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THE POTENTIAL USE OF CRUDE PALM OIL WASTES TO IMPROVE NUTRIENT LEVELS IN VEGETABLE PLANTS

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ABSTRACT

Application of crude palm oil waste combined to suitable concentration of benzyl-adenine give the significant effect to mean relative growth rate of vegetable plants and the same pattern in net assimilation rate crude palm oil waste has also significantly increased during 28 days old plants. Combination of treatment of suitable concentration of crude palm oil and benzyl adenine increased the growth and production of vegetable plants. The relative growth rate of vegetable plants was rapid 3 weeks after planting and gradually decreased at the end of the harvest time period. Combination of 400 mg.L^{-1} CPO with 1.0 mgL^{-1} till 10 mgL^{-1} BA increased the Mean Relative Growth Rate (MRGR), Net assimilation rate (NAR), Leaf area and dry weight of *Brassica juncea*, *Brassica oleraceae* and *Lactuca sativa*.

KEY WORD : Benzyladenine, Crude-palm-oil, Vegetable, Nutrient, waste

INTRODUCTION

Production of cooking oil in Riau province Indonesia has been used increasingly since 2000 until present. The statistical data indicate that in 2000 the production of cooking oil area bout 7.00 million ton and 12.38 million ton in 2004, 19,540,000 ton in 2008 and 25,000,000 ton in 2016 (BPS, 2015). Cooking oil are produced originated from fresh fruit of oil palm, and 30 % of row material will appeared became liquid waste. Crude palm oil (CPO) waste appearing as pollutant material and became toxic to environment. Waste of crude palm oil is looked as a needed requiring for treatment and accomplishment, therefore need to be managed carefully. In Indonesia CPO waste were used as substitution of organic fertilizer mainly by traditional farmers.

Some of the industrial of cooking oil palm conducted integrated waste management using life cycle analysis attempts to offer the most benign options for waste management (Jumin *et al.*, 2014). The fresh fruits of oil palm are processing into cooking oil, and about 30% of materials appear into waste as liquid or solid sludge. This accumulation of this waste in the field contributed to environment pollutants (Jumin, 2016; Jumin *et al*., 2014).

The objective of the experiment is to evaluate potential use of CPO liquid sludge sewage to improve the nutrient level in vegetable plants. This research will give an alternative way to utilize recycled CPO liquid waste as a fertilizer to improve nutrient level in vegetable plants.

MATERIALS AND METHOD

This research has been conducted in Faculty of Agriculture, Islamic University of Riau Indonesia. The experiment CPO liquid sludge were obtained from PTPN Sungai Galuh in the center of Sumatra Island along the strait of Malacca. Number treatment is 16 with 3 replication, therefore total number of unit experiment is 48. First factor of experiment is dose of CPO liquid sludge, as follow, 0.0 mL/L, 200 mL/L, 300 mL/L, and 400 mL/L. Second factor is benzyl-amino-purin (BA) with four

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levels as follow, 0.0 mg/L BA, 0.1 mg/L BA, 1.0 mg/L BA and 10 mg/L BA. The experiment were applied with three vegetable plant as of *Brassica juncea*, *Brassica oleraceae* and *Lactuca sativa.* The plants were maintained under natural light intensity with average 12 hours photoperiod, and organic fertilizer will be applied to plant with 20 g/polybag and every polybag were contained 5 kg soil.

Parameters

Relative mean growth rates

$$\mathbf{MRGR} = \frac{\ln W2 - \ln W1}{t2 - t1} \quad .. (1)$$

Where MRGR is mean relative growth rate; *W1* and *W2* are the dry weight of biomass of vegetable plants; beginning 10 days after planting (*t10*), (*t17*), (*t24*), and end *(t28)* 28 days after planting and *ln* is the natural logarithm. Equation (1) is the most common formula used when comparing relative differences between fly ash waste treatments (Jumin *et al*., 2014)

Net assimilation rates (NAR)

Refer to Jumin *et al.* 2014) this represents an excess of the mean rate of photosynthesis of the leaves of *Brassica juncea*, *Brassica oleraceae* and *Lactuca sativa* (horticulture plants) over the mean rate of respiration of the whole vegetable plants, both expressed as per unit leaf area. The NAR is based on an increase in plant biomass weight and leaf area at a fixed time of plant in all treatments and it is positively correlated with mean MRGR (Vernon and Allison, 1963)

