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Community Composition Of Top Soil Collembola In The Land Application Area Of Liquid Waste Oil Palm Plantation Factory Simpang Kanan District Rokan Hilir Regency

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Abstract. This research has been conducted to knowing and analyze the community composition of top soil Collembola in the land application area oil palm plantation at Simpang Kanan District, Rokan Hilir Regency. Sampling Area Assessed Through "Purposive Random Sampling" in which top soil Collembola which were collected by using Pitfall Trap. Location of sampling area through at three location. The first location at block 1 as control, the second location at block 2 which by using land application Flatbed system, and the third location at block 3 which by using land application longbed system. There were fourteen species of Collembola classified into three families and one order. The highest value of species compotition at first location as control was Entomobrya sp.1 amount 27.907 %. The second location (Block 2) which by using Flatbed system the highest value of species compotition was Entomobrya sp.3 amount 35.439%. The third location (Block 3) which by using Longbed system, the highest value of species compotition was Entomobrya sp.1 amount 27.076 %.

Keyword: Collembola, Composition, Oil Palm Plantation

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1 Introduction

Collembola is one of the largest classes of the phylum Arthropoda which is widely distributed on the forest floor, plantations, agriculture, shrubs and grasslands. Collembola has a body size between 0.25-8 mm, some can reach 10 mm. Collembola known as spring tails (Springtails), because it has a jumping device called the furcula or furka which is located on the ventral part of the fourth abdominal segment. The population of Collembola is very large, reaching 100,000 per m2 of land surface or millions per hectare [1]. Collembola plays a role in the cycle of matter and energy as decomposers of organic matter or detritivores. In addition, Collembola is widely used as a biological indicator (bioindicator) or monitoring (monitoring) an ecosystem [2]. Considering

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the large number of Collembola and their role as bioindicators and monitoring of an ecosystem, it is interesting to conduct research on the Collembola community, especially the soil surface Collembola in oil palm plantations. Oil palm plantations in Indonesia from year to year always increase in area, in 2015 the area of oil palm plantations was around 11,260,277 Ha, and in 2017 it was 12,307,677 Ha. The largest oil palm plantation area is in Sumatra, covering an area of 6,703,224 Ha in 2015, and it is estimated that the area will increase to 7,400,353 Ha in 2017. The largest oil palm plantation in Sumatra is in province, which is an area of 1,441,705 Ha in 2015, and increased in 2017 to an area of 2,493,176 Ha, both managed by large state-owned companies as well as by the private sector and the people[3]. Until now, the development of agricultural production, especially in the plantation sector, is still being developed by the government, because it is an important target to support industrial development in an effort to increase exports, besides that it is also directed at expanding employment opportunities [4]. The development of the palm oil industry followed by the construction of a factory can have a negative impact on the environment. This is due to the increasing weight of Palm Oil Mill (PKS) waste that must be disposed of, both liquid and solid waste [5]. The liquid waste produced is very large with a very high BOD (BOD 3000-5000 mg/l) which will cause an increase in the weight of the waste that must be disposed of. This is a problem for the environment as well as for industry and the government, because it causes pollution [4]. Palm oil mills have done quite a lot of handling their liquid waste by utilizing the waste to plantation areas with the Land Application system which aims to add nutrients to the soil. This system is first processed by the Ponding System (pond system), after a decrease in the level of pollution, then this waste is channeled to plantation land with two systems, namely the Flatbed system and the Longbed system [4]. PT. Cipta Agro Sejati is one of the palm oil mills that provides its liquid waste to the community-owned oil palm plantation area in the area around the factory.Research on the presence of Collembola on the soil surface in oil palm plantation areas that have been fertilized with PKS liquid waste has never been carried out.

2. METHODS

This research was conducted in the community-owned oil palm plantation area which was given liquid waste from the palm oil mill of PT. Cipta Agro Sejati, Rokan Hilir Regency from March to September 2018. The location of the sampling plot was determined using the Purposive Random Sampling method while the sampling in this study used the Pitfall Trap method. Implementation of identification and determination at the Ecology Laboratory, Department of Biology, Faculty of Mathematics and Natural Sciences, University of North Sumatra, Medan. In this study, physical-chemical measurements of the soil were also carried out by measuring the parameters of soil temperature, air temperature, air humidity, pH, and C-organic. The type of

Collembola soil surface and the number of individuals of each type obtained were calculated values:

