IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 11, Issue 4 Ver. I (April 2018), PP 23-27
www.iosrjournals.org

Analysis of C-Organic, Nitrogen, Phosphorus and Potassium in Application Areas and Without Application of Palm Oil Mill Effluent

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Abstract: *nutrients such as; nitrogen, phosphorus and potassium are essential nutrients needed by plants. organic matter becomes one of those nutrient sources. in the process of processing oil palm into crude palm oil (CPO) will be produced liquid waste and solid waste. the resulting liquid waste is 2.5 To 5 times larger than the processed cpo. the amount of waste generated becomes a problem for oil palm planters, so it is necessary to think of a solution to handle the waste management. utilization of palm oil mill effluent (POME) as a soil repairing materials becomes one of the alternative of waste utilization. This research aims to determine the levels of C-organic, nitrogen, phosphorus and potassium in the soil. Soil samples were taken at application area and without application of pome at 0- 400 cm from the edge of the application disc / trench. total sample is 30 units. Soil samples were analyzed in laboratory with parameters of C-organic, nitrogen, phosphorus and potassium. The data were processed by using least significant difference (LSD) test at 5% level. The results showed that there were differences of C-organic, nitrogen, phosphorus and potassium levels in the application area and without pome application at different sampling.*

Keywords – *application, distance, waste, palm oil*

Date of Submission: 26-03-2018 Date of acceptance: 09-04-2018

I. Introduction

Palm Oil Mill Effluent (POME) is produced from the processing of palm oil into crude palm oil (CPO), each processing of 1 ton CPO will produce 2.5 to 5 ton POME[(1,2)]. In 2016 the number of CPO production in indonesia reached 33,500,691 tons[(3)]. The amount of waste generated is very large from the processing of oil palm. If pome is not properly managed, it will have an impact on environmental sustainability. Waste with 2,000 - 3,500 mg/l biological oxygen demand (BOD) can be channeled to oil palm plantation area as source of organic material and nutrient. For every 100 ton of POME contains the average amount of; 55 kg of nitrogen, 9 kg phosphate, 85 kg of potassium and 18 kg of magnesium[(4)]. POME application in the soil is able to increase the nutrients of P, K, Ca And Mg[(5)]. The application of POME with land application method can decrease soil pH, C-organic and N-total soil[(6)]. This research aims to determine the effect of POME applications on C-organic, Nitrogen (N), Phosphorus (P) and Potassium (K) in soil and nutrient distribution at a distance of 0 cm to 400 cm from the edge of the dish and POME application trench. Through the results of this research, it is expected that palm oil planters obtain information about the effect of POME applications on soil nutrients.

II. Material And Methods

This research was conducted at Bukit Maradja Estate, PT SIPEF Sumatera Utara Province, Indonesia from april to August 2017.

Research Design: factorial randomized block design, consisting of two factors. The 1st factor is the sampling area (A). A0 = area without POME application and A1 = Area with POME application. The 2nd factor is the distance of sampling from the edge of the disk or the application trench (J). J0 = 0 cm from the edge of the application disk / trench, J1 = 100 cm from the edge of the application disk / trench, J2 = 200 cm from the edge of the application disc, J3 = 300 cm from the edge of the application disk / trench and J4 = 400 cm from the edge of disk / trench application. Each treatment was repeated 3 times to obtain 30 units of sample.

Research Location: Division I Bukit Maradja Estate, PT SIPEF, Sumatera Utara Province, Indonesia. POME application area is in block 97E18 year of planting 1997 with wide 24,46 ha and area without POME application at block 97E27 year of planting 1997 with wide of 20,25 Ha.

Research Duration: April to August 2017.

Total Sample: 30

Data Processing: Parameter test is arranged on the variance list and least significant difference (LSD) test is conducted with 5% level.

Research Stages: Research begins by conducting a survey location, then determine the sampling point in accordance with the treatment. soil samples were taken using a 20 cm deep soil drill, the soil was dried for analysis in the laboratory. Soil analysis was conducted in the Laboratory of Research And Development Center, PT. Nusa Pusaka Kencana Analytical & QC Laboratory.

