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Measure off Termites Diversity and Abundance in Various Oilpalm Typology in Tulang Bawang District, Lampung Province

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Abstract

The research was conducted on an oil palm plantation in Tiuh Tohou Village, Menggala, Tulang Bawang Regency, Lampung Province. The aims of this study were to measure the diversity and abundance of various typologies of oil palm in Tulang Bawang district, to study the highest relative abundance of termites in various typologies of oil palm in Tulang Bawang and to determine the effect of environmental factors on termite diversity. Termite sampling was carried out using the transect method. Data were analyzed using ANOVA and LSD test at a significance level of 5%. Six termite genera were found in five oil palm typologies (old oil palm, young oil palm, shrubs/grass, cassava and swampland), namely Globitermes, Odontetermes, Macrotermes, Hypotermes, Schedorhinotermes and Bulbitermes. However, it is estimated that three more genera will be found if the number of samples (typology) is added (extrapolated). There were differences in termite diversity according to oil palm typology (five genera in old oil palm, four genera in young oil palm, two genera in cassava, and only one genus in shrubs/grass. The relative abundance of termites was highest in old oil palm (18 counts), followed by by young oil palm (14 counts), cassava (5 counts) and shrubs/grass (3 counts) The relative abundance of termites is ranked in an exponential pattern, with the genera Macrotermes and Bulbitermes the most and the least abundant Environmental factors affecting genus richness termites are humidity, wood volume, litter weight and environmental factors that affect the distribution and frequency of finding termites affected by the level of canopy cover, humidity, wood volume, litter weight and organic litter C.

Keywords: abundance, diversity, oil palm, termites, typology.

1. Introduction

Oil palm (*Elaeis guineensis* Jacq) is a commodity that ranks first as a non-oil and gas foreign exchange contributor from the plantation sector. In 2010 foreign exchange from plantations reached more than USD 20 billion, which came from oil palm USD 15.5 billion, rubber USD 7.8 billion, and coffee USD 1.7 billion (ekonomi.kompasiana.com, 2013). The high foreign exchange value of the palm oil commodity is one of the drivers for the expansion and cultivation of this commodity. The expansion of oil palm is spread throughout Indonesia. For the province of Lampung, the expansion of oil palm plantations in 2010, it reached 153,160 ha spread over the Districts of Tulang Bawang, Way Kanan, Central Lampung and North Lampung (Dinas Perkebunan Provinsi Lampung, 2010).

Planting and expanding oil palm land is closely related to carrying capacity land as a growing medium for this commodity. Various changes influence soil fertility and health in the ecosystem so the expansion and clearing of new land will cause a shift in land use from forest, grassland, bush and swamp land to oil palm land.

The effect of land changes will have an impact on the presence and diversity of termites. The diversity of termites will decrease if the species richness of termites is low. The species richness of termites in an ecosystem is negatively correlated with the level of disturbance that occurs in that ecosystem (Eggleton et al., 2002).

This study aims to (1) measure the diversity of termites in various typologies of oil palm land in Tulang Bawang Regency using the transect method (2) Study the type of termites that has the highest abundance in various typologies of oil palm land in Tulang Bawang Regency on termite abundance and (3) To find out the influence of environmental factors on termites diversity.

2. Materials and Methods

2.1. Materials

This research was conducted on oil palm land, Old Village (Tiuh Tohou) Menggala Tulang Bawang, Laboratory of Plant Pests and Diseases, University of Lampung, Unila. The research time is from November 2016 to January 2017.

The materials used in this study were 70% alcohol, label paper, HVS, transparent plastic, black plastic, ribbon, and plastic rope. The tools used are small shovels, machetes, crowbars, sieves, tongs, Petri dishes, brushes, microscopes, compasses, densitometers, rulers, ovens, sample rings, soil thermometers, soil testers, weighing tools, termite identification books, drawing books, pencils, and books.

The research was conducted using a survey on oil palm land, then determining the termite sampling points. The termite sampling method was carried out using the Transect Method, namely measurements using a transect rope measuring 100 m x 2 m which was divided into 20 sections measuring 5 m.

Transect lines are laid out sequentially over the termite habitat. Termite sampling was carried out by digging each part of the transect with a crowbar and shovel. The termites obtained were put into bottles containing 70% alcohol and labeled with their habitat and typology. The termite specimens taken were the soldier's and worker's caste.

