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Abundance of Collembola in Biopore Infiltration Holes Filled with Organic Waste and Animal Waste

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ABSTRACT

Garbage and flooding are environmental problems that need attention. One solution to dealing with organic waste and flooding is the creation of biopore absorption holes (LRB). Organic waste can be processed into compost with the help of soil animals such as Collembola. The number of soil animals (Collembola) in the biopore hole is influenced by the type of waste used to fill the hole. The aim of this research was to determine the abundance of Collembola in LRBs containing organic waste and animal waste. Used 9 LRBs made from perforated pralon material. LRB group A which contains organic waste only (3 LRB), LRB B which contains organic waste and cow dung (3 LRB) and LRB C which contains organic waste and goat dung (3 LRB). The results of this research show that the LRB composting process has occurred with the help of Collembola. Four types of Collembola were found that were active in biopore infiltration holes (LRB), namely *Pseudosinella sp, Ceocobrya sp, Cyphoderus sp* and *Isotoma sp*. There were differences in the abundance of Collembola in LRB sets containing organic waste and animal waste. The Diversity Index value H' < 1, indicates that species diversity is low.

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1. INTRODUCTION

Waste and flooding are environmental problems that need attention. Community participation is needed in the development of appropriate technology to overcome these problems. One of these technologies is Biopore Infiltration Holes (BIH /"*Lubang Resapan Biopori*" (LRB). Simple Biopore Infiltration Hole technology, this principle is to reduce rainwater flowing without being optimally absorbed by the soil. This technology also slows down the rapid movement of surface water to the sea so that more water is absorbed into the soil through biopore infiltration holes. Biopore infiltration holes as an effort to reduce the accumulation of organic waste, LRB materials can use PVC pipes (Fathurrohman et al 2023; Sumbodo et al, 2024)

Animal waste is one of the natural bioactivators that can be used in the process of making organic fertilizer. Composting is the process of biodegradation of organic materials into compost. The decomposition or decomposition process is carried out by bacteria and fungi (Peni et al. 20 23; Prasetio et al. 2023; Safira et al. 2023). Animal waste contains microbes such as bacteria, fungi

and yeast ((Tawa et al. 2020). organic waste can be degraded into compost by soil organisms. One of the important soil organisms is Collembola. This animal acts as a decomposer of organic waste, rotting plant material, and regulates other communities by eating various microorganisms (microvores) such as fungi and bacteria (Bellini et al, 2023; Porter, 2024). According to Maretta et al (2022) the number of soil animals in the biopore holes is influenced by the type of waste used to fill the holes. The purpose of this study was to determine the abundance of Collembola in LRB filled with organic waste and animal waste.

2. METHOD

The study was conducted in the grassy yard of Widya Mandala Catholic University, Surabaya. The study was an experimental study. The biopore infiltration hole (LRB) tool was in the form of a PVC pipe with perforated walls (Fathurrohman et al. 2023). 9 LRB tools were used. LRB was planted in the soil. LRB was planted in the soil. The surface of the soil is grassy soil. A comparison of three Collembola habitat treatments was made in the LRB filled with organic waste and animal waste (cow). Comparison of organic waste 3 parts: Cow 1 part. LRB Group A was filled with organic waste only, LRB Group B was filled with organic waste and cow dung and LRB Group C was filled with organic waste and cow dung. Each treatment had 3 LRBs (Figure 1). After 45 days, the organic waste in LRB 1-3 was taken. The process of separating Collembola from the compost was carried out using the Berlese-Tullgren tool. Collembola were then identified. The research data are in the form of Collembola diversity, Collembola abundance, and species abundance index (H) (Shannon-Wienner index) of Collembola. The individual diversity value is calculated using the Shannon-Wienner index, with the formula:

$$H' = -\sum_{N}^{ni} ln \frac{ni}{N}$$

Description:
H' = Shannon-Wienner diversity index
Ni = Number of individuals of a species i
N = Total number of individuals of all species

Based on the Shannon-Wienner species diversity index, it is defined as follows:
a. H' value > 3 indicates high species diversity
b. H' value ≤ 3 indicates moderate species diversity
c. H' value < 1 indicates low species diversity (Bobbit, 2020; Maretta et al., 2022)

