International Journal of Ecophysiology Vol. 03, No. 01, 2021 |1 – 15

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Internasional Journal of Ecophysiology

Community Structure and Distribution of Coleoptera Soil IPM and Non IPM Upland Vegetable Agricultural Areas in Two Villages in Kabanjahe

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Abstract. The concept of Integrated Pest Management (IPM) is an effort developed by the government in order to reduce the use of pesticides in the agricultural sector. In the development of agriculture in Kabanjahe, both Non-IPM (Non Integrated Pest Management) and IPM (Integrated Pest Management), research is needed to determine the community structure and distribution of soil fauna, including soil coleoptera, and to determine the effect of soil physical and chemical factors on soil coleoptera community structure in the highland vegetable farming area of Kabanjahe district. Karo Regency. Determination of sampling points in this study was carried out using the "purposive random sampling" method, in two agricultural areas, in two villages, namely Sumber Mufakat and Gung Negri, Non-IPM agricultural land areas and IPM agricultural areas. While the active coleoptera sampling of the soil surface was carried out using the Pit Fall Trap method, and the Quadratic and Hand Sorting methods for Coleoptera that live in the soil. The results showed that the number of types and population density of coleopteran soil was more / higher in the area. IPM agriculture. The highest density and relative density values in the research area were the genus Callosoma for the IPM and Non-IPM lands of Sumber Mufakat Village and the IPM of Gung Negri Village, while for the Gung Negri Non-IPM land the genus Scapidium and the genus Tenebrio.

Keyword: Coleoptera, Integrated Pest Management (IPM), Non Integrated Pest Management

Received 5th November 2020 | Revised 25th December 2020 Accepted 28th January 2021

1 Introduction

Kabanjahe was located in the highlands of the Bukit Barisan mountains at an altitude of about 1,000 to 1,300 meters above sea level (asl) with a temperature range of 17.3–23.6 °C, rainfall 1,768 mm/year or an average of 147.33 mm/month and humidity of 93% [1]. Kabanjahe sub-district has 6 villages and 7 wards. Furthermore, it was explained that the Kabanjahe highlands which are also the capital of Karo Regency have an area of 44.65 km^2 with a population of 75,899 people, a population density of 1,669.9 people/km^2 [2],and a cool, suitable

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 e-ISSN: 2656 - 0674
DOI: 10.32734/ijoep.v3i1.10016
Journal Homepage: http://ijoep.usu.ac.id

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Internasional Journal of Ecophysiology

climate. as upland vegetable farming. The types of vegetables that are produced in this area are cabbage, potatoes, Chinese cabbage, mustard greens, carrots, chilies, tomatoes and leeks. Apart from these vegetables

this region is also known as a producer of oranges, coffee, cinnamon and sugar palm. The Karo people, especially those in the Kabanjahe sub-district, are people who have long relied on their economic point in the agricultural sector. This is because agricultural land is very fertile, making Tanah Karo the largest producer of agricultural crops, especially vegetables in North Sumatra. However, the agricultural products of the Karo community are greatly affected by pest attacks. It is undeniable that today there are still many farmers who use chemicals to eradicate pests. This method of eradication is successful on the one hand, but on the other hand, the use of pesticides with a constant frequency can cause major side effects. The impacts that arise, for example, occur resistance (immunity) to target pests, explosion of secondary pests that are not targeted, pesticide residues that cause poisoning to consumers, and environmental pollution which causes disruption of the balance of the ecosystem [3]. The concept of Integrated Pest Management (IPM) is an effort developed by the government in order to reduce the use of pesticides in the agricultural sector. Minister of Agriculture Regulation No. 48 / Permentan / OT.140 / 10/2009 states that IPM is an effort to control the attack of plant pests with control techniques in a single unit to prevent economic losses and environmental damage, and to create sustainable agriculture. The principles of IPM include the use of natural enemies, cultivation of healthy plants, periodic observations and expert IPM farmers [4] Through the Integrated Pest Control Field School, the Karo Regency Agriculture Service until 2019 has fostered several farmer groups spread across 6 villages and 7 sub-districts in Kabanjahe sub-district. However, in fact, after the completion of the Integrated Pest Control Field School implementation, there were still very few farmers implementing the IPM farming pattern, this was due to various reasons, such as poorly formed vegetables that were harvested, which also affected the selling value. However, based on information from the District Agriculture Office. Karo currently there are still farmers in Kabanjahe sub-district who persist with the IPM agricultural pattern, such as farmers in Sumber Mufakat village and Gung Negri village who have participated in the Integrated Pest Control Field School program from the start. Development of agriculture in Kabanjahe, both Non-IPM and IPM, it is deemed necessary to know the

