



## Characterization of oil palm empty fruit bunch as an ameliorant for the development of hiyung chilli pepper in swamp land

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**Key words:** Oil Palm Empty Fruit Bunch, Ameliorant, Pesticide, Hiyung Chilli Pepper, Swamp.

<http://dx.doi.org/10.12692/ijb/21.2.21-26>

Article published on August 10, 2022

### Abstract

Ameliorant is a material that can increase soil fertility by improving the physical and chemical conditions of the soil by adding ameliorant materials such as compost, manure, lime, and natural phosphate. The nutrient content of Oil Palm Empty Fruit Bunch (OPEFB) is 0,33 N-total; 2.53 C-Organic; 7.67 C/N ratios. The utilization of OPEFB can be a potential product when used for plant cultivation. OPEFB contains substantial amounts of N, P, K, Ca and Mg. Fourier transform infrared spectra showed the heterogenic functional groups on the EFB ameliorant surface and domination of silica content in RH Ameliorant. The results of the chemical analysis laboratory of OPEFB as an ameliorant showed that the older the OPEFB is, the lower the value of its chemical parameters pH, C-org, N, P, K, Ca, Mg, water content and C/N ratio values. Whereas the results of laboratory chemical analysis taken from OPEFB in different years showed the average value for the chemical parameters of cellulose by the gravimetric method was 48.28%, lignin was 20.40% and hemicellulose was 23.04%. The results show that OPEFB have potentials as good ameliorant. Therefore, it can be suggested that the application of these ameliorant may possibly increase soil fertility especially soil in swamps.

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## Introduction

During the last five years (2014-2018), the area of oil palm plantations in Indonesia has continued to increase with an average growth rate of 7.89%, except in 2016, the area of oil palm land decreased slightly by 0.5% or decreased by 58,811 Ha. From 2014 to 2018, the total area of oil palm area increased by 3,571,549 Ha. With the growth in the oil palm area, there will be an increase in the production of Fresh Fruit Bunches (FFB) and *Crude Palm Oil* (CPO) which causes a high potential for the development of the palm oil industry. The problem that arises from the palm oil industry is the abundance of factory waste.

Oil Palm Empty Fruit Bunch (OPEFB) is solid waste that is wasted from the process of separating boiled bunches from the fruit (Mangoensoekarjo, 2008; Kamal, 2014) whose number continues to increase, and is still not utilized properly (Sari *et al.*, 2018). The potential of OPEFB waste has a lot of economic value, one of which is that it can be used as an ameliorant to overcome soil fertility problems, especially soil in swamps (Aryanti *et al.*, 2017).

Giving ameliorant will have an impact on increasing fertilization efficiency and increasing soil pH (Armaini *et al.*, 2018), because it will synergistically have an effect on improving plant growth (Istina *et al.*, 2014) such as improving the root environment. Several studies have utilized OPEFB in the form of OPEFB compost enriched with marine mud and rice husk biochar as an ameliorant in rice plants (Andayani & Hayat, 2019). Apart from being an ameliorant, OPEFB is able to replace the use of chemical insecticides into pesticides for pest control so that it is environmentally friendly through liquid smoke (Sari *et al.*, 2018).

So far, the use of OPEFB into liquid smoke, especially in South Kalimantan, is still very rarely done. Liquid smoke is used for the cultivation of fruit, flower, and vegetable crops, liquid smoke sprayed on plant leaves makes the leaves healthier, liquid smoke can also shift the use of chemical fertilizers which are 100% natural

fertilizers, can reduce odors when added to manure with quality fertilizer better (Basri, 2010). Thus, the use of OPEFB can be applied to the process of cultivating plants such as cayenne pepper.

One type of cayenne pepper that is quite famous is cayenne pepper hiyung. The name cayenne pepper hiyung is taken from the name of a village in Tapin Regency which has the potential as a producer of cayenne pepper as a result of natural local wisdom that has economic value.

This cayenne pepper is cultivated in Hiyung Village, which is located in Tapin Tengah District (Central Bureau of Statistics of Tapin Regency, 2019). Besides being known for its spicy taste, another advantage of this cayenne pepper lies in its durability which can last up to 8-10 days (Hayati & Hardarani, 2019b).

In this study, the cultivation of cayenne pepper will be carried out in swamp land in the land of PT. Sungai Puting HCT with the aim of optimizing the use of swamp land in South Kalimantan. The problems that occur in cultivation in swamp land are expected to be overcome by giving ameliorant by utilizing EFB waste. Therefore, the use of OPEFB waste as an ameliorant can influence the development of cayenne pepper in swamp areas. The purpose of this study was to characterize OPEFB as an ameliorant in cayenne pepper cultivation in swamp land.