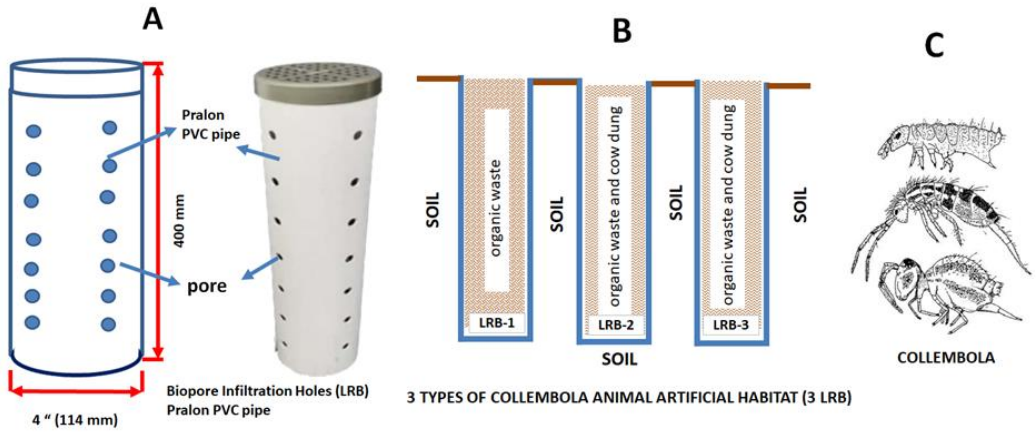

Figure 1. Collembola research activities in biopore infiltration holes (LRB). (A) LRB PVC pipes, (B) installation of LRB in the soil and (C) Collembola animals.

3. RESULTS AND DISCUSSION

3.1. Collembola Diversity

Collembola are very small terrestrial arthropods that are generally found associated with edaphic environments. Because most species are between 1 and 5 mm in size and live hidden under rocks and plant debris, or even in the soil. The body of Collembola is divided into head,

thorax, and abdomen. The head always has a pair of four-segmented anterior antennae, but in some taxa there can be subsegmentation or partial fusion of antennal segments. The thorax has three segments similar to other hexapods, pro, meso, and metathorax, and each has a pair of legs. The number of abdominal segments remains constant in Collembola, and is always six (Bellini et al., 2023). Springtail's distribution area is very wide, namely in terrestrial environments, living on plantation land (Manalu et al 2022; Silaen, 2020; Utom et al. 2019; Qonita et al 2021) forest land (Taise et al) or able to live in former toxic metal mining land (Gruss et al, 2024; Ernilasari et al 2021; Harto et al 2021. This animal can appear on the surface of fresh or salt water puddles, or even in underground coastal waters Collembola have been recorded from all continents, including the Arctic and Antarctic, and can live in dry desert areas to permanent snow and ice fields (Bellini et al 2023; Hao et al, 2023) In a study conducted using 9 biopore infiltration holes (LRB), which were filled with organic waste only (3 LRBs). organic waste mixed with cow dung (3 LRBs) and organic waste mixed with goat dung 3 LRBs). Installation of LRB into the soil and LRB environment diagram see Figure 2. In this study in the LRB environment, species diversity (biodiversity abundance) of Collembola was found as many as 4 species, namely *Pseudosinella sp, Ceocobrya sp, Cyphoderus sp* and *Isotoma sp*. (Figure 3 and Table 1).