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 e-ISSN: 2656 - 0674DOI:XXX.XXX/XXXXX.X.X
Journal Homepage: http://ijoep.usu.ac.id

types of fauna that exist, especially soil fauna. One type of soil fauna that we often encounter is the soil Coleoptera. Coleoptera is an order that has high and abundant diversity, besides that it plays an important role in ecosystem function [5] . The role of beetles is needed in the ecosystem because of the activity of beetles as plant eaters, predators, scavenger, and decomposers. The activity of herbivorous beetles is very important to the ecosystem because herbivorous beetles are important pests to plants and can affect other insect populations. In addition, beetles also play many roles as scavenger and decomposers in the process of decomposing organic matter both on the soil surface and in the soil [6]

2 MATERIALS AND METHODS

2.1 Methods

Determination of the location and sampling plot was carried out using the method of "Purposive Random Sampling", namely the sampling plot was randomly determined on two agricultural areas, in two villages, namely Desa Sumber Mufakat and Gung Negri, an area of Non-IPM agricultural land and an IPM agricultural area. Meanwhile, soil coleoptera samples were taken by using the Pit Fall Trap method for adult coleoptera, the Quadratic method and the Hand Sorting method for larvae..

2.2 Implementation

2.2.1. Soil Coleoptera Sampling

2.2.1.1. Pit Fall Trap Method.

In each area to be sampled, 15 trap holes were made about the size of a jam bottle with a distance of 10 m, then planted the jam bottles until the surface of the bottles was parallel to the ground. In the bottle, 4% to 1/3 of the bottle is put in formalin and a little datergen is added. The bottle is covered with plastic to avoid rainwater. After 24 hours the bottle is taken along with its contents. The animals obtained were separated and put into a collection bottle then preserved with 70% alcohol.

2.2.1.2. Quadratic and Hand Sorting Methods.

In each area, 15 plots measuring 30 x 30 cm were made, with a distance between each square of 10 m. Soil from each square is taken to a depth of 30 cm and the soil is put into burlap (plastic sacks). Sampling was carried out at 06.00-09.00 WIB. Then the soil was immediately sorted to get ground coleoptera larvae. The obtained larvae were collected and cleaned with water and counted, then put into sample bottles and preserved with 4% formaldehyde, then taken to the Animal Ecology Laboratory of FMIPA USU Medan to identify and count the number of individuals from each type obtained, this method quite effective as was done by [7].

2.2.2. Soil Coleoptera Species Identification

Soil coleoptera samples that have been preserved first are grouped according to their type, then determined and identified by looking at morphology with the help of loops, binocular stereo microscopes and using several reference books such as; [8],[9], [10], and [11]

2.3. Measurement of Physical and Chemical Properties of Soil

Soil in each square measured relative humidity, temperature, pH, organic content and moisture content. Measurements of relative humidity, temperature, soil pH were carried out before the soil was taken from the square. Relative humidity and pH were measured using a Soil Tester and soil temperature was measured at the surface with a depth of 10 cm using a Soil Thermometer. Measurement of organic levels and soil water content was carried out at the Animal Ecology Laboratory of the USU Department of Mathematics and Natural Sciences. The soil that can be cleaned of the remains of plants and other soil animals that are still present, then stirred until blended and partially taken for analysis.

2.3.1. Measurement of Soil Water Content

Measurement of soil moisture content is carried out by weighing 50 grm of soil samples and then drying in an oven at 105°C until a constant weight is obtained. Calculation of water content is carried out using the formula according to Wilde (1972):

$$KA\ (\%) = \frac{A-B}{A} x\ 100 \qquad (1)$$

KA = groundwater content

A = Soil wet weight

B = dry weight of soil

2.3.2. Soil Organic Level Measurement

Measurement of soil organic content was carried out by weighing 50 grm of soil samples, then drying it in an oven at 105°C until the temperature was constant, then the soil was crushed with a mortar and stored again in a drying oven for 1 hour. Furthermore, 25 gram is taken and burned in a furnace (Furnace Mufle) with a temperature of 700°C for 3.5 hours. The percentage of organic content is calculated by the formula:

