AGRICULTURE WASTE UTILIZATION ON THE DIFFERENT FORMULATION ORGANIC FERTILIZERS AND ITS EFFECT OF SOIL CHEMICAL PROPERTIES

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https://doi.org/10.35410/IJAEB.2023.5849

ABSTRACT

Depleted oil bleaching earth (DOBE) is a waste discharge from palm oil refineries spent bleaching earth (SBE) processing facilities. Seven types of organic fertilizer have been formulated using DOBE and tested accordingly to the soil on crop establishment for planting performance in order to investigate its efficiency on the nutrient's availability in the soil. The experiment was carried out at Integrated Organic Farm MARDI, Serdang. From the results, it shown a variation of value in chemical properties of the soil, however there is no significant difference in main nutrient content. As the correlation study done for several elements (N, P, K, Ca and Mg) chemical properties, it did show these elements have a positive correlation and strong association to each element. From the analysis that has been done, it gave indication and baseline data to further improve the formulated organic fertilizers.

Keywords: DOBE, organic fertilizer, soil, nutrient status, chemical properties.

1. INTRODUCTION

Organic fertilizers are a significant source of organic matter that alters the physical, chemical, and microbiological properties of the soil. In order to achieve a higher yield and maximum value of growth production (Dauda *et al.*, 2008), excessive amounts of inorganic fertilizers are applied in vegetables production (Steward *et al.*, 2005). However, the use of inorganic fertilizer may cause many problems to human health and environment (Arisha & Bardisi, 1999). In recent times, consumers are demanding for higher quality and safer food (Ouda and Mahadeen, 2008). They highly interested in organic products and there is a trend for organic vegetables to be sold at premium prices because of its niche market. In organic vegetable cultivation, inorganic fertilizer is not allowed with exception of naturally occurring mineral sources. The substitutes for inorganic fertilizer are mostly in organic nutrient sources that can be grouped into such as animal sources, plant sources, green manures and compost (Aini *et al*., 2005) which can serve as alternative practice in organic crop production. It showed that organic nutrient sources also can improve soil structure (Bin, 1983; Dauda *et al.*, 2008), increased microbial biomass (Suresh *et al*., 2004). Though high amounts of manure or composts are required initially at organic farm, the quantity of subsequent application may be reduced as soil physical, chemical and biological improve with time (Aini *et al*., 2005).

The oil content of used bleaching earth is significant (20-40%). This oil is partially extracted with hexane before the used bleaching earth is disposed of in landfills (Nursulihatimarsyila et al. 2010). This trash is subsequently referred to as 'depleted oil bleaching earth' (DOBE). Based on 19 million tonnes of crude palm oil production, it is predicted that around 150,000 tonnes of

DOBE are generated each year (Econ, MPOB, 2011). DOBE is an acidic (pH 5.0) and hydrophobic substance. The hydrophobic property of DOBE is related to the presence of oil. Following the extraction of oil from wasted bleaching earth, the remaining oil concentration in DOBE is believed to be roughly 8%, resulting in the DOBE disposal in landfills is controversial because to the potential for environmental damage.

Furthermore, the sector must spend logistical costs in order to dispose of this material. This is an untenable position because landfill disposal is likely to become difficult due to environmental concerns and land shortages.According to Loh et al. (2011), this waste material is effective as a bio-organic fertiliser and supplies a suitable amount of nutrients for plant growth. Organic fertiliser is used not just to feed plants but also as a soil improvement. Organic fertiliser is made from plant- or animal-based resources that are byproducts or end products of naturally occurring processes, such as animal dung and composted organic wastes. It is high in organic matter, which can improve soil structure, quality, and water retention (Li et al. 2017). The presence of a high concentration of bentonite clay in DOBE allows it to be used as a soil amendment, which can improve soil quality. Bentonite clay (montmorillonite) is composed of a 2:1 dioctahedral clay mineral with an alumina octahedral layer sandwiched between two silica tetrahedral layers (Deng et al. 2017).

Montmorillonite possesses a high specific surface area, a high adsorption capacity, chemical and mechanical stability, a high cation exchange capacity, and swelling ability, in addition to being nutrient-rich (Madejova 2003; Noble et al. 2001). Because of these features, applying DOBE to soil may increase soil quality and plant productivity. It enhances the negative charge on the soil surface by exchanging positively charged ions in most nutrients such as K+, Ca2+, Mg2+, Fe2+, Na+, and Mn2+ (Loh et al. 2013). DOBE contains additional nutrients that are required for plant growth. As a result, DOBE has the potential to be utilised as a fertiliser that offers nutrients for plant growth.

2. MATERIALS AND METHODS

The experiment was conducted at Integrated Organic Farm, MARDI Serdang. Tomato (*Lycopersicon esculentum* Mill.) was used as the test crop in this study and was grown on raised beds under rain shelter for one cropping cycle. There are seven organic fertilizers formulated and enriched with fish meal, Christmas rock island phosphate (CIRP) and bunch ash in certain formulation and ratio. It was named as NC2 and NC5 as the main ingredient was normal compost and enriched accordingly to ratio 2:3:3 and 5:5:5. Others was, Depleted Oil Bleaching Earth with 5:5:5 and 2:3:3 ratio named as DOBE 5 and DOBE2, Bio-charcoal 5:5:5 and 2:3:3 ratio known as BIOC 5 and BIOC 2, Chicken dung fertilizer as CD and no fertilizer application serve as the CONTROL of this study. All experiments were done in five replicates.