After the termites are obtained, identification is carried out in the laboratory using a microscope and a highway identification book. The identified termite genus is then grouped into termite functional groups. The variables observed included the number of termite genus/wealth, termite abundance (termite distribution), soil temperature, soil pH, soil moisture, canopy cover level, litter weight, wood volume, bulk density, total N content of soil and litter and C/ N ratio of soil and litter.

2.2. Methods

This study used analysis of variance (ANOVA) with SPSS 16.0 at a 5% level. ANOVA was carried out to differentiate the effect of land typology on the variables measured to test the two mean values with the Least Significant Difference Test (LSD) at the 5% level. The number of termite genera from each type of land use is described visually using the genus accumulation curve with SWin9 estimation (Colwell, 2013). The termite abundance formula uses the formula used by Swift & Bignell (2001), namely

$$KR = F/N \tag{1}$$

Description:

KR = relative abundance
F = frequency of finding termites of the Genus x
F = found/maximum number of sections (20 sections)
N = total frequency of findings

3. Results and Discussion

3.1. Results

3.1.1. Number of Genus/species richnees of termites

The results of termite identification in various typologies of oil palm indicate that the number of genera or termite richness is as follows;

Table 1. The richness of the of the termite genus in various oil palm typologies

No	Genus	L1	L2	L3	L4	L5
1	Globitermes	1				
2	Odontotermes	1	1			
3	Macrotermes	1	1	1	1	
4	Hypotermes	1	1	1		
5	Schedorhinotermes	1				
6	Bulbiteermes		1			
	Total	5	4	2	1	0

Description: old oil palm (L1), young oil palm (L2), shrub/ grass (L3), cassava (L4), land around swamp (L5)

There are 6 genera of termites namely Globittermes, Odontotermes, Macrotermes, Hypotermes, Schedorhinotermes, and Bulbitermes. Macrotermes were found in almost all typologies except swamp areas, whereas Schedorhinotermes were only found in old swamps, and Bulbitermes were found in young oil palm typologies.

Hypotermes were found in 3 typologies except for cassava and around swamps. Odontetermes is only found in oil palm typology. swamp. Odontetermes is only found in oil palm typology. The most common genus found is in the old oil palm typology. Meanwhile, termites that were not found at all were a typology around the swamp.

3.1.2. Termite Distribution (Termite abundance)

The distribution of findings (termite abundance) illustrates the distribution of termite findings in various typologies. The ranking of termite abundance in a row is old palm typology (90%), young oil palm (70%), cassava (25%), shrubs and grasses (15%), and typology around swamps (0%). This can be seen in table 2 below.

Table 2. The richness of the of the termite genus in various oil palm typologies

No	Genus	L1	L2	L3	L4	L5
1	Globitermes	10				
2	Odontotermes	5	10			
3	Macrotermes	55	45		25	
4	Hypotermes	10	10	10		
5	Schedorhinotermes	10		5		
6	Bulbiteermes		5			
	Total	90	70	15	1	0

Description: old oil palm (L1), young oil palm (L2), shrub/ grass (L3), cassava (L4), land around swamp (L5)

The relative abundance of termites found in the oil palm typology can be seen in Table 3, below;

Table 3. The richness of the of the termite genus in various oil palm typologies

No	Genus	L1	L2	L3	L4	L5	KR
1	Globitermes	2				0	0.050
2	Odontotermes	1	2			0	0.075
3	Macrotermes	11	9	2	5	0	0.675
4	Hypotermes	2	2	1		0	0.125
5	Schedorhinotermes	2		5		0	0.050
6	Bulbiteermes		1			0	0.025
	Total						

Description: old oil palm (L1), young oil palm (L2), shrub/ grass (L3), cassava (L4), land around swamp (L5)

3.1.3. Environmental factors

The results of the measurement of environmental variables can be seen in table 4 below