$$KO\ (\%) = \frac{A-B}{A} x\ 100 \qquad (2)$$

KO = Soil organic content

A = constant weight of soil,

B = dry weight of ash

2.4. Data analysis

Soil coleoptera types and the number of individuals of each type obtained were calculated: population density, relative density of each species, frequency of presence, index of similarity (Sorensen's Similarity) and distribution [12]; ([13] in [14]) using the following formula:

a. Population Density (D)

$$D = \frac{Number\ of\ individuals\ of\ a\ type}{Number\ of\ sample\ units} \quad (3)$$

b. Relative Density (RD)

$$RD = \frac{The\ density\ of\ a\ type}{Total\ density\ of\ all\ types} x100\ \% \quad (4)$$

c. Attendance Frequency (AF)

$$AF = \frac{The\ number\ of\ sample\ plots\ occupied\ by\ a\ species}{The\ total\ number\ of\ sample\ units} x100\ \% \quad (5)$$

Information :

0-25% = the constancy is very rare

25-50% = the constancy is rare

50% -75% = frequent constants

> 75% = the constancy is very frequent [14]

d. Diversity Index (diversity)

$$\boldsymbol{H' = \sum_{i=1}^{s} pi \ln pi} \quad (6)$$

Information :

H´ = diversity index

Pi = proportion of species to i in community (ni / N)

s = number of species in the community

e. Equitability Index (Uniformity)

$$E = \frac{H'}{H\ Max} \quad (3)$$

E = Equitability Index

H max = ln S (S = number of genera).

3. Results and Discussion

3.1. Coleoptera Soil Found in the Study Area.

From the research that has been carried out in the area of IPM and Non-IPM agricultural land in Sumber Mufakat Village and Gung Negri Village, Kabanjahe District, Karo Regency, 2 sub orders, 7 super families, 8 families and 10 genus Coleoptera soil were found as shown in the table below.

Table 1. Coleoptera Classification of Soil Found in IPM and Non-IPM Agricultural Areas in Sumber Mufakat Village and Gung Negri Village.

NO	Sub Ordo	Super Family	Family	Ordo	Location			
					SM		GM	
					N-IPM	**IPM**	**N-IPM**	**IPM**
1	Adepahaga	Caraboidea	Carabidae	*Callosoma*	+	+	+	+
2				*Phylopaga*	+	+	+	+
3			Cicindellidae	*Cicindella*	+	-	-	-
4	Polyphaga	Cantharoidea	Cantharidae	*Podabrus*	-	+	-	+
5		Cucurlionoidea	Cucurlionidae	*Hylobius*	-	-	-	+
6		Elateroidea	Elateridae	*Melanotus*	-	+	-	+
7		Scarabaeoidea	Scarabaeidae	*Pinatus*	+	+	-	+
8		Staphylinoidea	Staphyllinidae	*Scapidium*	+	+	+	+
9				*Staphilinius*	+	+	+	+
10		Tenebrionoidea	Tenebrionodae	*Tenebrio*	+	+	+	+
				Total	7	8	5	9

In Table 1, we can see that in the IPM area of Sumber Mufakat Village, there are more types of Coleoptera soil than in the Non-IPM area of Sumber Mufakat Village. This also happened in the area of Gung Negri Village. There are more Coleoptera types of IPM land in Gung Negri Village compared to the NIPM area of Gung Negri Village, this is because Non-IPM activities can reduce the number of Coleoptera types of soil, especially in the village of Gung Negri.

3.2 Density and Relative Density of Coleoptera Soil in the Study Area.

Coleoptera soil density and relative density in each study area can be seen in Table 2 where the highest total colepotera density was found in IPM areas when compared to Non-IPM areas, namely in Sumber Mufakat Village, namely 4.96 individuals / 9000 cm^3, and in Gung Negri Village with

3.13 individuals / 9000 cm³, while for the Non-IPM area the population density found in Sumber Mufakat Village and Gung Negri Village was not so different, namely 2.06 and 2.07 individuals / 9000 cm³ respectively.

