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# Arthropods Population in Palm Oil Plantation with and without Applications of Palm Oil Mill Effluent

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**Abstract**

Arthropods role are very important in overhauling organic and inorganic matter, and together with other soil organism, participate in the process of biogeochemical cycles. Environmental factors affect the presence of organisms in the soil, including Arthropods. The factors which affecting the availability of Arthropods in soil are moisture, soil temperature, soil pH and soil organic matter. So it is necessary to study the type and amount of Arthropods contain in land applied by palm oil mill effluent, and as a benchmark on land that is not applied by palm oil mill effluent. This research was conducted to determine the type and amount of arthropods cropland which produce palm oil with the application and without the application of palm oil mill effluent. The research used randomized complete block design with 2 factors and 3 replications. Factor 1: land with application and without the application of palm oil mill effluent, Factor 2: the sampling soil distance of 0 cm, 100 cm, 200 cm, 300 and 400 from the trench of palm oil mill effluent application. The results showed that the application of palm oil mill effluent contributes a significant effect on arthropods population. Arthropods population in the areas with the application of palm oil mill effluent is more common at a distance of 400 cm from the application ditch ($A_1J_4$). Arthropods found in the area without the application and with the application of palm oil mill effluent consists of 6 classes, 13 orders, 18 families and 19 species. The six classes are *Insecta, Arachnida, Malacostraca, Entognatha, Centipede and Diplopoda*.

***Keywords:*** Arthropods; Diversity; Microorganism; Palm Oil Mill Effluent.

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## 1. Introduction

Export commodities development of palm oil in Indonesia continues to increase from year to year. Palm oil mill effluent containing organic compound materials biodegrade in anaerobic atmosphere becomes simple acid compound, particularly acetic acid and gas. With the biological processes in an anaerobic atmosphere, levels of Biochemical Oxygen Demand (BOD) can be reduced from 25,000 mg/l to 5,000 mg/l. The research result from *Pusat Penelitian Kelapa Sawit* (PPKS) showed that *Pabrik Kelapa Sawit* (PKS) which is efficient enough produce 0.6-0.8 $m^3$ of liquid waste (POME)/ton Fresh Fruit Bunches treated [5].

Increased biodiversity can bring benefits to economy and environment. Arthropods have a very vital role in the food chain, especially as decomposers, because without these organisms nature will not recycle organic materials. In addition, Arthropods also act as prey for small predators, so it will keep the continuity of other Arthropod [6].

Besides a role in the food web, Arthropods also play a role in soil decomposition. Arthropods on soil surface will destroy larger size substance into smaller size one so that decomposition process can be continued by other soilfauna [4].

The utilization of palm oil mill effluent that has been processed into the plantation area as a fertilizer will give effect to soilfauna in particular from the group of Arthropods, both the existence types, density, frequency of attendance and the community structure (species diversity) in the area [1].

Soil macrofauna found in palm oil plantations which applied with palm oil mill effluent are the kind of insects that consists of eight orders, namely: *Blattaria, Coleoptera, Hemiptera, Hymenoptera, Isoptera, Orthoptera and Neuroptera* [10].

Arthropods existence of the habitat depends on environmental conditions [8]. Palm oil mill effluent affecting the diversity of arthropods due to a higher diversity of arthropods found in the plantation area irrigated by POME than plantation area which is not irrigated by POME [7].

Based on that statement, this study was conducted to compare the population of arthropods in oil palm plantations with the application and without the application of palm oil mill effluent, so can inventory the types of arthropods which found in the field.

## 2. Material and Methods

This research was conducted in *Divisi A Kebun Pengarungan PT. Asam Jawa Torgamba, Kabupaten Labuhan Batu Selatan, Sumatera Utara* in March to July, 2016. The palm oil mill effluent are derived from progenitor pool is distributed to Flat Bed with the size of the trench (18 x 1.25 x 1.25) $m^3$. The applications of palm oil mill effluent to Areal Land Application were done by tractor tank system.

The making of constructions was made in *gawangan mati*, between the rows of trees associated with the

channel trench with a certain slope. Soil samples were collected with a size of 20 cm x 20 cm x 10 cm.