Observation Parameters: C-Organic (walkley and black titration), N (kjeldahl distillation), P (Spectrophotometry) and K (flame photometry).

III. Result

3.1 POME

POME application method is done by a ditch or long-bed system that is done by pipeline which is connected to the ditch around the block. Inside the block there are 2 types of ditches, namely primary ditch and secondary ditch as seen in figure 1.

A B

Figure 1. (A) primary ditch/trench and (B). secondary ditch/trench

The primary trenches are 480 m x 1.5 m x 0.5 m and the secondary trench is 180 m x 1 m x 0.5 m. The primary trench aims to accommodate the waste water pumped from the control pool through the pipeline. Then the waste in the primary trench will continue to flow into the secondary trench with a dose of 750 m3 / ha / year. The characteristics of POME streamed in the application trench are as follows.

Table 1 POME Characteristics

No	Indicator	Concentration
1	BOD	803 mg/l
2	C-Organik	22,26 mg/l
3	N	457 mg/l
4	P	12 mg/l
5	K	375 mg/l
6	Mg	56 mg/l
7	pH	7,53

BOD of POME value which recommended to be channeled to palm oil plant area is 2.000-3.500 mg / l. From the result of analysis, BOD pome which channeled is 803 mg / l, it is much lower than the recommended value. BOD <2,000 mg / l has no negative impact on soil organisms but the organic and nutrient material contained in the POME is quite low so waste only serves as irrigation water [(5)]. The C-organic POME value is 22.26 mg / l.

3.2 Nutrient Content

soil nutrient content in the application area and without pome application at several different sampling distances is presented in Table 2.

Table 2. C-Organic, Nitrogen, Phosphorus and Potassium

	C-Org (%)	N (%)	P (ppm)	K (C mol kg^{-1})
A_0J_0	2.45	0.25	55.18	0.52
A_0J_1	2.84	0.28	15.77	0.58

A_0J_2	3.44	0.34	12.74	0.52
A_0J_3	3.15	0.31	16.31	0.56
A_0J_4	2.78	0.28	12.26	0.69
A_1J_0	1.22	0.15	9.73	0.55
A_1J_1	1.42	0.17	14.78	0.84
A_1J_2	2.19	0.24	41.33	0.61
A_1J_3	2.07	0.23	46.09	1.02
A_1J_4	2.01	0.22	58.35	0.78
A	*	*	Ns	*
J	*	*	Ns	Ns
A*J	Ns	Ns	*	Ns

Notes :

A_o = areal without POME application
A_1 = areal with pome application
J_o= 0 cm from the edge of the application disc / trench
J_1 = 100 cm from the edge of the application disc / trench
J_2 = 200 cm from the edge of the application disc / trench
J_3 = 300 cm from the edge of the application disc / trench
J_4 = 400 cm from the edge of the application disc / trench
* = significant ns = not significant

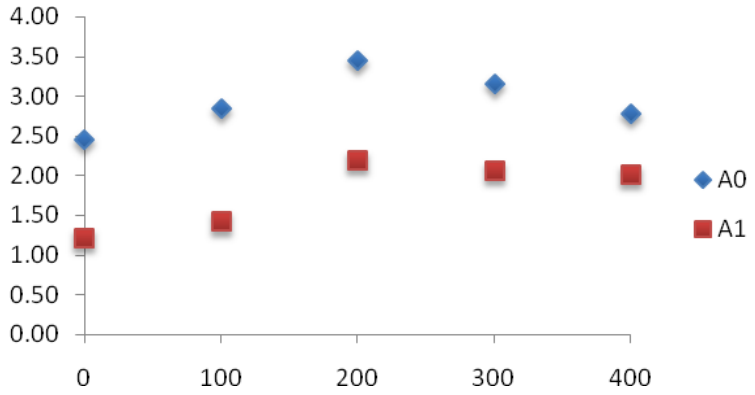

Figure 2. The average of C -organic in the application area and without POME application based on the distance from the edge of the POME application trench