Net assimilation rate of the photosynthetic efficiency of plants was measured by (Chow Wei, Z, 2010) methods. Net assimilation rate of *Brassica juncea*, *Brassica oleraceae* and *Lactuca sativa*.(E) is defined as the rate of increase of dry weight of vegetable plants (W) per unit leaf area (L) (Jumin *et al*., 2014; South, 1995; Vernon and Allison, 1963) as presented in equation 2 thus;

$$E = \frac{1}{L}\frac{dW}{dT} \quad .. (2)$$

Paramenter of ***W2*** *etc.* and ***L2*** *etc* and ***L1*** etc sample will be used to calculate for *EM* for each time-interval (***t2*** etc–***t1*** *etc*), usually as proposed by (Jumin *et al*., 2014; South, 1995) equation 3 thus;

$$EM = \frac{(W2 - W1)(Loge\ L2 - Loge\ L1)}{(T2 - T1)(L2 - L1)} \quad .. (3)$$

Plant height

The plant height of *Brassica juncea*, *Brassica oleraceae* and *Lactuca sativa.* were counted on a sub-sample four times namely on 10, 17, 24 and 31 days after planting. This data is one of indicator of the plants growth.

Leaf are

The Leaf area of *Brassica juncea*, *Brassica oleraceae* and *Lactuca sativa* collected leaves measured on a sub-sample using a leaf area meter (Jumin *et al.,* 2014) and image analysis software. Leaf area are measured a four times namely on 10, 24 and 31 days after planting. The all data collected will analyze by statistical and presented with tables or graphic or histogram (Jumin *et al*. 2014).

Biomass

Biomass is biological material derived from horticulture plants and its counted at the end of experiment (Biomass Energy Center, 2012). Data will be analyzed with statistical analyses and presented with histogram or table. Chemical contents of CPO waste will analyzed with appropriate procedures at Laboratory of Agro-technology, Faculty of Agriculture, Islamic University of Riau Indonesia.

Generative parameters

Generative parameter counted is the first flowering, harvest time and dry weight of seeds. The parameters were counted beginning from first flowering blossom until harvest time. Harvest time is counted if more than approximately 95 % of seed matured and already to harvest. Dry weight of seed was counted if water content approximately 12%.

All data were analyses with statically analyses by Duncan Multiple Range Test and significantly different between all treatments will be checked it at $P \leq 0.05$ and presented with table and histogram.

Chemical content

The Chemical content of CPO and plant tissue as nitrogen, phosphorus, calcium, and heavy metals and others (pH, Biological Oxygen Demands, Chemical Oxygen Demands, fat, Ammoniums, Lead (Pb), silver (Cu), Cadmium (Cd) and Zn) contents will analyzed at the Laboratory for testing and certification of industrial quality product and trade Province Pekanbaru, PT. Central Alam Resources Lestari (Central Plantation Services) laboratory.

RESULTS AND DISCUSSION

Various estimates growth process over a period of time can be derived from primary growth data (Whitehead, 1962). The estimates of mean relative growth rate are usually considered separately and are only rarely used together indirectly in considering growth processes (Whitehead, 1962). In the course of experiment involving the comparative growth of *Brassica juncea*, *Brassica oleraceae* and *Lactuca sativa* over arrange of environmental factors, it has been found that the ratio of MRGR to and biomass (Figure 3 and 4) of leaf area of *Brassica juncea*, *Brassica oleraceae* and *Lactuca sativa* increase appears to have considerable biological importance and can also be used in the accurate termination of the mean unit leaf rate, i.e. NAR (Whitehead, 1962).