Population Density (D), Relative Density (RD), Attendance Frequency (AF) to determine the composition of the Collembola community of soil using the formula according to [6] as follows:

a. Population Density (D)

$$D = \frac{Number\ of\ individuals\ of\ a\ type}{Number\ of\ sample\ units} \quad (1)$$

b. Relative Density (RD)

$$RD = \frac{The\ density\ of\ a\ type}{Total\ density\ of\ all\ types} x100\ \% \quad (2)$$

c. Attendance Frequency (AF)

$$AF = \frac{The\ number\ of\ sample\ plots\ occupied\ by\ a\ species}{The\ total\ number\ of\ sample\ units} x100\ \% \quad (3)$$

Information :

0-25% = the constancy is very rare

25-50% = the constancy is rare

50% -75% = frequent constants

> 75% = the constancy is very frequent [6]

The composition of the community was determined by sorting the highest relative density values to the lowest. The composition of the organism making up the community that occupies an area can be written in the form of the name of the constituent type, and is usually arranged in tabular form [6].

3. Result and Discussion

3. 1. Types of Collembola on Ground Surface

From the results of research that has been carried out on oil palm plantation areas that were applied with palm oil mill effluent, 14 species of ground surface Collembola were found, which belong to 3 (three) families, and 1 (one) order, as listed in Table 1. below :

Table 1. Collembola soil surface found at the study site

Class	Ordo	Famili	Speises	Location		
				1	2	3
Collembola	Entomobryomorpha	Entomobryidae	1. *Entomobrya* sp. 1	+	+	+
			2. *Entomobrya* sp. 2	+	+	+
			3. *Entomobrya* sp. 3	+	+	+
			4. *Entomobrya* sp. 4	+	+	+
			5. *Lepidocyrtus* sp. 1	+	+	+
			6. *Lepidocyrtus* sp. 2	+	+	+
			7. *Rambutsinella* sp.	+	+	+
			8. *Ascocyrtus* sp.	+	+	+
			9. *Pseudosinella* sp.	+	+	+
			10. *Acrocyrtus* sp.	+	+	+
			11. *Homidia* sp.	+	+	+
		Paronellidae	12.*Pseudoparonella* sp.	+	+	+
			13. *Bromachantus* sp.	+	+	+
		Coenaletidae	14. *Coenaletes sp.*	+	+	+
			Total	14	14	14

Description : Location I: Block 1, Location II: Block 2, Location III: Block 3, (+): Found.

In Table 1. it can be seen that the Collembola class with the most number of species found in the three research sites is from the Entomobryidae family which consists of 11 species. In the families Paronellidae and Coenaletidae there are only 2 and 1 species, respectively. Species from the Entomobryidae family found in oil palm plantation areas showed the number of species and a wide distribution of species. [7] stated that Collembola species from the family Entomobryidae are abundant on the soil surface, both in the tillage layer in agricultural areas, plantations, and in the litter layer on the forest floor. Furthermore, [1] explained that Collembola from the family Entomobryidae live actively on the soil surface. This can be seen from the morphological characteristics that are typical for groups that live on the ground surface, which are pigmented, have antennae and well-developed furka.

[8] and [9] stated that Collembola from the family Entomobryidae acts as an effective decomposer and helps a lot of nutrient cycling in the soil and is stated to be able to describe the status of land productivity in a habitat. Collembola with this slender shape (silender springtail) is known to have behavior as a feeder of fungi, lichen, bacteria, as well as certain plant pollen and organic litter decomposers [9]

2. Density and Relative Density of Ground Surface Collembola

From the results of data analysis that has been carried out, the highest soil surface Collembola Density (D) value is found at location II with a total density value of 236.52 (Ind/ m^2) and the

lowest Density (D) value at location I with a total density value of 214. 11 (Ind/m^2), as shown in Table 2 below:

Table 2. Value of density (individual/ m^2) and relative density (%) of surface Collembola

No	Species	Location I		Location II		Location III	
		D (Ind/m2)	RD (%)	D (Ind/m2)	RD (%)	D (Ind/m2)	RD (%)
1	*Entomobrya* sp.	59,75	27,91	42,32	17,90	62,24	27,08
2	*Entomobrya* sp.	35,69	16,67	24,90	10,53	53,94	23,47
3	*Entomobrya* sp.	17,43	8,14	83,82	35,44	39,83	17,33
4	*Entomobrya* sp.	2,49	1,16	3,32	1,40	2,49	1,08
5	*Lepidocyrtus*	11,62	5,43	10,79	4,56	4,98	2,17
6	*Lepidocyrtus* sp.	5,81	2,71	2,49	1,05	1,66	0,72
7	*Rambutsinella*	18,26	8,53	12,45	5,26	4,15	1,81
8	*Ascocyrtus* sp.	6,64	3,10	2,49	1,05	4,15	1,81
9	*Pseudosinella*	17,43	8,14	11,62	4,91	14,11	6,14
10	*Acrocyrtus* sp.	2,49	1,16	1,66	0,70	3,32	1,44
11	*Homidia* sp.	2,49	1,16	4,15	1,75	6,64	2,89
12	*Pseudoparonella* sp.	3,32	1,55	3,32	1,40	4,98	2,17
13	*Bromachantus* sp.	19,09	8,92	14,94	6,32	8,30	3,61
14	*Coenaletes* sp.	11,62	5,43	18,26	7,72	19,09	8,30
	Total	214,11	100,00	236,52	100,00	229,88	100,00