The genus with the highest density value in IPM agricultural areas was obtained from the genus Callosoma (3.30 individuals / 9000 cm³) with a relative density of 66.53%, followed by Tenebrio (1.00 individuals / 9000 cm³) with a relative density value of 20.16%, while the lowest was Melanotus (0.03 individuals / 9000 cm³) with a relative density of 0.60%. In the Non-IPM agricultural area of Sumber Mufakat Village, the highest density was the genus Callosoma (1.03 individuals / 9000 cm³) with a relative density of 50% followed by Scapidium (0.43 individuals /9000 cm³) with a relative density of 20.87% and the lowest was Cicindella and Pinatus (0.07 individuals / 9000 cm³) with a relative density value of 3.40%.

Table 2. Density (individuals / 9000 cm³) and Relative Density (%) of Coleoptera Soil at the Study Site.

NO	Genus	Non IPM		IPM		Non IPM		IPM	
		S MUPAKAT		S MUPAKAT		G.Negri		G. Negeri	
		D	RD	D	RD	D	RD	D	RD
1	Callosoma	1,03	50,00	3,30	66,53	0,5	24,15	1,43	45.69
2	Cicindella	0,07	3,40	-	-	-	-	-	-
3	Hylobius	-	-	-	-	-	-	0,53	16,93
4	Melanotus	-	-	0,03	0,60	-	-	0,10	3,19
5	Phyllopaga	0,23	11,17	0,17	3,43	0,1	4,83	0,20	6,39
6	Pinatus	0,07	3,40	0,13	2,62	-	-	0,03	0,96
7	Podabrus	-	-	0,13	2,62	-	-	0,10	3,93
8	Scapidium	0,43	20,87	0,07	1,41	0,7	33,82	0,10	3,19
9	Staphylinius	0,1	4,85	0,13	2,62	0,07	3.38	0,17	5,43
10	Tenebrio	0,13	6,31	1,00	20,16	0,7	33,82	0,47	15,06
	Total	2,06	100	4,96	100	2,07	100	3,13	100
	Total Genus	7		8		5		9	

In the IPM area of Gung Negri Village, the highest density was found in Callosoma (1.43 individuals / 9000 cm^3) with a relative density of 45.69 followed by Hylobius (0.53 individuals /9000 cm^3) with a relative density of 16.93% and the lowest was Pinatus (0.03 individuals / 9000 cm^3 with a relative density of 0.96%. In the Non-IPM agricultural area of Gung Negri Village, the highest densities were Scapidium and Tenebrio (0.7 individuals / 9000 cm^3) with a relative density of 33.32%, followed by Callosoma (0 , 50 individuals / 9000 cm^3) with a relative density of 24.15%. The lowest density was the genus Phyllopaga (0.1 individuals / 9000 cm^3) with a relative density of 4.83%.

From Table 2, it can be seen that the genus Callosoma has the highest population density in each study area, both IPM and Non-IPM. This shows that the genus Callosoma has a wide tolerance value to soil environmental factors, as seen by its relat ive density value of 20%. This is consistent with what [15] stated, that organisms that show a high level of tolerance to all environmental factors will be widespread.

3.3. The Attandance Frequency of Each Genus Coleoptera Soil in the Study Area

The frequency of presence is often expressed as a constancy. From this constancy, land animals are grouped into four groups, namely accidental (very rare) if the constants are 0–25%, accessories types (rarely) if the constants are 25% -75%, the type of constants is constant (often) if the constants are 50% -75% and absolute type when the constancy is more than 75% (Suin, 1997). The coleoptera constancy value obtained varies considerably, as shown in Table 3 below.

Table 3. The Attandance Frequency (%) and Constancy (Ko) of Coleoptera Soil in Each Study Area

NO	Genus	Non IPM		IPM		Non IPM		IPM	
		S MUPAKAT		S MUPAKAT		G.Negri		G. Negeri	
		AF	Ko	AF	Ko	AF	Ko	AF	Ko
1	Callosoma	93,33	abso	8,67	Aksi	53,33	Kons	86,87	Abso
2	Cicindella	13,33	Aksi	-	-	-	-	-	-
3	Hylobius	-	-	-	-	-	-	20,00	Aksi
4	Melanotus	-	-	6,67	aksi	-	-	20	Aksi
5	Phyllopaga	40,00	asse	13,33	aksi	13,33	Aksi	40,00	Asse
6	Pinatus	13,33	aksi	20,00	aksi	-	-	6,67	Aksi
7	Podabrus	-	-	13.33	aksi	-	-	13,33	Aksi
8	Scapidium	53,33	kons	13,33	aksi	33,33	Asse	20,00	aksi
9	Staphylinius	20,00	aksi	26,67	asse	13,33	Aksi	33,33	Asse
10	Tenebrio	26,67	asse	0,87	aksi	66,67	Abso	46,47	Asse