Composite samples of soils at 0-20 cm depth at three on points on each bed were sampled before the application of fertilizer (initial) and after harvest of cropping season for soil nutrient status. The soils were air dried and ground to pass a 2 mm sieve for analyses. For total nitrogen in soils, it was determined using Micro Kjedahl digestion followed by distillation and titration with 0.1 M HCl (Bremner and Keeney, 1966). While, organic carbon was determined by Walkey and Black employing rapid titration method (Nelson and Sommers, 1982). Available phosphorus in soils was extracted based on the Bray and Kurtz no.2 procedure. Soil pH was measured at 1:2.5 ratios

with deionized water using glass electrode (McLean, 1982). The exchangeable cations were extracted by leaching with 1 M ammonium acetate and their concentration was determined using Inductively Coupled Plasma-Optical Emission Spectrophotometer (ICP-OES).
The data were all analyzed statistically using the Statistical Analysis System 9.1 (SAS). Following the analysis of variance (ANOVA), differences between treatment means were determined using Duncan Multiple Range Test with significance taken at $P \leq 0.05$.

3. RESULTS AND DISCUSSION

Application of animal-waste-derived organic fertiliser should be the mainstay of sustainable agriculture, taking into account soil fertility, microbial abundance, disease protection, and economic concerns (Bhunia et al ., 2021). Chemical content in the organic fertilizers that been used in this experiment is shown in Table 1. There are seven different organic fertilizers are used. Six of them were enriched with fish meal, ash and CIRP. The main based was normal compost, DOBE and rice husk char.

As shown in Figure 1.0, at initial stage of planting, value of soil pH was stable at pH 6 to pH 7. Only BIOC 5 shown high acidity compare to others but significant difference among the treatments. The highest EC value is 39546.000 us/cm resulted from CD compared to NC 2, which produced the lowest EC value at 592.980 us/cm. Meanwhile, total nitrogen was in the equal range of 0.2 to 0.3%. The highest soluble P was at 629.800 ug/g while in contrast the lowest amount was at 504.5 ug/g. The highest of CEC value was shown using CONTROL treatment of 7.708 meq/100g. Moreover, for all of the treatment conducted on the tomatoes, the organic carbon assembled in the same amount of 2.278%.

At the end of planting from figure 2.0, soil pH remains stable at pH 6 to 7 with maximum value stated at 6.998 from treatment NC. The highest EC value was at 527.660 us/cm. furthermore, the lowest value for total nitrogen was 0.179 % also with NC 2 and the highest value was at 0.232 % using DOBE 5. CD produces the maximum amount of soluble P at 643.125 ug/g. The CEC value shown the highest amount produced was at 11.630 meq/100g followed by the highest total carbon at 1.836% using DOBE 2.

In comparison, soil pH was pleasantly stable at pH 6 to pH 7 regardless any treatment been carried out. NC5 and CD were drastically increased in EC value at 1013.080 us/cm and 39546.000 us/cm. Total nitrogen remains at the range of 0.2 to 0.3%.
All of the treatment shown increments for the CEC value, meanwhile the total organic carbon was uniformly decrease for all the treatment tested.
DOBE treated with POME reached maturity after 21 weeks of composting. The findings revealed that composted DOBE alone produced the quickest and cheapest method of de-oiling DOBE (Haryati and Theeba, 2021). In order to establish the favourable impacts of this material on soil development and crop production, as well as to define the suggested application rates for organic crop production, extensive studies on various rates of treated DOBE and DOBE-based fertiliser are necessary. The findings indicate that composted DOBE has the potential to be used as organic fertiliser. This alternative will help to increase efforts to break down the oil in DOBE. These findings imply that the proposed composting process could be used for the quick and

efficient treatment of industrial waste containing oily bleaching earth and waste sludge (pioTroWska-Cyplik et al 2013).

As for correlation studies, the correlation coefficients are presented in Table 2. The additional and maybe the most important aspect in the combined chemical analysis is the inclusion of soil pH as a variable of significant correlation to all the nutrient elements. This correlation can be explained by considering that pH is the main soil characteristic to influence the CEC of highly weathered soils and the dominant ionic forms in solution. The pH and the CEC are, almost always, reported as soil characteristics to show good association to soil adsorption of elements.