### *2.1. Experimental Design*

The study used Factorial Randomized Block Design with two factors and 3 replications. Factor I was soil applications of palm oil mill effluent and land without the application of palm oil mill effluent. Factor II was soil sampling retrieval distance which consists of 5 levels i.e.: 0 cm, 100 cm, 200 cm, 300 cm, and 400 cm from the trenches application of palm oil mill effluent. Each treatment consists of three replications.

Testing parameters of the Arthropods average population are arranged on the list of variance and Least Significant Difference (LSD) test is done with the level of 5% and 1%

### *2.2. Observation and Interpretation of Data*

The observations made in this study are:

1. Arthropods Classification
2. The Population of Arthropods
3. Population Abundance and Relative Abundance; Calculation and interpretation of the data obtained at each point of observation is done in the following manner:

Fauna Population Abundance and Relative Abundance [9]

$$\text{K type A} = \frac{\text{A type individual total}}{\text{Total of Sample Unit}} \quad \text{..... (1)}$$

$$\text{KR type A} = \frac{\text{K type A}}{\text{All type of Total K}} \quad \text{..... (2)}$$

Note:

K = Population Abundance

KR = Relative Abundance

Interpretation:

1) If A is a type of fauna that are beneficial to agriculture, the higher the value of K or KR mean soil management and crop cultivation leads to sustainability of cultivation.

2)If A is a type of fauna detrimental to agriculture, the higher the value of K or KR mean soil management and crop ecologically unfavorable and at a certain value (threshold) threatens the sustainability of cultivation. It is also influenced by the abundance of other fauna that act as predators to the detriment fauna.

## 3. Result and Discussion

### *3.1 Arthropods Classification*

Arthropods found in the area without the application and with the application of palm oil mill effluent are quite varied in existence. Arthropods which are obtained from the research are grouped in classes, orders, families and species (Table 1)

**Table 1:** Classification of Arthropods on Areal Without and With Application of Palm Oil Mill Effluent

| Class | Order | Family | Spesies |
|---|---|---|---|
| Insecta | Coleoptera | Staphylinidae | Megarthrus depressus |
| | | | Aleochara lanuginosa |
| | Dermaptera | Forficulidae | Forficula auricularia |
| | Diptera | Sciaridae | Corynoptera perpusilla |
| | Hemiptera | Cydnidae | Cydnus aterrimus |
| | Hymenoptera | Myrmicinae | Myrmica rubra |
| | Orthoptera | Gryllidae | Gryllus bimaculatus |
| Arachnida | Araneae | Theridiidae | Latrodectus mactans |
| | Acari | Dictynidae | Dictyna arundinacea |
| | | Ascidae | Arctoseius magnanalis |
| | | Uropodidae | Uropoda afghanica |
| | | Poronoticae | Poronoticae sp. |
| | | Dermanyssidae | Dermanyssus gallinae |
| | | Sarcoptiformes | Peloribates angulatus |
| Malacostraca | Isopoda | Oniscidae | Oniscus asellus |
| Entognatha | Collembola | Entomobrydae | Entomobrya unostrigata |
| Chilopoda | Gheophilomorpha | Geophilidae | Geophilus gracilis |
| | Scolopendromorpha | Scolopendridae | Scolopendra sp. |
| Diplopoda | Polydesmida | Polydesmidae | Polydesmus angustus |

Arthropods found in the study site consist of 6 classes, 13 orders, 18 families and 19 species. Classes obtained in the area of research are Insecta (insects), Arachnid (spider), Malacostraca (flea dirt), Entognatha (spring tails), Centipede (centipedes) and Diplopoda (millipedes).

### *3.2 Total Population of Arthropods*

Arthropods number of each type in an area without the application and with the application of palm oil mill effluent can be seen in Table 2.