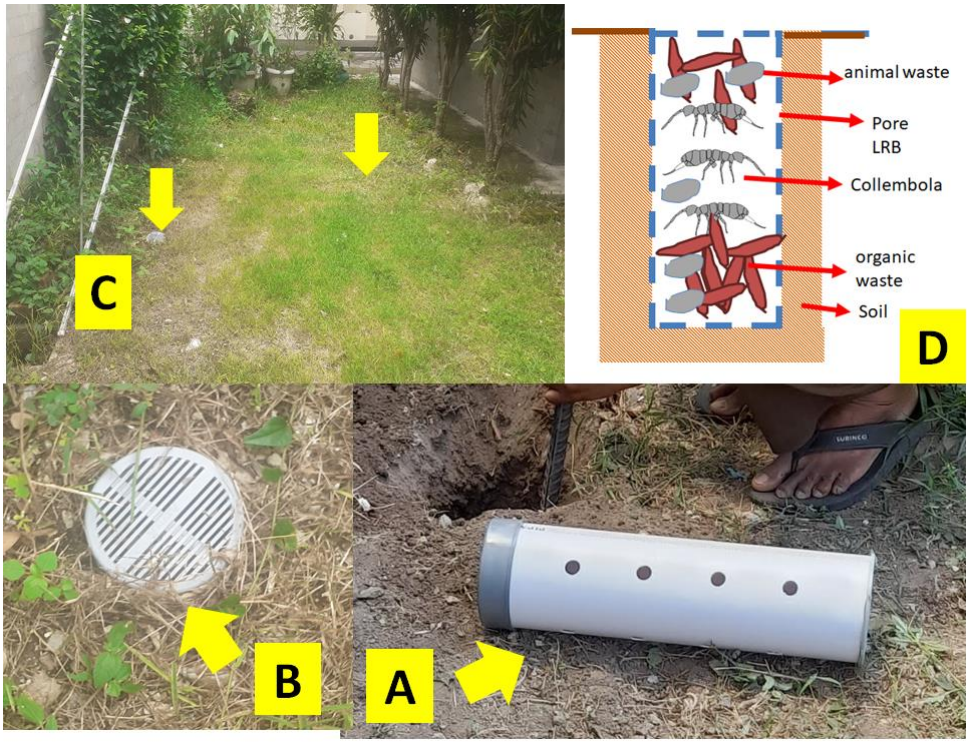

Figure 2. Biopore infiltration biopore installation activities (LRB) and LRB diagram. (A) digging a hole in the ground to plant the PVC pipe LRB, (B) LRB that has been planted in the ground, the top of the LRB hole cover is visible inside, (C) LRB research location and (D) a diagram depicting the LRB environment

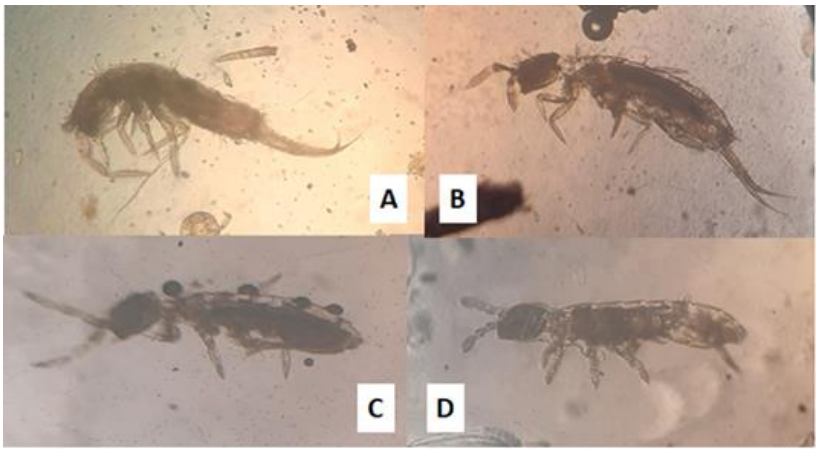

Figure 3. Diversity of Collembola found in LRB. (A*) Pseudosinella sp*, (B), *Ceocobrya sp*, (C) *Cyphoderus sp* and (D*) Isotoma sp*

Table 1. Diversity, abundance and Shannon-Winner Diversity Index (H`)) in biopore infiltration holes (LRB) filled with organic waste (LRB A), organic waste and cow dung (LRB B) and organic waste and goat dung (LRB C)

No	Species (Diversity)	Familia	Abundance of Collembola in LRB									Total number of each Species (LRB 1-9)
			LRB A			**LRB B**			**LRB C**			
			organic waste			organic waste + cow dung			organic waste + goat dung			
			LRB 1	LRB 2	LRB 3	LRB 4	LRB 5	LRB 6	LRB 7	LRB 8	LRB 9	
1	*Pesudosinella* sp	Entomobryidae	5	0	6	0	24	6	21	23	12	97
2	*Ceocobrya* sp	Entomobryidae	2	2	1	9	15	0	12	23	24	88
3	*Cyphoderus* sp	Entomobryidae	2	0	4	4	5	6	2	14	23	60
4	*Isotoma* sp	Isotomidae	6	5	11	12	14	19	25	23	16	131
		abundance (tail/LRB)	15	7	22	25	58	31	60	83	75	
		Average abundance, tails per LRB group	15			38			73			
		H=Diversity Index	-0,5242			-0,57029			-0,59522			