Table 4. The results of the measurement of environmental variables

No	Measurement environmental	Old oil palm typology	Young palm oil typology	Shrub/grass	Cassava	Land around swamp
1	Kanopi (%)	70a	60a	43b	45b	0c
2	Temperature (^{0})	30ab	31b	31b	29a	36c
3	pH	6,7tn	6.5tn	6.7tn	6tn	7tn
4	Soil moisture (%)	69a	68ab	75bc	70b	77d
5	Wood volume (m^3/m^2)	1.129a	0.275a	0.048a	0b	0b
6	Litter weght (g/m^2)	2200tn	1108tn	496tn	378tn	65tn
7	Litter organik C (%)	61a	56a	50b	53a	30b
8	N. Total litter (%)	1.5tn	1.4tn	1.3tn	1.7 tn	0.9tn
9	Litter C/N (%)	41tn	40tn	39tn	32tn	34tn
10	Soil Organik C (%)	1.5a	1.6a	5.7b	1.1a	3.7b
11	N. Total Land (%)	0.21a	0.19a	0.47b	0.18a	0.39b
12	Soil C/N (%)	7.10tn	8.21tn	12.11tn	6.11tn	9.56tn
13	Bulk density (g/m^3)	1.24tn	1.35tn	1.05tn	1.38tn	1.16tn

Description: Number followed by the same letter did not differ according to the BNT test at 5% significant level, tn = result have no real effect.

The results of the measurement of environmental variables show that have no significant effect, namely pH, litter weight, total litter N, litter C/N, soil C/N, and bulk density. The level of canopy cover on young and old oil palms was not significantly different, while on other lands it was significantly different. The temperature on old, young, and grassland is not different, while the other lands are different. Soil moisture in mature oil palms is not different from young oil palms but different from another land. The wood volume in old oil palm is not different from that of young oil palm and grass but different from cassava and swamp land. Litter organic C (%) in old oil palm is not different from that of young oil palm and cassava but different from grass and swamp land. Soil Organic C (%) in old oil palm is not different from that of young oil palm and cassava but different from grass and swamp land. N total land in old oil palm is not different from that of young oil palm and cassava but different from grass and swamp land.

3.2. Discussion

Based on the research that has been done, 6 genera of termites were found, namely Globittermes, Macrotermes, Ondontotermes, Hypotermes, Schedorhinotermes and Bulbitermes. There are differences in termite diversity in various typologies, namely in old oil palm typology 5 termite genera were found (Globitermes, Macrotermes, Ondontotermes, Hypotermes, Schedorhinotermes in young oil palm typology found 4 termite genera (Macrotermes, Ondontotermes, Hypotermes, Bulbitermes), bush/grass typology found 2 genera (Macrotermes, Hypotermes) and cassava typology only found 1 genus (Macrotermes) Table 1. The genera Globittermes and Schedorhinotheres are only found in old oil palm areas. These two genera of termites are termites that are affected by the introduction of litter or wood into their microhabitat and feed. The more litter weight and wood volume, the higher the frequency of finding the two termites.

A higher subterranean termite called Globitermes sulphureus can be found in Southeast Asian countries such as Malaysia, Thailand, Vietnam, Singapore and Myanmar. This higher termite species is a pest in coconut and oil palm plantations and is considered a secondary pest (Hussin et al., 2018). However, in the typology of oil palm in Tulang Bawang, the relative abundance is not large, only 0.050 (see Table 3), the distribution/finding of termites is also only in old oil palm with 10 termites (see Table 2), so that it is not too potential as a pest.

Species of the genus Schedorhinotermes (Rhinotermitidae) are known to be frequently associated with different groups of thermophilous staphylinids such as the Trichopseniini (Bourguignon et al., 2006). The dominance and adaptation of these termites to various types of land causes Schedorhinothermes to be potential pests. However, in the typology of oil palm in Tulang Bawang, the relative abundance is not large, only 0.050 (see Table 3), the distribution/finding of termites is also only in old oil palm with 10 termites (see Table 2), so it is not too potential as a pest.

The Genus Bulbitermes was only found in the young oil palm typology because we found rotten dead wood in this typology. The decayed remains of dead wood are suitable habitats for the genus Bulbittermes (Prastyaningsih, 2005). The relative abundance value is lower when compared to other genera (0.025) Table 3, the distribution/finding of termites in the typology of young oil palm is only 5 termites (see Table 2). This indicates that Bulbittermes do not have very potential as a pest in oil palm plantations.

The genus Macotermes is the most common genus found in various oil palm typologies. The distribution of termites in various land types (typologies) shows their ability to adapt quite well to changes in habitat. The wide distribution of Macrotermes in various types of land use makes this termite a potential pest, although its attack on oil palm plants does not cause death (Subekti et al., 2008).