## Material and methods

The materials used in the first phase of research are 1) OPEFB aged 7 years, 5 years, 3 years as an ameliorant and analyzed for chemical content. 2). EFB that has just come out of the palm oil mill is used as an ingredient for making liquid smoke into pesticides. 3). Liquid smoke resulting from pyrolysis is to be analyzed for its chemical content. 4). Materials in the laboratory to analyze the chemical content of OPEFB and liquid smoke such as  $K_2Cr_2O_7$ , concentrated  $H_2SO_4$ ,  $HNO_3$ ,  $HClO_4$ , pH 4 and pH 6 buffer solutions, He gas,  $N_2$  gas,  $O_2$  gas, aquades, aquabides, tissue, labels, aluminum foil, and other analytical materials.

### Characteristics of OPEFB chemical content and liquid OPEFB

The research method was experimental OPEFB waste which was used as an ameliorant which was applied to cayenne pepper plants in swamp land. The first stage of research is to determine the characteristics of the research material, namely OPEFB which will be used as an ameliorant. As an ameliorant material, we will take EFB that has decomposed naturally in the field by differentiating the length of time the OPEFB has been stacked, namely OPEFB which is 7 years old, 5 years old, and 3 years old. This first phase of research obtained the best chemical content of EFB used as an ameliorant to be applied to the cultivation of cayenne pepper in the tidal land of PT. HCT. This research was conducted through a field survey and

took TKKS as an ameliorant. The data obtained were processed descriptively, and the data on the chemical content of OPEFB ameliorants were analyzed at the BALITTRA Banjarbaru Laboratory and PT. Indonesia's Biotechnology Biodiversity.

## Results and discussion

### Chemical characteristics of ameliorant OPEFB

The parameters observed for the object of this research are Soil chemical properties.

The experimental fields before the application of the ameliorant were pH, EC, C-Organic, N-total, C/N ratio, P-Bray, K-total, Ca-dd, Mg-dd, Na-dd, K-dd, CEC, Al -dd, Gen. Base, Gen. Al, Fe, S, Moisture Content, FeS<sub>2</sub> (Table 1).

**Table 1.** Initial soil analysis.

Sample	pH H <sub>2</sub> O _ _	pH KCl	C-Org (%)	N	P Tsd (ppm P)	K <sub>2</sub> O Potential (mg/100g)	Kdd	Nadd	Ca-dd	Mgdd	Kindergarten (cmol+)/kg	Al-dd	Hdd	Gen. Base (%)	Gen.Al (%)
318	4.39	3.78	2.53	0.33	78.51	45.16	0.24	0.59	7.62	15.41	46.66	4.04	2.01	51.14	13.51
Sample	Fe <sup>+</sup> Ppm		SO <sub>4</sub> <sup>-</sup>		Water content (%)		C/N Ratio								
318	74.63		482.91		7.78		7.67								

Data source: laboratory results from Ballitra Banjarbaru.

Oil palm empty fruit bunches are an ameliorant in plant cultivation. Giving ameliorant will have an impact on increasing fertilization efficiency. Increasing the efficiency of fertilization in a synergistic manner will have an effect on improving plant growth and increasing yield components (Zulkifli *et al.*, 2016). OPEFB has the potential as an affordable ameliorant (Istina *et al.*, 2014). From the results of chemical analysis laboratory of OPEFB as

an ameliorant in Table 2 showed that the older the OPEFB is, the lower the value of its chemical parameters, be it pH, C-org, N, P, K, Ca, Mg, water content and C/N ratio values. The results of laboratory chemical analysis taken from OPEFB in different years (Table 3) showed the average value for the chemical parameters of cellulose by the gravimetric method was 48.28%, lignin was 20.40% and hemicellulose was 23.04%.

**Table 2.** Chemical analysis of oil palm empty fruit bunches (OPEFB).

Sample	Code	pH	C - Org	N	P	K	Ca	Mg	Water content (%)	C/N Ratio
%										
347	3 years	5.86	40.28	2.54	0.07	0.14	0.67	0.99	22.22	15.86
348	5 years	4.84	33.02	2.23	0.07	0.10	0.80	0.96	12.31	14.81
349	7 years	4.76	34.64	2.78	0.15	0.07	0.73	0.86	15.28	12.46

Data source: laboratory results from Ballitra Banjarbaru.

