RESEARCH ARTICLE | NOVEMBER 27 2013

Effect of spent bleaching earth based bio organic fertilizer on growth, yield and quality of eggplants under field condition FREE

K. Y. Cheong; S. K. Loh; J. Salimon

AIP Conf. Proc. 1571, 744–748 (2013)
https://doi.org/10.1063/1.4858743

Effect of Spent Bleaching Earth Based Bio Organic Fertilizer on Growth, Yield and Quality of Eggplants Under Field Condition

K. Y. Cheong[a], S. K. Loh[b] and J.Salimon[a]

[a]*School of Chemical Science and Food Technology, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia.*
[b]*Malaysian Palm Oil Board, No.6, PersiaranInstitusi, Bandar BaruBangi, 43000 Kajang, Selangor Malaysia*

Abstract. Spent bleaching earth (SBE) is a solid waste generated from the bleaching process in palm oil industry. This solid waste is currently disposed directly in landfills without treatment, causing severe water and air pollution. Recently, dumping of SBE in landfills or public disposal sites has been prohibited in most countries. Meanwhile, high costs associated with the large area of land needed for storage of the residue has lead to the interest in regenerate SBE. Thus, a recent novel approach has been carried out on the utilization of SBE in agriculture as an alternative method for disposal. In this study, a field experiment was conducted at an experimental plot in Plant House National University Malaysia to evaluate the effect of SBE on the growth and quality of eggplant. Growth and quality parameters of eggplant including total fruit yield, total biomass, macronutrients concentration of leaf were studied through close monitoring and assessment. Field trials conducted showed that SBE is effective in promoting eggplant growth and nutrient uptake compared to the control treatment under field conditions. Therefore, with the proper and effective ways in handling SBE through conversion of SBE into beneficial bio organic fertilizer, this material which is a waste in the past will become an advantage in agriculture as a substitute for commercial fertilizers.

Keywords: Spent bleaching earth, fertilizer, growth, quality, eggplant.
PACS: 88.20.dj

INTRODUCTION

Pre-treatment of crude palm oil (CPO) in a refining process which involves degumming and bleaching generates plentiful of spent bleaching earth (SBE). It was estimated that about 600,000 metric tonnes or more of bleaching earth were utilized worldwide in the refining process based on the worldwide production of more than 60 million tonnes of oils [1]. SBE is a discarded palm oil refinery (POR) waste containing high percentage of residual oil (~20-40%) [2]. Disposal of SBE by incineration, inclusion in animal feeds, land filling method or concrete manufacturing is generally practiced. In Malaysia, the current most common practice is disposal at landfills - causing fire and pollution hazards due to the degradation of the residual oil in it, and the associated greenhouse gas (GHG) emissions upon its disposal. Others studies on the regeneration of SBE in different application are including residual oil recovery for biodiesel production [3] and used as adsorbent [4].

To date, SBE is still dumped off at landfills because there is no available scientific solution to address the problem. Research studies on the use of spent clay co-composted with rice husk, rice husk ashes, chicken litter and other beneficial biomass or agriculture by-products as soil amendment to improve soil fertility for plant growth is getting interest [5-7]. Therefore, the main objective of this study focused on recovery of SBE as fertilizer or soil amendment and its effect on growth, yield and quality of eggplant under field condition.

MATERIAL AND METHODS

Materials

The 2013 UKM FST Postgraduate Colloquium
AIP Conf. Proc. 1571, 744-748 (2014); doi: 10.1063/1.4858743

Spent bleaching earth was obtained from the MPV Technologies (PasirGudang) Sdn. Bhd. Eggplant seed variety MTe1 (*Solanummelongena var. esculenta L*) used was sourced from Malaysian Agriculture Research and Development Institute (MARDI) Serdang. Commercial organic fertilizer used was pure chicken litter organic fertilizer. Commercial chemical fertilizer used was Baja Serbajadi chemical fertilizer (TABLE (1)).

TABLE (1). Treatments in the Field.

Symbol	Treatments
T1	Control
T2	Spent bleaching earth
T3	SBE-based bio organic fertilizer
T4	Commercial organic fertilizer
T5	Commercial chemical fertilizer

Methods

Formulation and production of SBE-based bio organic fertilizer

SBE-based bio organic fertilizer were formulated using oil palm biomass e.g. oil palm trunk, oil palm frond, empty fruit bunches at ratio 1:1:0.5 (wt %) and enhanced with urea (46 % N), Christmas Island rock phosphate (25 % P), muriate of potash (66 % K). It was homogenized using an automatic and continousstainlees steel grinder (Dickson DFY-300, speed 24000r/min, grinding capacity 300g, voltage 240V/5HZ, power 1000W).

Physico-chemical characteristics of SBE-based bio organic fertilizer

Total nitrogen (N) and sulphur (S) were examined using an elemental analyzer (CNS-LECO 2000). Total organic carbon (OC) and organic matter (OM) contents were determined by wet oxidation using the Walkley-Black dichromate digestion method [8]. The factor used to convert OC to OM content was 1.724 [8]. The C:N ratio was calculated from the measured values of total OC and N. CEC were determined using 1*M* NH_4-acetate buffered at pH 7.0 [8]. The available phosphorus (as P_2O_5) of samples was determined using the molybdenum blue method with molybdenum in sulphuric acid. Colour formation was measured by spectrophotometer UV-120-01 at λ=880 nm [8]. pH was measured using deionized water at a sample/water ratio of 1:5 using PH 211 microprocessor pH meter [6].