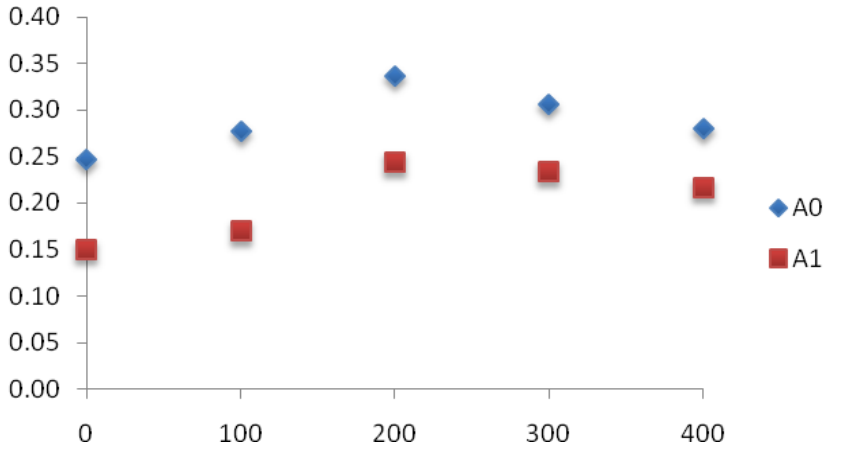

Figure 3. The Average of N contain in the application area and without POME applications based on the distance from the edge of the POME application trench.

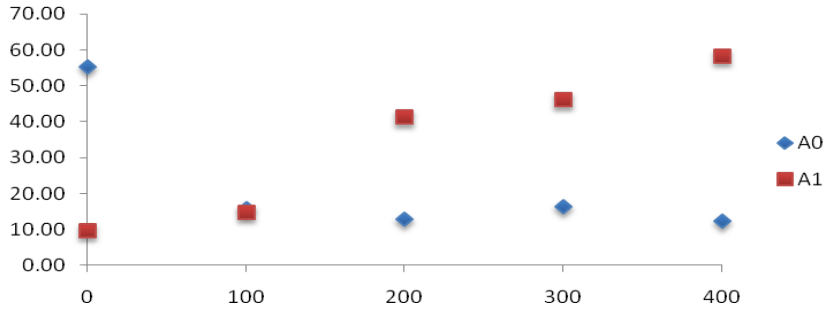

Figure 4. The average of P contain in the application area and without POME applications based on the distance from the edge of the POME application trench

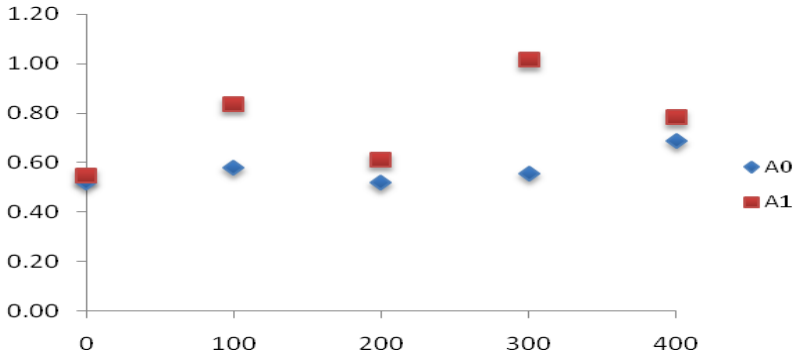

Figure 5. The average of K contain in the application area and without POME applications based on the distance from the edge of the POME application trench

IV. Discussion

The average of C-organic soil differs significantly in the treatment of POME applications and without applications. The average of C-Organic on the POME (A_1) application field is lower than on the land without the POME (Ao) application, this is due to the low BOD of POME that flows in the area (803 Mg / L), much lower than the recommended BOD for land application (2,000-3.500 Gr / L). C-organic POME value is 22.26 mg / l. Furthermore, it can also be caused by differences in vegetation density in the area, when researching vegetation seen in areas without pome application overgrown by various types of grass, grass-covered land will continuously produce high organic material resulting from decomposition of roots and dried leaves. The vegetation of grasses forms a black soil because of the large quantities of organic material left behind from the roots and the remaining grass[7].