MRGR of maize after treatment with CPO waste is presented in Figure 2. The chemical analyses of CPO waste are presented in Table 1 and CPO waste physically shown in Figure 1. Treatment of g/ polybag of CPO waste to vegetable plants combined to treated with BA significantly increased average mean relative growth rates by 0.607 mg.day^{-1} with 0.1 mg.l^{-1} BA for *Brassica juncea*, 0.129g.day^{-1} with 10 g/L BA for *Lactuca sativa*, and 0.238 g.day^{-1} with 1.0 g/L BA for *Brassica oleacea* (Table 2), NAR from 0.421 to 0.38 mg.m^{-2}.day^{-1} for *Brassica juncea*, 0.308 to 0.329 mg.m^{-2}.day^{-1} for *Lactuca sativa* and 0.409 to 438 mg.m^{-2}.day^{-1} for *Brassica oleraceae* (Table 3), and dry weight of vegetable plants from 2.6 to 3.1 g per plant for *Brassica juncea*, 0.8 to 1.1 g per plant for *Lactuca sativa* and 0.7 to 1.6 g for *Brassica oleraceae* (Figure 5). Based on the mean relative growth rate parameter showed that during 3 weeks after planting the plants growth are increasing rapidly and decreased after wards in all plants

Table 1. Nutrient contents of crude palm oil sewage

Parameter	Unit	Threshold	Results
BODs	mg.l^{-1}	5000	169.1
CODs	mg.l^{-1}	10000	1.4
pH	-	6.0-9.0	7.73
Fat	mg.l^{-1}	2500	23
Ammoniums	mg.l^{-1}	500	170.8
Phosphorous	mg.l^{-1}	12.	7.0
Calcium	mg.l^{-1}		320
Lead (Pb)	mg.l^{-1}	0.01	0.1
Cuprum (Cu)	mg.l^{-1}	2.0	0.06
Cadmium (Cd)	mg.l^{-1}	0.05	<0.001
Zink (Zn)	mg.l^{-1}		0.31

*) Threshold especially for eating directly

Fig. 1. Crude palm oil wastetaken from reservoirs and its waste it will analysis to find chemical and organic compounds

Table 2. Mean relative growth rates (MRGR) horticulture plants growth on land after treated crude palm oil waste

Treatments (ml/L)	MRGR 2nd weeks g.day^{-1}	MRGR 3rd Weeks. g.day^{-1}	MRGR 4st weeks g.day^{-1}
Brassica juncea			
0	0.361a	0.465a	0.564a
200	0.414b	0.519b	0.607b
300	0.389c	0.488c	0.571a
400	0.375c	0.479c	0.561a
Lactuca sativa			
0	0.1062a	0.1072b	0.1092a
200	0.1171a	0.1181ab	0.1193b
300	0.1174a	0.1425b	0.1277b
400	0.1215b	0.1184ab	0.1296b
Brassica oleraceae			
0	0.085a	0.109a	0.209a
200	0.096b	0.119a	0.228b
300	0.084ab	0.146b	0.238b
400	0.087a	0.119a	0.219b

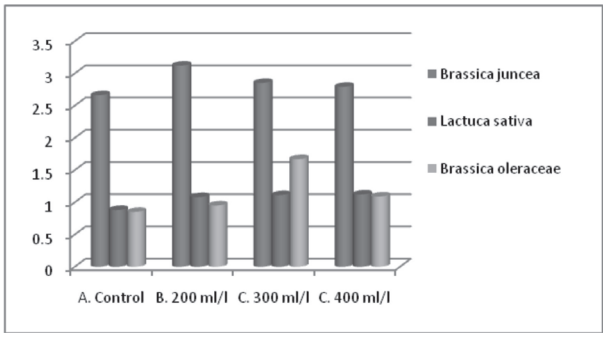

Fig. 2. Dry weight (g) of plants after pouring with crude palm oil waste and treated with 0. 1 mg/l benzyladenine (BA)

Table 3. Net Assimilation Rates (NAR) vegetable plants after treated with crude palm oil waste

Treatments (ml/L)	NAR 2nd weeks mg.m^{-2}. day^{-1}	NAR 3rd weeks mg.m^{-2}. day^{-1}	NAR 4st weeks mg.m^{-2}. day^{-1}
Brassica juncea			
0	0.381a	0.391c	0.421c
200	0.407b	0.442a	0.451a
300	0.398ab	0.439a	0.445a
400	0.381a	0.419b	0.438b
Lactuca sativa			
0	0.206c	0.243a	0.308c
200	0.217b	0.225a	0319b
300	0.218b	0.236a	0.319b
400	0.226a	0.224a	0.329a
Brassica oleraceae			
0	0.299a	0.309c	0.409b
200	0.308a	0.319b	0.419b
300	0.307a	0.330a	0.438a
400	0.307a	0.319b	0.419b