In the typology of oil palm in Tulang Bawang, the distribution/ distribution and abundance of these termites was the largest compared to other genera, namely Distribution/finding (55) Table 2 and termite abundance (0.675) Table 3. The genus Macrotermes has the characteristics of building a mound nest. Which is the nest. The number of nests found in old and young oil palms indicates that the macro and micro habitat conditions are suitable for Macrotermes. This also indicates that the food sources are many so this genus is more commonly found in various typologies. The typology around the swamp has relatively high humidity, ranging from 75%-77%. High soil moisture because it has land adjacent to the swamp so it is often inundated. This decrease in aeration quality is thought to be the cause of the low distribution and findings of Macrotermes in the typology around the swamp (0) Tables 2 and 3.

Odontotermes were only found in the typology of old and young oil palms (see Table 1). The existence of dead wood pillars from oil palm and other woody plants becomes the microhabitat and food source for these termites. According to Prastyaningsih (2005), Odontotermes live and thrive on logs in primary and secondary forests. The relative abundance of the genus was 0.075 (see Table 3). Intensive tillage activity at the beginning of planting is one of the reasons for the increasing population of Odontotermes (Samb et al., 2011).

Hypotermes were found in the typology of old, young shrub/grass oil palms (see Table 1). Old and young oil palm vegetation makes it possible to provide food for termites. Termites are able to decompose organic materials derived from plants, then the nutrients from the decomposition are returned to the soil so that they can be used by plants (Nandika et al., 2003).

Six genera found in the typology of oil palm in Tulang Bawang Regency were functional groups that ate wood, while subterranean termites were not found. Subterranean termites are more sensitive to changes or disturbances in their habitat, either in the form of intensive tillage, or the use of herbicides and fertilization (Jones et al., 2003).

The highest ranking curve for termite genera was Macrotermes (1), followed by Hypotermes (2), Odontotermes (3), Globittermes and Scherhinotermes (4 and 5), and the lowest was Bulbittermes (6). The relative abundance pattern of termites in the oil palm agroecosystem is an exponential pattern. In the picture, it can be seen that the relative abundance of termites is decreasing (see Figure 1).

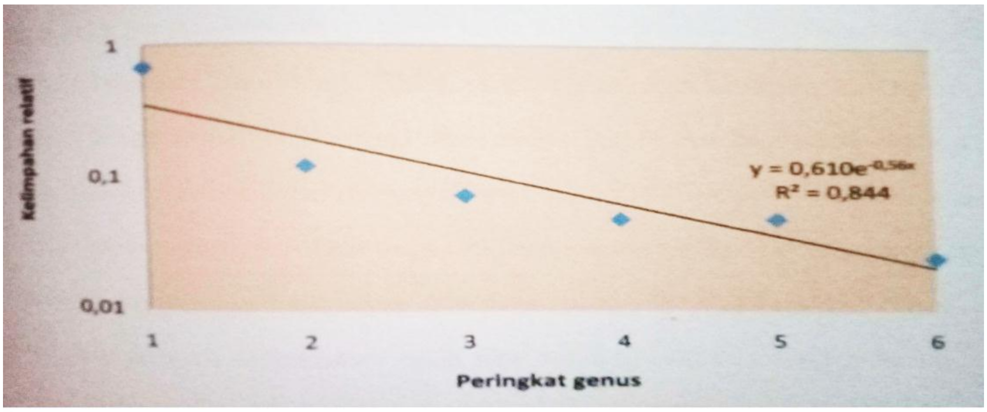

Figure 1: Termites genus relative abundance ranking curve
Description: X axis, 1 = Macrotermes, 2= Hypotermes, 3= Odontotermes, 4=Globitermes, 5=Schedorhinotermes and 6= Bulbitermes

Environmental factors that affect the richness of the termite genus are humidity, wood volume, litter weight, and environmental factors affect distribution and frequency finding termites is influenced by the frequency of finding termites are influenced by the level of canopy cover, humidity, wood volume, heavy litter, and organic litter C. these factors interact and influence each other (Yunilasari, 2008). Increasing the level of canopy cover will cause distribution and frequency of canopy cover will cause distribution and frequency (see Table 4). The level of canopy cover is also related to the amount of litter and plant material as well as the soil. The old oil palm vegetation allows it to provide food for termites in the form of more litter and wood compared to other typologies. Soil moisture in various typologies of oil palm plants ranges from 68% -77% with the moderately moist category. Humidity correlates with genus richness, termite frequency, and distribution. Humidity affects the movement of termites, when humidity is low, termites will move to areas with low temperatures or high humidity (Yunilasari, 2008). The expansion of oil palm plantations managed in monoculture intensively has resulted in low termite diversity in this agroecosystem. From the genus accumulation curve, it can be estimated that the oil palm ecosystem is inhabited by 9 species of termites (see Figure 1). This means that if the oil palm land in Tulang Bawang is managed in monoculture and intensively, then only 9 genera of termites will be preserved. The low number of genera found can be caused by many factors. According to Jones et al., (2003), planting monocultures, intensive tillage, and regular fertilization can lead to a decrease in termite diversity.