C-Organic content in the soil is significantly different in the treatment of sampling distance. The highest C-organic is at a distance of 200 cm from the edge of the application disk and gradually decreases at a distance of 300 cm, 400 cm, 100 cm and 0 cm from the edge of the application disc / trench. this situation is illustrated in Figure 1.

N levels differ significantly in POME application areas and without POME applications. On average, the rate of N in the non-application area (Ao) was higher than in the POME application area (A_1), with values of each Ao = 0.29% and A_1 = 0.20%. this is in line with the soil C-organic condition. Organic matter is the main source of N in the soil. Besides N, organic materials contain other elements especially C, P, S and micro elements[7].

From the research, changes in soil chemical properties due to the application of liquid waste of the palm oil industry by land application method showed a decrease in pH and N total content in the soil[6]. The loss of N from the soil is caused because N is used by plants or microorganisms, N in the form of NH_4^+ can be bonded by the illite-type clay mineral so it cannot be used by plants, N in NO_3 form is easily washed by rain water (leaching), denitrification process is the process of reduction of nitrate to N_2[7].

The Average Of N Content Is Significantly Different In The Treatment Of Sampling Distance From The Edge Of The Application Disc, The Highest N Rate Is Found At A 200 Cm Sampling Distance From The Application Trench (0.29%) And The Lowest At 0 Cm From The Edge Of The Application Disk (0.20%).

The N Nutrient Element Has Hygroscopic Volatile Properties. Its Availability In The Soil Depends On The Hydrolysis Which Is Strongly Influenced By The Activity Of Microorganisms, From The N Property, The N Element Distribution Can More Easily Be Spread Evenly On The Disk And The Area Around The Disk. The Result Of Chemical Element Analysis On Research Of Nutrient Distribution In Soil And Palm Oil Plant Root

Production Showed That The Distribution Of N Element With Distance From 50-400 Cm Trees Spread Almost Evenly[8]

The Average of P content is not significantly different in pome application treatment and sampling distance, but is significantly different in the interaction between the two. Although not significantly different but the highest P is in the POME application area (A1) is 34.06 ppm and on the area without application (Ao) is 22.45 ppm. This means P Is higher as much as 65% in the application area than in the area without the POME App. POME application in soil can increase P, Ca, Mg and K[4]. Based on the sampling distance, the highest average p is at a distance of 400 cm and the lowest at a distance of 100 cm from the edge of the application disc / trench.

The availability of P in the soil depends on: (1) number and type of soil minerals, (2) soil pH, (3) cation effect, (4) anion effect, (5) saturation of P level, (6) organic material, (7) time and temperature, and (8) inundation. P is immobilized in soil because most of the p in soil is absorbed into a form not available to plants[9]

The average of K in the soil differs significantly in the application area and without the POME application. K in POME is 375 mg / l. K level in the application area of POME is 0.76 C mol kg^{-1} and in the area without application is 0.57 C mol kg^{-1}. At a distance of 300 cm from the application trench containing the highest K, it is 0.79 C mol kg^{-1}. Basically, K in the soil comes from minerals consisting of soil primers such as: feldspar, mica and others. potassium can also be derived from artificial fertilizer (ZK) and potassium fertilizers such as calcium nitrate, gypsum, phosphate rock and super phosphate. furthermore, plant residues and manure can also be a potential source of potassium [10].

V. Conclusion

The POME application increases the levels of P and K in the soil, but does not increase the levels of C-organic and n in the soil. on average, the highest levels of C-organic and N are at a distance of 200 cm from the edge of the application disc, P at a distance of 400 cm from the edge of the application disc and K at a distance of 300 cm from the edge of the application disc / trench. POME can be used as a source of P and K for plants.

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