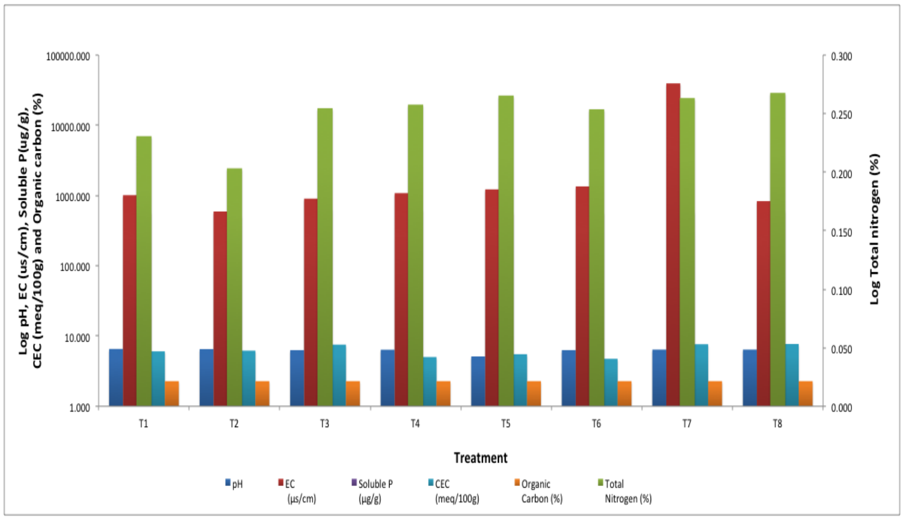

Figure 1.0: Graph $\log_{10}$ value some chemical properties of soil at initial stage of planting

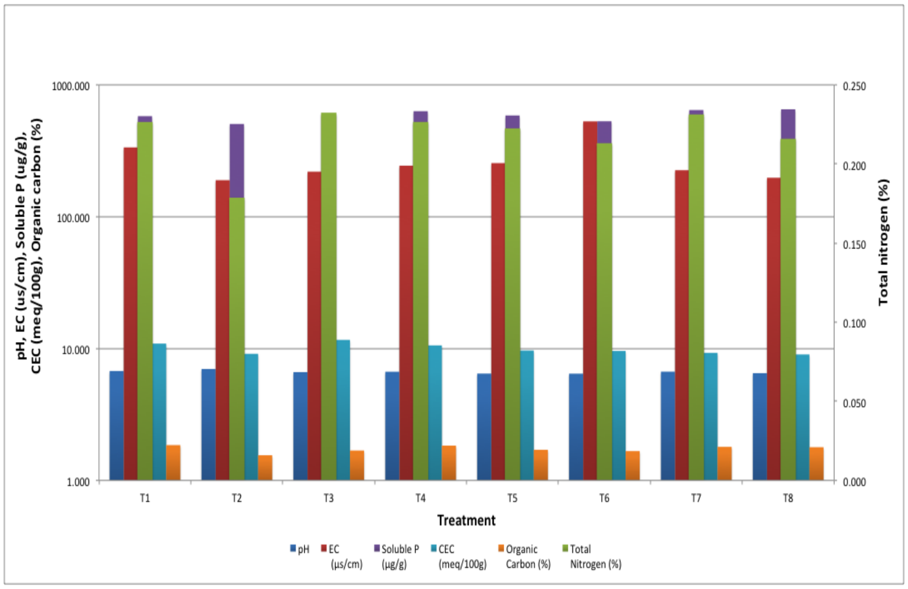

Figure 2.0: Graph $\log_{10}$ value some chemical properties of soil at the end stage of planting

Vol. 08, No. 04; 2023

ISSN: 2456-8643

Table 1: Some chemical characteristic organic fertilizer used in experiment

Organic fertilizer	N (%)	P_2O_5 (%)	K_2O (%)	CaO (%)	MgO (%)	Ash (%)	Organic Matter (%)	C (%)	C/N
NC 5	4.60	7.02	5.24	8.42	1.93	39.92	60.1	34.8	7.6
NC 2	2.79	4.26	2.82	7.45	1.44	53.81	46.2	26.8	9.6
DOBE 5	4.86	8.00	5.93	8.12	1.34	45.84	54.2	31.4	6.5
DOBE 2	2.27	6.23	3.36	6.57	2.51	59.51	40.5	23.5	10.3
BIOC 5	5.07	8.19	5.48	8.12	1.25	44.13	55.9	32.4	6.4
BIOC 2	1.92	5.39	3.09	5.25	0.96	44.97	55.0	31.9	16.6
CD	2.03	4.15	4.13	18.44	2.21	49.78	50.2	29.1	14.3

Table 2: Correlation coefficients between pH, EC and cec to some soil chemical properties

Chemical properties	pH	EC	CEC
N	**0.571***	**0.632***	**0.504***
P	**0.706***	**0.562***	**0.500***
K	**0.289**	**0.698***	**0.441***
Ca	**0.682***	**0.497***	**0.447**
Mg	**0.595***	**0.541***	**0.511**

note EC- exchangeable cation, CEC- Cation change capacity

**Significant to 1%.

***Significant to 0.1%.

4. CONCLUSION

From the results the following conclusions can be drawn. It shown a variation of value in chemical properties of the soil, however there is no significant difference in main nutrient content. The experiment was done only in one season planting of tomato. It is currently continued in order the see the effect of organic fertilization in long term run. As the correlation study done for several elements (N, P, K, Ca and Mg) compare to pH, EC and CEC, it did show these elements have a positive correlation and strong association to each element. From the analysis that has been done, it gave indication and baseline data to further improve the formulated organic fertilizers.

ISSN: 2456-8643

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