.

Haneda, NF. C Kusmana. K Ramadhan. 2023. Keanekaragaman jenis arthropoda tajuk di hutan mangrove Ciletuh, Sukabumi, Jawa Barat. Silvikultur Tropika. 14(2): 158–167.

Jeffrey, S., C. Gardi, A. Jones, et al. 2010. European Atlas of Soil Biodiversity. European Commission, Publications Office of the European Union, Luxembourg, EUR 24375 EN.

Magurran,A.1988. Ecological Diversity and Its Measurement. USA. Springer

Mukashema, A. Veldkamp, A. Vrieling, A. 2014. Automated high resolution mapping of coffee in Rwada using expert Bayesian network. Internasional Journal of Applied Earth Observation and Geoinformation. 33: 331-340

Najiyanti, S. dan Danarti. 2004. Budidaya Tanaman Kopi dan Penanganan Pasca Panen. Jakarta: Penebar Swadaya.

Najima, K. and Yamane, A. 1991. The Effect of Reforestation on Soil Fauna in the Philippines. Philippines Journal of Science. 120 (1) : 1-9.

Nurhadi. 2011. Komposisi Arthropoda Permukaan tanah di Kawasan Pabrik Pupuk Sriwijaya. Jurnal Ilmiah Ekotrans Universitas Ekasakti Padang: vol 11 No. 1

Odum, E.P. 1993. Dasar-dasar Ekologi. Terjemahan Tjahjono Samingan. Edisi Ketiga. Yogyakarta: Gadjah Mada University Press.

Prastowo, B. Karmawati ,E .Rubijo. Siswanto. Indrawanto ,C. Munarso ,SJ. 2010. Budidaya dan Pasca Panen Kopi. Bogor (ID): Pusat Penelitian dan Pengembangan Perkebunan.

Ramadhan, R.A.M., Amalia, I.S., Azizah, D.N. andNurhidayah, S., 2023. Keragaman danDominasi Serangga Nokturnal di InkubatorFakultas Pertanian Universitas PerjuanganTasikmalaya. AGROSCRIPT Journal of Applied Agricultural Sciences, No. 52, pp.101–114.

Samudra, BF. Izzati, M. Purnaweni, H. 2013. Kelimpahan dan keanekaragaman arthropoda tanah di lahan sayuran organik "urban farming". Prosiding Seminar Nasional Pengelolaan Sumberdaya Alam dan Lingkungan 1: 1-2.

Suheriyanto, D. 2008. Ekologi Serangga. Malang : UIN Press.

Sembiring, A. 2020. Kelimpahan dan Keragaman

Macrofauna di Taman Hutan Raya Sultan Syarif Hasyim. JPI: Vol 16: No. 2.

Semiun, CG. Stefanus, S. 2016.

Setiawan ,J. Maulana ,F. 2019. Keanekaragaman Jenis Arthropoda Permukaan Tanah di Desa Banua Rantau Kecamatan Banua Lawas. Banjarmasin. JPH: Vol 8 No. 4

Utomo, M. 2012. Tanpa Olah Tanah Teknologi Pengelolaan Pertanian Lahan Kering. Lembaga Penelitian Universitas Lampung. Lampung.