Information : Location I : Block 1, Location II : Block 2 (Flatbed), Location III : Block 3 (Longbed); D = Density, RD =Relative Density.

The high value of the total soil surface density of Collembola found in Block 2 with a flat bed system and the high number of species found is related to soil physico-chemical factors in Block 2 that support the survival of Collembola with a soil temperature of 26°C, humidity 73%, pH reached 6.7 and C-organic contained 0.57%. The coconut mill liquid waste application system also determines the density of Collembola because in the Flatbed system the liquid waste does not flow but the liquid waste settles. At location II there is a very high density value for Entomobrya sp.3 species, possibly due to the aggregation carried out by Entomobrya sp. the 3rd. The food factor is an important factor in determining the increase or decrease in the number of Collembola individuals on the soil surface so that the type of composition of plant organic matter will determine its density [10]; [11]. Furthermore, Sugiyarto et al., (2007) also explained that the more organic matter available, the number of Collembola individuals on the soil surface will also increase.

3.3. Frequency of Presence (Constant) Collembola Ground Surface

The frequency of attendance is often expressed as a constant. From the frequency of presence or constant, soil fauna can be grouped into four groups. Accidental group (very rare) if the constant is 0-25%, accessory group (rare) if the constant is 25-50%, constant group (often) if the constant is 50-75%, and absolute group (very often) if the constancy is more than 75% [6]. The results of data analysis regarding the frequency of presence and its constant for each Collembola soil surface found at each research location are presented in Table 3.

Table 3. Value of Presence Frequency (%) and Collembola Constancy of Soil Surface at Each Research Location

No	Species	Location I		Location II		Location III	
		AF	Kons	AF	Kons	AF	Kons
1	*Entomobrya* sp. 1	50,00	Konstan	41,67	Assesori	50,00	Konstan
2	*Entomobrya* sp. 2	40,00	Assesori	26,67	Assesori	60,00	Konstan
3	*Entomobrya* sp. 3	21,67	Aksidental	60,00	Konstan	50,00	Konstan
4	*Entomobrya* sp. 4	3,33	Aksidental	5,00	Aksidental	5,00	Aksidental
5	*Lepidocyrtus* sp. 1	15,00	Aksidental	13,33	Aksidental	8,33	Aksidental
6	*Lepidocyrtus* sp. 2	10,00	Aksidental	5,00	Aksidental	3,33	Aksidental
7	*Rambutsinella* sp.	26,67	Assesori	16,67	Aksidental	8,33	Aksidental
8	*Ascocyrtus* sp.	10,00	Aksidental	3,33	Aksidental	6,67	Aksidental
9	*Pseudosinella* sp.	28,33	Aksidental	15,00	Aksidental	15,00	Aksidental
10	*Acrocyrtus* sp.	3,33	Aksidental	3,33	Aksidental	5,00	Aksidental
11	*Homidia* sp.	3,33	Aksidental	6,67	Aksidental	10,00	Aksidental
12	*Pseudoparonella* sp.	5,00	Aksidental	5,00	Aksidental	10,00	Aksidental
13	*Bromachantus* sp.	21,67	Aksidental	16,67	Aksidental	11,67	Aksidental
14	*Coenaletes* sp.	20,00	Aksidental	28,33	Assesori	33,33	Assesori

Note: Location I: Block 1, Location II: Block 2, Location III: Block 3, FK= Frequency of Attendance

At Location I, the highest frequency of presence (AF) was found in the species Entomobrya sp.1 with a value of 50%, while the lowest frequency was found in the species Acrocyrtus sp, Homidia sp. and Entomobrya sp.4 with a value of 3.33%. At Location II, the highest frequency of presence (AF) was found in Entomobrya sp.1 species with a value of 41.67%, while the lowest frequency of presence was found in Ascocyrtus sp. and Acrocyrtus sp, with a AF value of 3.33%. At Location III, the highest frequency of presence (AF) was found in the species Entomobrya sp.3 with a value of 60%, while the lowest frequency of presence was found in the species Lepidocyrtus sp 2. with a AF value of 3.33%.