The owner of the oil palm land where the study is located is active in applying fertilizer and pesticide treatments so that they have a negative impact on soil-eating termites but a positive impact on wood-eating termites. The presence of wood-eating termites in various typologies of oil palm has negative and positive impacts. Positive impact because termites are able to break down litter and other woody materials into nutrients needed by plants. It has a negative impact because it has the potential as a pest because it eats woody materials that contain high cellulose contained in staple crops such as oil palm. If the food source comes from the rest of the stumps, it will attack the surviving staple plants such as oil palm trunks, so that they have the potential to become pests.

4. Conclussion

Based on the results of the research, it can be concluded that (1) there are differences in termite diversity in various typologies of oil palm, namely the number of genera/riches of termites using the transect method. (2) The termite genus which had a higher abundance compared to other termite genera was Macrotermes (0.75), while the lowest was Bulbitermes, namely 0.025 and (3) An environmental factor that affect the richness of the termite genus are humidity, wood volume, and litter weight and environmental factor that affect distribution and frequency of termite findings are influenced by the level of canopy cover, humidity, wood volume, litter weight, and litter organic C.

References

Bourguignon, T., & Roisin, Y. (2006). A new genus and three new species of termitophilous staphylinids (Coleoptera: Staplylinidae) associated with Schedorhinotermes (Isoptera: Rhinotermitidae) in New Guinea. *Sociobiology*, *48*(2), 395-408.

Dinas Perkebunan Provinsi Lampung. (2010). *Leading Plantation Commodities (Oil Palm Commodities)*. Lampung: Penerbit Disbun Lampung.

Eggleton, P., Bignell, D. E., Hauser, S., Dibog, L., Norgrove, L., & Madong, B. (2002). Termite diversity across an anthropogenic disturbance gradient in the humid forest zone of West Africa. *Agriculture, ecosystems & environment*, *90*(2), 189-202.

Hussin, N. A., Zarkasi, K. Z., & Ab Majid, A. H. (2018). Characterization of gut bacterial community associated with worker and soldier castes of Globitermes sulphureus Haviland (Blattodea: Termitidae) using 16S rRNA metagenomic. *Journal of Asia-Pacific Entomology*, *21*(4), 1268-1274.

Jones, D. T., Susilo, F. X., Bignell, D. E., Hardiwinoto, S., Gillison, A. N., & Eggleton, P. (2003). Termite assemblage collapse along a land-use intensification gradient in lowland central Sumatra, Indonesia. *Journal of Applied Ecology*, *40*(2), 380-391.

Nandika, D. Rismayadi, Y. & Diba, F. (2003). *Termites: Biology and control*. Surakarta: Muhamadiyah university Press.

Prastyaningsih, S.R. (2005). *Soil macrofauna diversity in various land use types in Jambi*. Tesis Pasca Sarjana UGM. Yogyakarta.

Samb, T., Ndiaye, A. B., & Diarra, K. (2011). Biodiversity of termites in relation to human activity: impact on the environment in Matam (Senegal). *Research Journal of Pharmaceutical, Biological and Chemical Sciences*, *2*(1), 313-323.

Subekti, N., Duryadi, D., Nandika, D., Surjokusumo, S., & Anwar, S. (2008). Distribution and Morphology Characteristic of Macrotermes gilvus Hagen in The Natural Habitat. *Jurnal Ilmu dan Teknologi Hasil Hutan*, *1*(1), 27-33.

Swift, M., & Bignell, D. (2001). *Standard methods for assessment of soil biodiversity and land use practice* (pp. 3-34). Bogor: International Centre for Research in Agroforestry.

Yunilasari, M. (2008). *The distribution of subterranean termites in the Taman Rasuna Kuningan Jakarta apartment and their potential aspests*. Skripsi. Departemen Fakultas Kehutaanan, Institute Pertanian Bogor.