3.2. Abundance of Collembola

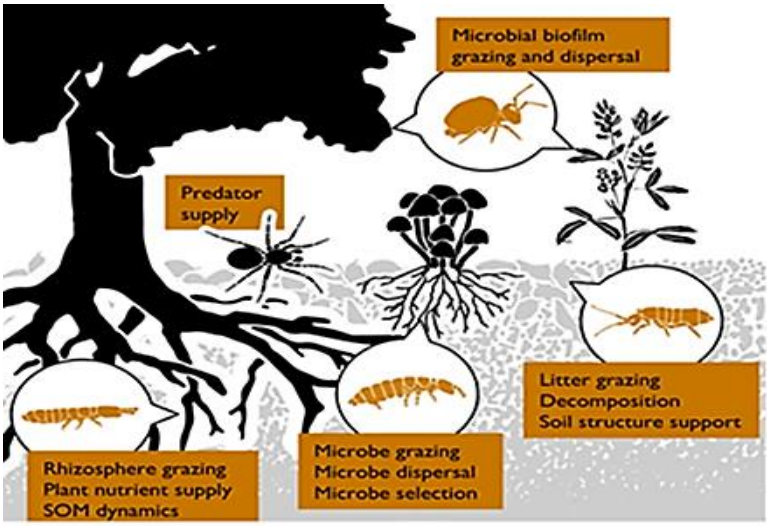

Figure 4. Collembola activity in the ecosystem. Collembola acts as a decomposer of organic waste, eating fungi, eating bacteria, and decaying plant material (Potapov et al, 2020; Porter, 2024)

The presence of Collembola in the soil is used to predict and control the actions of primary decomposers such as bacteria and fungi. Collembola in the ecosystem have a role as decomposers, eating fungi, eating bacteria, and eating decaying plant material, as illustrated in Figure 4. (Machado et al, 2019; Potapov et al, 2020; Porter, 2024). Given the highly varied role of each Collembola species in a very complex soil ecosystem, the diversity and abundance of Collembola in a habitat or ecosystem can be used as an indicator of a very active and specific food web process.

In the observation of 9 LRBs conducted in the study, the average abundance of Collembola in each LRB from the smallest to the highest number was obtained as follows: LRB 2, 7 were found; LRB 1, 15 were found; LRB 3, 22 were found; LRB 4, 25 were found; LRB 6, 31 were found; LRB 5, 58 were found; LRB 7, 60 were found; 75 were found (LRB 9), and 83 were found (LRB 8). In LRB 2, no Collembola *Pseudosinella sp* and *Cyphoderus sp* were found, in LRB 4 no *Pseudosinella sp* were found, while in LRB 6 no *Ceocobrya sp* were found. (Table 1 and Figure 5.)

The number of Collembola in LRB 8 is greater than in LRB 2. (Figure 5). This can be explained as follows, goat manure contains nutrients that can be used for the growth of fungi and bacteria. This condition is beneficial for the growth of Collembola, because the availability of fungi and bacteria in the waste environment will support the growth of Collembola, thus making the number of Collembola in LRB 8 greater than in LRB 2.