The situation found with different constants varies between locations because the location is a plantation land that often has human activities in it. Soil management, planting and harvesting of fruit that affect the presence of soil Collembola. These activities cause disruption of

Collembola activities at the location so that the frequency of their presence is generally quite low. According to [13] on plantation land, plantation activities carried out will determine the population, species, and activities of soil organisms. [14] added that various plantation activities will affect the activity of soil biota although not all soil biota show the same response.

3.4. Composition of Collembola Species Soil Surface at the Research Site

The composition of the Collembola species on the soil surface at each study site was obtained based on the ordering of the relative density values from the highest to the lowest value, the species composition varied, as shown in Table 4.

Table 4. The order of composition of each soil surface Collembola at each research location

Location I			Location II			Location III		
Spesies	RD (%)	Composition Order	Spesies	RD (%)	Composition Order	Spesies	RD (%)	Composition Order
Entomobrya sp.1	27,91	1	*Entomobrya* sp.3	35,44	1	*Entomobrya* sp.1	27,08	1
Entomobrya sp.2	16,67	2	*Entomobrya* sp.1	17,90	2	*Entomobrya* sp.2	23,47	2
Bromacha ntus sp	8,92	3	*Entomobrya* sp.2	10,53	3	*Entomobrya* sp.3	17,33	3
Rambutsin ella sp	8,53	4	*Coenalestes* sp.	7,72	4	*Coenalestes* sp.	8,30	4
Entomobrya sp.3	8,14	5	*Bromachantus* sp	6,32	5	*Pseudosinella* sp.	6,14	5
Pseudosinella sp.	8,14	5	*Rambutsinella* sp	5,26	6	*Bromachantus* sp	3,61	6
Lepidocyrtus sp 1	5,43	6	*Pseudosinella* sp.	4,91	7	*Homidia* sp.	2,89	7
Coenalestes sp.	5,43	6	*Lepidocyrtus* sp 1	4,56	8	*Lepidocyrtus* sp 1	2,17	8
Ascocyrtus sp.	3,10	7	*Homidia* sp.	1,75	9	*Pseudoparonella* sp.	2,17	8
Lepidocyrtus sp 2.	2,71	8	*Entomobrya* sp.4	1,40	10	*Rambutsinella* sp	1,81	9
Pseudoparonella sp.	1,55	9	*Pseudoparonella* sp.	1,40	10	*Ascocyrtus* sp.	1,81	9
Acrocyrtus sp.	1,16	10	*Ascocyrtus* sp.	1,05	11	*Acrocyrtus* sp.	1,44	10
Homidia sp.	1,16	10	*Lepidocyrtus* sp 2.	1,05	11	*Entomobrya* sp.4	1,08	11
Entomobrya sp.4	1,16	10	*Acrocyrtus* sp.	0,70	12	*Lepidocyrtus* sp 2.	0,72	12

Information : Location I: Block 1, Location II: Block 2, Location III: Block 3; KR = Relative Density

The composition of the soil surface Collembola community found is inseparable from the physicochemical factors of the soil at the research site. One of the environmental factors that influence the life of Collembola is temperature or soil temperature. According to [12] at temperatures that are too high cause several physiological processes of soil fauna including repro ductive activities, metabolism, respiration to be disturbed. [15] explained that the presence of soil fauna, especially Collembola, was also strongly influenced by soil moisture. The high value of soil moisture indicates the water content in the soil is quite high as well. The results of measurements of physical-chemical factors that have been carried out include humidity, temperature, not too low and not too far between locations. At each location there is a soil temperature ranging from 26-27 °C, soil moisture ranging from 72.7-73.7% Soil moisture plays a major role in the distribution of soil surface Collembola [16]. Agricultural cultivation affects the size of the population and the activity of soil biota [17];[18]

4. CONCLUSIONS

The results of this study can be concluded that the soil surface Collembola found at the research site consists of 1 order, 3 families and 14 species in each location, both Location I as Control, Location II (Block 2), namely the area of application of liquid waste with a Flatbed system, and Location III (Block 3), namely the application of liquid waste with the Longbed system. The highest composition of Collembola species at location I (Control) was *Entomobrya* sp.1, with a RD value of 27.91% at location II (Block 2) with the Flatbed system the highest composition was *Entomobrya* sp.3 with a RD value of 35.44 % and at location III (Block 3) with the Longbed system, the highest Collembola composition was *Entomobrya* sp.1 with a RD value of 27.07%.

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