From Table 3, it can be seen that in the Non-PHT Sumber Mufakat Village, 1 genus is absolute, namely Callosoma, 1 genus is constant, namely Scapidium, 2 genera are accessory, namely Phyllopaga and Tenebrio and 3 genus are accidental namely Pinatus, Staphyllineus and Cicindella. In the IPM agricultural area in Sumber Mufakat Village, there was no absolute and constant genus, only 1 assesoria genus was found, namely Staphylineus and 7 accidental genera.

In the IPM agricultural area in Gung Negri Village, it was found that 1 genus was absolute, namely Callosoma, there was no constant genus, 3 genera were accessories (Staphylineus, Phyllopaga and Tenebrio) and 5 genus were accidental (Hylobius, Melanotus, Pinatus, Podabrus and Scapidium). In the NPHT area of Gung Negri Village, 1 genus is absolute (Tenebrio), 1 genus is constant (Callosoma), 1 genus is accessory (Scapidium), and 2 genera are accidental (Phyllopaga and Staphylineus).

From Table 3, it can be seen that the number of genera that are absolute, constant, and accessories and accidental are found to vary in each area of the study. In the IPM agricultural area in Sumber Mufakat Village, there are no absolute organisms. Generally, many genera are accidental and accessory in nature. This could be due to the fact that many genera do not dominate the land. Based on the Relative Density value = 10% and the Presence Frequency 25%, the soil Coleoptera can be grouped as in **Table 4.**

Tabel 4. RD Value = 10% and AF = 25% Soil Coleopera Obtained in Each Research Area.

NO	Genus	Non IPM		IPM		Non IPM		IPM	
		S MUPAKAT		S MUPAKAT		G.Negri		G. Negeri	
		D	RD	D	RD	D	RD	D	RD
1	Callosoma	50,00	93,33	-	-	24,15	53,33	45,69	86,87
2	Phyllopaga	11,17	40,00	-	-	-	-	-	-
3	Scapidium	20,87	53,33	-	-	33,82	33,33	-	-
4	Tenebrio	-	-	-	-	33,82	66,67	15,06	46,47

From Table 4, it is clear that in the Non-IPM of Sumber Mufakat Village, 3 genera of Coleoptera soil were obtained which had RD values = 10% and AF = 25%, namely Callosoma, Phyllopaga, and Scapidium. Whereas in the IPM area of Sumber Mufakat Village, there was no Coleoptera which had a RD value of = 10%. In the Non-IPM area of Gung Negri Village, there were 3 genera of Coleoptera soil that had RD = 10% and AF = 25%, namely Callosoma, Scapidium and Tenebrio. Meanwhile, in the IPM area of Gung Negri Village, there were 2 genera that had RD values = 10% and AF = 25%, namely Callosoma and Tenebrio. This situation shows that in the NIPM area in Sumber Mufakat Village, 3 genus of coleoptera are found that can live and develop well, while in areas where IPM is not found, there is no coleoptera genus that can live and develop properly. In the Non-IPM area in Gung Negri Village, 3 genera of coleoptera were found that could live and develop well, while in the IPM area there were 2 genera that could live and develop well.

According to [14], land animals with a high frequency of presence generally have a high density. Furthermore, [7] explains that if the value of relative density is greater than 10% and the frequency of its presence is greater than 25%, it indicates that the animal can live and develop well in this habitat. Furthermore, [15] states that organisms in a n environment are closely related to the conditions around them, naturally the distribution of animals is regulated by the amount and variety of materials needed by these organisms in addition to physical factors and the tolerance limits of organisms to environmental components.