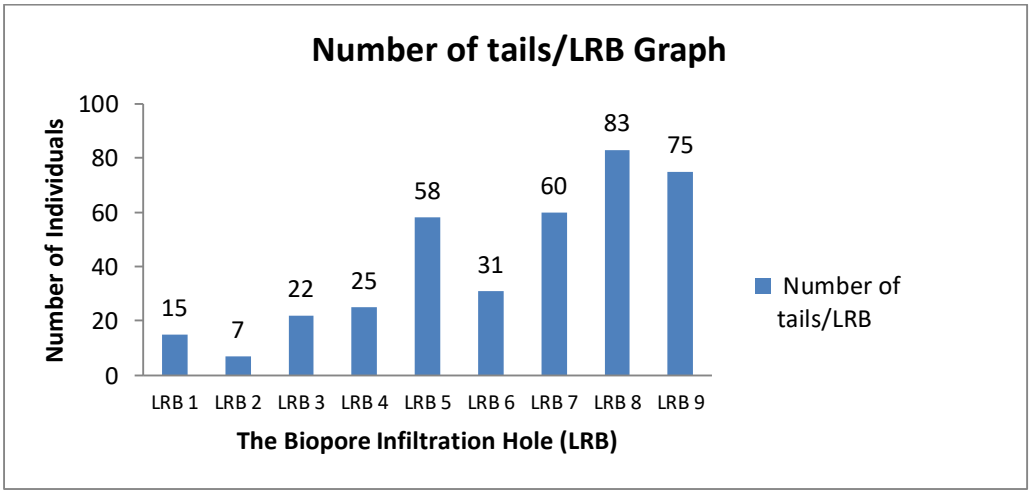

Figure 5. Graph of Collembola abundance per biopore infiltration holes (LRB) 1-3 (filled

with organic waste). LRB 4-6 (filled with organic waste and cow dung) and LRB 4-6 (filled with organic waste and goat dung)

The abundance of Collembola from LRB when grouped according to the LBR content material, the average results per LRB are as follows: LRB A filled with organic waste only found 15 ((15 + 7 + 22) / 3), LRB B filled with organic waste + cow dung found 38 ((25 + 58 + 31) / 3) and LRB B filled with organic waste + goat dung found 72 ((60 + 83 + 75) / 3). (Table 1 and Figure 6), Animal waste contains nutrients that can be used for the growth of fungi and bacteria. This condition is beneficial for the growth of Collembola, because the availability of fungi and bacteria in the waste environment will support the growth of Collembola. This can be seen why the number of Collembola in LRB Group C is greater than in LRB Group A which only contains organic waste (Figure 6).

The abundance of Collembola in LRB filled with animal waste (LRB B and LRB C) was greater than in LRB filled only with organic waste (LRB A). This condition is because animal waste provides food for Collembola in the form of bacteria and fungi. This is in line with the opinion of Tawa et al, (2020) who stated that animal waste contains microbes (bacteria and fungi) and Potapov et al, (2020) and Porter (2024) who stated that Collembola are microvores or eaters of bacteria and fungi.

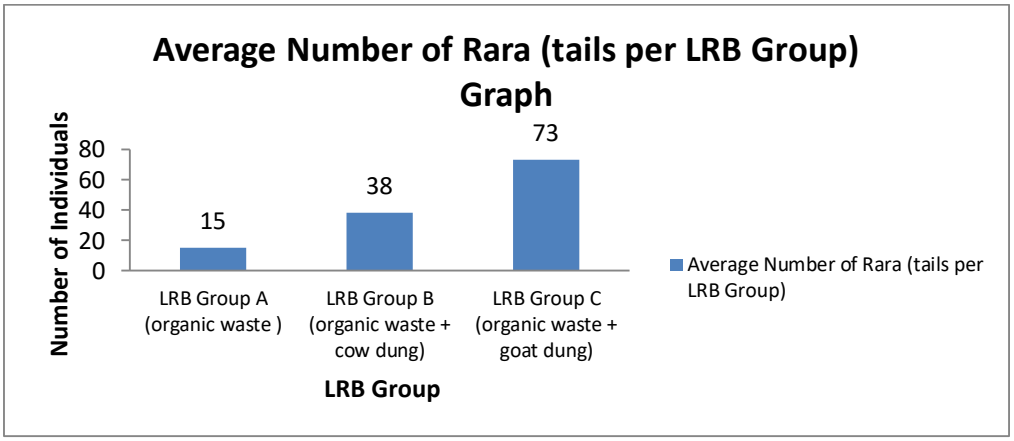

Figure 6. Graph of Collembola abundance per biopore infiltration hole (LRB) group. LRB Group A (average number of LRB 1-3), LRB Group B (average number of LRB 4-6) and LRB Group C (average number of LRB 7-9).