One of the efforts to improve soil fertility status is to provide ameliorant material which has a role in addition to reducing soil acidity which is a limiting

factor for plant adaptation, increasing soil nutrient status through nutrient substitution mechanisms, especially N, P and K which are difficult for farmers to

access, and has a positive effect. against colonization and microbial interactions so that it can increase its role in providing nutrients for plants (Basu *et al.*, 2011; Istina *et al.*, 2014) . In addition to amelioration, fertilization is an effective effort to increase crop productivity, but fertilization according to the recommended dosage is difficult for farmers to achieve due to the lack of financial capacity of farmers and the availability of scarce fertilizers.

Ameliorant or soil improvement agent is able to improve the physical, chemical, and biological properties of the soil. Ameliorant consists of organic ameliorant and inorganic ameliorant. Organic

ameliorant is material from living things that undergo composting, and has complex nutrients, but in small amounts. Meanwhile, inorganic ameliorant is an ameliorant from mineral materials and organic materials that are chemically processed, having nutrients quickly available to plants because the reaction is ionic. Gypsum application @ 100% GR of RSC of water and poultry manure @10 t.ha<sup>-1</sup> found more efficient over others treatments in the term of plant height and grain/ achene yield of raya and sun flower, soil chemical properties and can be successfully used to control the development of salinity/ sodicity in soil due to continuous use of brackish water (Avais *et al.* 2018).

**Table 3.** Chemical analysis of oil palm empty fruit bunches (OPEFB).

No.	Sample Test		Parameter		
			Cellulose	Lignin	Hemicellulose
			Gravimetry	Gravimetry	Gravimetry
	PT BBI	Customer	%	%	%
	2108.03115	Age/Year			
1		2013 - 2014	49.72	21.91	23.87
2	2108.03116	Age/Year	46.95	18.96	22.15
		2015 - 2016			
3	2108.03117	Age/Year	48.17	20.34	23.12
		2017 - 2018			

Source of data: laboratory results of PT. Indonesia's Biotechnology Biodiversity.

The application of ameliorant materials such as organic fertilizer, mineral soil, zeolite, dolomite, natural phosphate, organic fertilizer, agricultural lime, husk ash, purun rat (*Eleocharis dulcis*) can increase soil pH and soil bases. TKKS is one of the organic ameliorants derived from industrial waste from the Palm Oil Mill (PKS). OPEFB ameliorant can improve soil structure, increase the ability of the soil to hold water, increase pH, prevent alkaline leaching and contribute element K (potassium) up to 7.3% (Alfian *et al.*, 2017).

Research by Alfian *et al.* (2017) stated that the application of organic ameliorant in the form of OPEFB combined with *cocopeat* significantly increased the height of oil palm seedlings on ultisol soils. OPEFB contains macro and micro nutrients and

contributes a lot of humus so it is good for improving the chemical and biological properties of the soil. Elements of N and Mg in OPEFB are elements that make up chlorophyll in leaves. In addition, EPEFB increases elemental K and decreases levels of exchanged Al (Yunindanova *et al.*, 2014).

Provision of OPEFB can increase the height of oil palm seedlings because it contains essential nutrients such as N, P and K (Azlansyah *et al.*, 2014), 50 g EFB and 50 g *cocopeat* can increase the height of oil palm seedlings by 28.20 cm (Andri *et al.*, 2017) . Giving 100 g of OPEFB to oil palm nurseries for 3 months resulted in 8.25 mm bulbs (Nurmayulis *et al.*, 2014). Andri (2016) reported that the administration of 50 g of OPEFB combined with 50 g of *cocopeat* increased the diameter of the oil palm by 12.5 mm.

## Conclusion

The parameters observed for the object of this research are Soil chemical properties. The experimental fields before the application of ameliorant were pH (4.39), EC(3.78), C-Organic (2.53), N-total (0.33), C/N ratio (7,67), K-total (45,16), Ca-dd (7,62), Mg-dd (15,41), Na-dd (0,59), K-dd (0,24), Al –dd (4,04), Gen Base (51,14), Gen Al (13,51), Fe (74,63), SO<sub>4</sub>(482,91), moisture content (7,78). The results of the chemical analysis laboratory of OPEFB as an ameliorant showed that the older the OPEFB is, the lower the value of its chemical parameters, be it pH, C-org, N, P, K, Ca, Mg, water content and C/N ratio values. Whereas the results of laboratory chemical analysis taken from OPEFB in different years showed the average value for the chemical parameters of cellulose by the gravimetric method was 48.28%, lignin was 20.40% and hemicellulose was 23.04%. The results show that OPEFB have potentials as good ameliorant. Therefore, it can be suggested that the application of these ameliorant may possibly increase soil fertility especially soil in swamps.

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