3.4. Diversity Index (H') and Uniformity Index Value (E) of Coleoptera Soil in Each Research Area.

The diversity and uniformity of fauna species in a community is strongly influenced by environmental conditions and the interactions between organisms with one another. The value of the Shannon-Wiener diversity index (H') is an index of biota diversity in an area where the higher the value, the higher the diversity and vice versa. The equality index value is useful for seeing the magnitude of the distribution of each individual in a community [16] and [17]

Table 5. Diversity Index Value (H') and Uniformity Index Value

Location	Non IPM	IPM	Non IPM	IPM
Value	S MUPAKAT	S MUPAKAT	G.Negri	G. Negeri
Diversity Index	1,46	1,28	1,33	1,42
Uniformity Index Value	0,75	0,62	0,83	0,65

Based on the Shannon – Wiener (H') index value, it is obtained that the diversity values vary in each research area. The highest diversity value is found in the Non-IPM of Sumber Mufakat Village with a value of 1.46. The second highest value of diversity is the IPM land in Gung Negri Village with a value of 1.42. And the lowest diversity value is the IPM land in Sumber Mufakat Village with a value of 1.28. The low value of IPM land diversity in Sumber Mufakat Village is due to the fact that there is a coleoptera type of coleoptera land that has a dominant number of individuals when compared to the location of the Non-IPM area. Krebs (1985) states that the diversity and uniformity of a community is high if the abundance of existing species is the same or almost the same and vice versa if the community has few species or certain species are abundant and there is dominance from certain individuals, the diversity of the community will be low. However, the overall category of diversity on all the farms studied was low.

The highest uniformity value (E) was found in the Non-IPM land of Gung Negri Village with a value of 0.83 and the lowest was in the IPM land of Sumber Mufakat Village with a value of 0.63. From table 6, it can be seen that the distribution of Coleoptera soil on all lands is low and the individual distribution is uneven. The higher the uniformity index value (E> 1) the level of distribution of individuals in a particular community is more evenly distributed and there are no individuals who dominate. Conversely, the lower the uniformity index value (E <1), the lower the level of uniformity (Krebs, 1985).

Table 6. Correlation Analysis to Measurement Parameters

No	Observation Parameters	Correlation Value
1	Air Humidity (%)	1,00
2	pH	0,99
3	Soil Temperature (°C)	1,00
4	Ground Water Level (%)	1,00
5	Soil Organic Content (%)	1,00

From the correlation analysis, it can be seen that the correlation value shown in the 5 factors of measurement parameters shows a value of 1 or close to 1, which means that the parameters measured, namely humidity, pH, soil temperature, soil moisture content and soil organic content greatly affect the diversity of soil Coleoptera because According to Usman & Akbar (2000), to determine the correlation value (relat ionship) of the total density (D) value of soil macrofauna for all generations in the area of Sei Liput oil palm plantations with soil physico-chemical factors, Pearson Correlation Analysis (r) was carried out using SPSS version 21.00 software. Usman & Akbar (2000) explain that the value of r includes the following: The largest r value is +1 and the smallest r value is -1.r = +1 indicates a perfect positive relationship (unidirectional), while r = -1 indicates a perfect negative relationship (opposite direction) .r has no units or dimensions. The + (positive) or - (negative) sign only shows the direction of the relationship with the Interpretation of the value of r as follows: If r = 0 means uncorrelated, If r = 0.01-0.20 means that the correlation is very low, if r = 0.21-0.40 it means that the correlation is low, if r = 0.41-0.60 it means that the correlation is rather low, if r = 0.61-0.80 means the correlation is sufficient, if r = 0.81-0.99 means high correlation, if r = 1 means very high correlation (perfect correlation).

4. CONCLUSIONS

From the results of research conducted on community structure and distribution of soil Coleoptera in the highland vegetable farming areas of IPM and Non-IPM in Sumber Mufakat Village and Gung Negri Village, the following conclusions were obtained: Soil Coleoptera was obtained, consisting of 8 families and 10 genera. The highest density and relative density values in the study area were the genus Callosoma for IPM and Non-IPM in Sumber Mufakat Village and Gung Negri Village IPM, while for Gung Negri Non-IPM land by genus Scapidium and genus Tenebrio. From the value of the frequency of presence, the genus Callosoma is an absolute genus in the Non-IPM of Sumber Mufakat Village and Gung Negri Village's IPM, while the absolute genus of Gung Negri Village Non-IPM is the Tenebrio genus.From the Coleoptera similarity index value, it was found that all types of animals found on all land showed very similar species similarity. From the value of the diversity index and uniformity index on all lands, the low category is obtained. The distribution of Coleoptera on all land groups is grouped with an average morista index> 1. From the correlation test, it was found that the physical and chemical frequency of the soil had a close relationship with the Coleoptera diversity of the soil.

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