**Table 2:** Number of Arthropod population by type

| No | Spesies | Without Application | With Application |
|---|---|---|---|
| 1 | Aleochara lanuginosa | 2 | 0 |
| 2 | Arctoseius magnanalis | 4 | 2 |
| 3 | Corynoptera perpusilla | 22 | 18 |
| 4 | Cydnus aterrimus | 6 | 0 |
| 5 | Dermanyssus gallinae | 29 | 21 |
| 6 | Dictyna arundinacea | 1 | 0 |
| 7 | Entomobrya unostrigata | 1 | 0 |
| 8 | Forficula auricularia | 0 | 3 |
| 9 | Geophilus gracilis | 6 | 16 |
| 10 | Gryllus bimaculatus | 2 | 0 |
| 11 | Latrodectus mactans | 0 | 1 |
| 12 | Megarthrus depressus | 2 | 5 |
| 13 | Myrmica rubra | 111 | 535 |
| 14 | Oniscus acellus | 5 | 0 |
| 15 | Peloribates angulatus | 5 | 4 |
| 16 | Polydesmus angustus | 2 | 1 |
| 17 | Poronoticae sp. | 4 | 16 |
| 18 | Scolopendra sp. | 6 | 17 |
| 19 | Uropoda afghanica | 3 | 3 |
| Total of Individual | | 211 | 642 |

Arthropods population is mostly found in the areas with palm oil mill effluent application by 642 individual (304.26% compared to areas without application), while in areas without application found as many as 211 individual. The overall number of species found that 19 species, in an area without the application only 17 species (*Latrodectus mactans* and *Forficula auricularia* are not found). While in the area with application there are 13 species and 6 species are not found; *Aleochara lanuginosa, Cydnus aterrimus, Dyctina arundinacea, Entomobrya unostrigata, Gryllus bimaculatus,* and *Oniscus asellus*.

Differences in the type and number of arthropods which found in areas without application and with the application of mill effluent prove that the presence of the organism, especially arthropods in the soil is influenced by environmental factors. Arthropod existence in one habitat depends on environmental conditions [8]. Reference [7] stating that palm oil mill effluent affecting the diversity of arthropods, due to a higher diversity of arthropods found in the plantation area irrigated by POME than plantation which is not irrigated by POME.

Arthropod population show higher average number in the area with mill effluent application than in area without application. Arthropod population of trench applications is also varies. The average population of arthropods (Table 3)

**Table 3:** The average population of arthropods (individual)

| Treatment | A0 (without application of POME) | A1 (with application of POME) | Total | Average |
|---|---|---|---|---|
| J0 (0 cm of trench applicationsi) | 7,00 | 49,00 | 56,00 | 28,00 |
| J1 (100 cm of trench applications) | 22,67 | 26,00 | 48,67 | 24,33 |
| J2 (200 cm of trench applications) | 14,00 | 16,00 | 30,00 | 15,00 |
| J3 (300 cm of trench applications) | 11,67 | 15,33 | 27,00 | 13,50 |
| J4 (400 cm of trench applications) | 15,00 | 107,67 | 122,67 | 61,33 |
| Total | 70,33 | 214,00 | | |
| Average | 14,07 a | 42,80 b | | |

The highest Arthropods population is in the treatment with the application of mill effluent at a distance of 400 cm (A1J4) that is equal to 107.67 and the lowest is on treatment without application of mill effluent at a distance of 0 cm (A0J0) that is equal to 7.00. LSD test showed that the area of the mill effluent application give significant effect on arthropods when compared with the total areal without application of the wastewater. In the (A1) areas where wastewater is applied, Arthropods on average is 42.80 while in areas without application of POME (A0) is lower at 14.07. In the treatment of soil sampling distance can be seen that LSD test showed that the distance does not significantly affect total Arthropods. However, at a distance of 400 cm from the application ditch there was an increase in total Arthropods. This happens because at a distance of 400 cm from the POME application ditch is close to the palm roots. According to Lines-Kelly [3] *rhizosphere* is an environment in the soil around the roots of a plant where the chemical and its biological activity are influenced by the roots directly. In line with the growth of plant roots secrete compounds that are soluble in water, for example amino acids, sugars and organic acids that will provide food for microorganisms. The availability of food supply has resulted in the microorganisms activity around *rhizosphere* is much higher than around a far soil environment from the roots of plants.