The Collembola species found in this study were 4 species, namely *Pseudosinella sp*, *Ceocobrya* sp, *Cyphoderus* sp and *Isotoma* sp. According to Potapov et al, (2020) that members of the Entomobryidae family act as microbivores, while members of the *Isotomidae* family play a role in decomposing organic waste*. Pseudosinella sp, Ceocobrya sp,* and *Cyphoderus sp* which belong to the Entomobryidae family act as microbivores (eat microorganisms such as bacteria and fungi in the LRB. *Isotoma sp* (Isotomidae) in the LRB plays a role in decomposing organic waste. The number of Isotoma sp is the highest (131), this is related to its role in decomposing organic waste and animal waste (Figure 7). There is an uneven number of species in each LRB, for example that the *Pseudosinella sp* species are not greater than the *Cyphoderus sp* species. In LRB 4 and LRB 9, the *Cyphoderus sp* species are more numerous than the *Pseudosinella* sp species, although the total number of *Pseudosinella sp* species is greater than the *Pseudosinella sp* species (see Table 2). This may be due to different conditions in the LRB, for example the growth of certain fungi or bacteria that are in accordance with the Collembola species.

Table 2. Number of individuals in the LRB of *Pseudosinellasp* and *Cyphoderus sp.*

No	Spesies	Family	LRB									Number
			1	2	3	4	5	6	7	8	9	
1	*Pesudosinella* sp	Entomobryidae	5	0	6	**0**	24	6	21	23	**12**	97
3	Cyphoderus sp	Entomobryidae	2	0	4	**4**	5	6	2	14	**23**	60

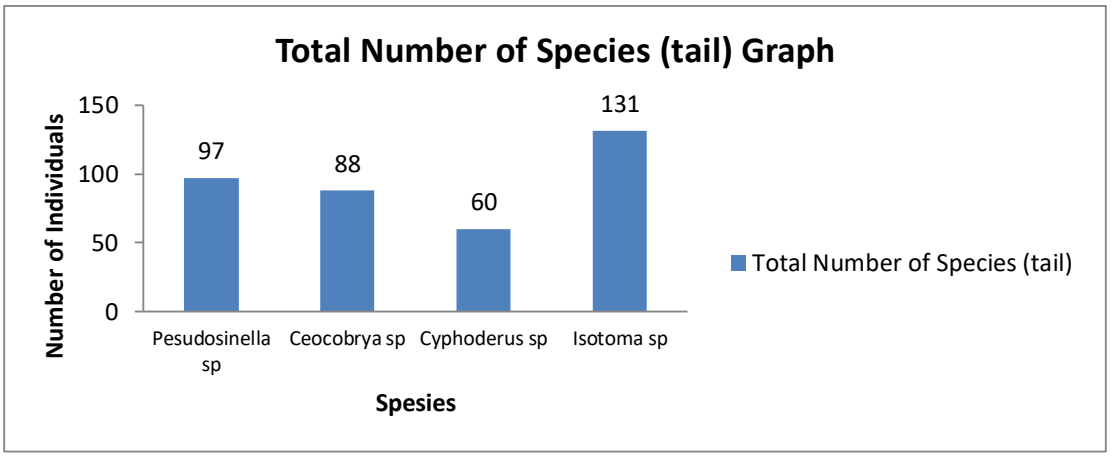

Figure 7. Graph of the total number per species in biopore infiltration holes (LRB) 1-9

3.3. Diversity Index (H)

The H value in the LRB group filled with only organic waste was -0.52420, the LRB group filled with organic waste and cow manure was -0.57029 and the LRB group filled with organic waste and goat manure was -0.59522. According to Maretta et al, (2022) the H' value <1 indicates low species diversity. (Table 1). This condition is possible because the Collembola habitat in the LRB is an isolated and limited habitat.

4. CONCLUSION

The conclusion in this study is that there has been a composting process of LRB with the discovery of 4 types of Collembola that are active in biopore infiltration holes (LRB), namely Pseudosinella sp, Ceocobrya sp, Cyphoderus sp and Isotoma sp. There is a difference in the abundance of Collembola in LRB filled with organic waste and animal waste. In LRB group A which is filled with organic waste only, 15 were found, LRB B which is filled with organic waste + cow manure, 38 were found and LRB C which is filled with organic waste + goat manure, 72 were found. Diversity Index (H). The value of H' <1 indicates that species diversity is low.

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