Rapidly growing corn, either during the early days after planting or during four weeks the planting (Jumin *et al*., 2014) often grow according to the variable interest law (South, 1995). The *Brassica juncea*, *Brassica oleraceae* and *Lactuca sativa* plants show a higher MRGR on all treatments with crude palm oil waste and BA. Studies on field crop *Brassica juncea*, *Brassica oleraceae* and *Lactuca sativa* showed that the NAR differed between doses of the treatments (Jumin *et al*. 2014).

Some treatments caused a slight increase in dry weight and it was difficult to identify differences in other crude palm oil waste treatment. However, comparing mean relative growth rate of crude palm oil waste treatments to the no crude palm oil is easier and quite different. The difficulties in calculating the lower mean relative growth rate caused difficulties in measuring biomass dry weight of plants. This means a higher mean relative growth rate is easily calculated than the lower mean relative growth rate, because there are many indicated problems to apply in small scale. In addition, the general acceptance of the mean relative growth rate technique as an appropriate method to remove size-related growth differences has likely diverted attention from the search for better methods of growth (Jumin *et al*., 2014)

Most vegetables during their early days of growth a slight show an ontogenetic drift in mean relative growth rateas their size increases. In fact, many vegetables plants exhibit a declining mean

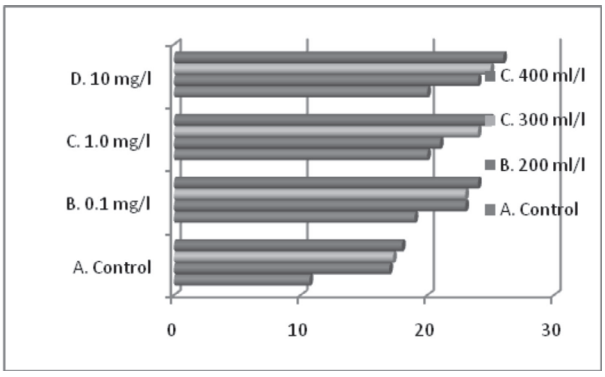

Fig. 3. Biomass (g) of *Lactuca sativa* treated with crude palm oil waste and benzyladenine

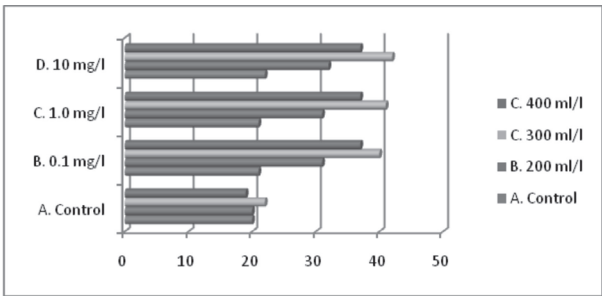

Fig. 4. Biomass (g) of *Brassica juncea* treated with crude palm oil waste and benzyladenine

relative growth rates over time (Jumin *et al*., 2014). In such CPO waste treatments cases, neither the instantaneous relative growth rates nor the mean relative growth rates are independent of size. Only in a few special cases will non-transplanted seedlings grow at a constant interest rate. In most of these cases, seedlings have been fertilized at an exponentially increasing rate. Some traditional farmers in Sumatera have applied fly ash waste as substitutes for fertilizers to woody plants (Jumin *et al*., 2014). Preliminary observation shows the positive effect of crude palm oil waste to mean relative growth rate and dry weight of *Brassica juncea*, *Brassica oleraceae* and *Lactuca sativa* plants.

CONCLUSION

Vegetable plants production increased with CPO treatment. Crude palm oil treatment with vegetable plants at suitable doses increased Ba in mean relative growth rate, net assimilation rate, leaf area and biomass of *Brassica juncea*, *Brassica oleraceae* and *Lactuca sativa* plants. Right now and future, palm oil waste is disposed in new way, it will contribute to organic fertilizer and never became pollutant to the environment.

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