### *3.3 Population Abundance and Relative Abundance*

Population abundance and relative abundance of Arthropods in areas without application and the application of palm oil mill effluent can be seen in Table 4.

**Table 4:** Population Abundance and Relative Abundance of Arthropods in Areal Without Application and the Application of POME

| No. | Spesies | Areal Without POME Application | | Areal With POME Application | |
|---|---|---|---|---|---|
| | | K | KR (%) | K | KR (%) |
| 1 | Aleochara lanuginosa | 0,13 | 0,95 | 0,00 | 0,00 |
| 2 | Arctoseius magnanalis | 0,27 | 1,90 | 0,13 | 0,31 |
| 3 | Corynoptera perpusilla | 1,47 | 10,43 | 1,20 | 2,80 |
| 4 | Cydnus aterrimus | 0,40 | 2,84 | 0,00 | 0,00 |
| 5 | Dermanyssus gallinae | 1,93 | 13,74 | 1,40 | 3,27 |
| 6 | Dictyna arundinacea | 0,07 | 0,47 | 0,00 | 0,00 |
| 7 | Entomobrya unostrigata | 0,07 | 0,47 | 0,00 | 0,00 |
| 8 | Forficula auricularia | 0,00 | 0,00 | 0,20 | 0,47 |
| 9 | Geophilus gracilis | 0,40 | 2,84 | 1,07 | 2,49 |
| 10 | Gryllus bimaculatus | 0,13 | 0,95 | 0,00 | 0,00 |
| 11 | Latrodectus mactans | 0,00 | 0,00 | 0,07 | 0,16 |
| 12 | Megarthrus depressus | 0,13 | 0,95 | 0,33 | 0,78 |
| 13 | Myrmica rubra | 7,40 | 52,61 | 35,67 | 83,33 |
| 14 | Oniscus acellus | 0,33 | 2,37 | 0,00 | 0,00 |
| 15 | Peloribates angulatus | 0,33 | 2,37 | 0,27 | 0,62 |
| 16 | Polydesmus angustus | 0,13 | 0,95 | 0,07 | 0,16 |
| 17 | Poronoticae sp. | 0,27 | 1,90 | 1,07 | 2,49 |
| 18 | Scolopendra sp. | 0,40 | 2,84 | 1,13 | 2,65 |
| 19 | Uropoda afghanica | 0,20 | 1,42 | 0,20 | 0,47 |
| | Total | 14,07 | 100,00 | 42,80 | 100,00 |
| | Index (%) | 100,00 | | 304,19 | |

Based on Table 4 it can be seen that the population abundance of arthropods in oil palm plantations in the area of POME application is very high at 42.80 (304.19% compared with no POME application). In areas without POME application that is equal to 14.07. *Myrmica rubra* species in areas without POME has an abundance of a population of 7.40 with a relative abundance of 52.61%. Population abundance increased in the areas where the POME application of 35.67 with a relative abundance of 83.33%.

According to Borror and his colleagues [2] that Hymenoptera order contains lots of valuable species as parasites or predators of insect pests and the most important pollinators of plants; the bees. Hymenoptera is one group that is very attractive in terms of their biology, because they show great diversity of habits and increased behaviors complexity in terms of social organization of hornets, bees, and ants.

*Myrmica rubra* species is a species that give benefit for both agriculture and plantation because their nest is inside the soil and will decompose organic matter faster. The higher the value of population abundance and relative abundance make the soil and plants cultivation leads to sustainability cultivation.

## 4. Conclusion

1. Arthropods found in the study site consist of 6 classes, 13 orders, 18 families and 19 species. Kelas yang ditemukan adalah kelas Insecta, Arachnida, Malacostraca, Entognatha, Chilopoda dan Diplopoda.
2. Application of palm oil mill effluent on plantations gives significant effect on the population growth of Arthropods.
3. Total population of arthropods on POME application land is as much as 642 individuals, on land without POME applications is 211 individuals.
4. Arthropods population abundance in palm oil plantations is highest in areas with the POME application of 42.80 and in areas without POME application of 14.07.

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