Field experiment

The study was conducted in Experimental Plot K, Plant House, UniversitiKebangsaan Malaysia, Bangi, Selangor during the month of October 2011 to December 2011.Seeds of eggplant were sown in cell packs and placed in a greenhouse for seed germination. After two weeks, seedlings were moved into polybag with one seedling per bag. Eggplant seedlings were then transplanted to field plots. The experiment was carried out using completely randomized block design with five replications in each treatment plot. However, in the end of the experiment, only three plants per plot were used in this study. The plot size used was 2 m x 1 m and the planting distance between plot was 50 cm. Fertilizer rates 170: 70: 180 kg / ha of N: P: K was applied to plot treatments [9].Application rates of fertilizers are based on crop N needs and estimated rates of fertilizer N supply. The soil of the experimental field was analyzed and presented in TABLE (2).

TABLE (2). Physico-Chemical Properties of the Experimental Soil.

Properties	Mean
% Clay	31.67
% Coarse sand	21.60
% fine sand	32.25
% slit	13.33
Texture	Sandy clay loam
pH	5.05

Cation exchange capacity (meq/100g)	6.34
% N	0.08
K (meq/100g)	0.34
CaO (meq/100g)	3.64
MgO(meq/100g)	0.47
% Organic carbon	0.46

Vegetative growth

At harvest stage, the mature fruit of eggplant for each treatment plot were collected every week and total fresh fruit yield was recorded. Total biomass was also recorded in this study.

Plant analysis

Plant samples were analyzed for nutrient (N, P, K) content using ashing method.

Statistical analysis

The average data obtained for the growth parameters and leaves chemical composition of crop were analyzed using Analyses of Variance (ANOVA). The treatment means were compared using Tukey's post-hoc test at the 5% probability level.

RESULTS AND DISCUSSION

Physico-Chemical Characteristics of SBE-Based Bio Organic Fertilizer

Spent bleaching earth is montmorillonite and bentonite-based natural clay having similar characteristics as that of zeolite, thus hypothetically it mimics zeolite in many ways. It contains essential mineral elements (N, P, K) for potential use as soil supplement for plant growth (TABLE (3)). Besides, the initial high C: N ratio of SBE causing detrimental effect in limiting bioavailability of soil N for plant growth. Through the formulation of SBE with agricultural biomass e.g. oil palm trunk, oil palm frond, empty fruit bunch and chicken manure, a more balanced nutrient NPK was achieved. The pH of the formulated SBE-based bio organic fertilizer is increased with the addition of agriculture biomass due to the alkalinity generated. Furthermore, the C: N ratio was improved tremendously after formulated with agriculture biomass which is from 293 to 14. This decrease to an optimal C: N ratio can stimulate the rapid N mineralization and production of NH_4^+ needed in plant growth.

TABLE (3). Chemical Properties of SBE and SBE-Based Bio Organic Fertilizer.

Element (%)	**SBE**	**SBE-based bio organic fertilizer**	***Commercial organic fertilizer**	***Commercial chemical fertilizer**
Total N	0.06	1.57	5.00	12.00
Available P_2O_5	2.36	1.93	3.00	12.00
Exchangeable K_2O	0.27	1.94	2.00	17.00
Organic carbon	17.43	22.09	-	-
C:N	293	14	-	-
pH	5.33	6.99	-	-

*Data obtained from commercially available fertilizer packaging labels.
- Not determined

Effect of SBE Based Bio Organic Fertilizer on Vegetative Growth, Yield and Quality

The total fresh fruit yield and total biomass (dry weight of stem, leaf and fruit) of the plants treated with SBE-based bio organic fertilizer demonstrating an overall 82 % and 68 % increase in production compared to that eggplant treated without treatment (FIGURE 1). This showed that application of SBE-based bio organic fertilizer promotes plant growth, improves crop quality while increasing crop productivity and yield.

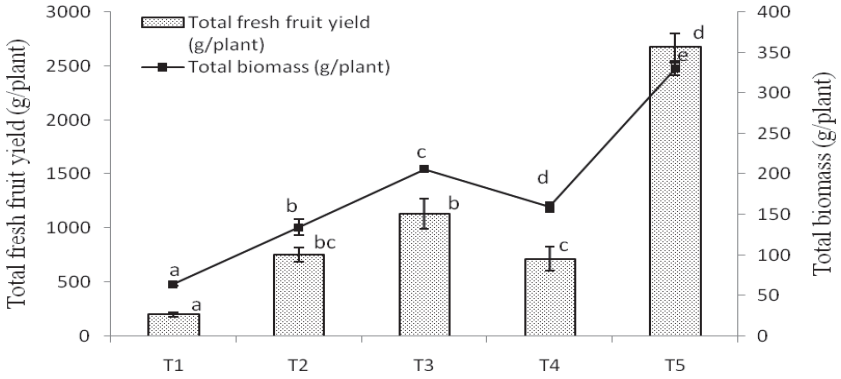

FIGURE 1. Total Fresh Fruit Yield and Total Biomass of Eggplant at Different Treatment with Different Letters showed significant different at P>0.05.

Effect of SBE Based Bio Organic Fertilizer on Leaf Nutrient Composition

Total N and P content in eggplants treated with SBE-based bio organic fertilizer showed significant difference with the plants treated without treatment (TABLE (4)). These increase of nutrients uptakes by crop after application of SBE also evidenced by Crocker et al. 2004 [5]. This results of the increase in nutrients N, P, K uptake by crops is due to the cationic exchange properties exhibit in SBE which causing the nutrients are resistant to leaching while still being available for uptake by plant roots [6].

TABLE (4). Leaf Nutrient Concentration of Eggplant.

Treatment	Total N (%)	P (%)	K (%)
T1	2.46±0.36a	0.33±0.06a	6.43±0.43a
T2	2.56±0.20ab	0.47±0.09ab	7.35±0.46ab
T3	3.25±0.34bc	0.56 ±0.03b	7.03±0.79ab
T4	2.59±0.27ac	0.43±0.07ab	7.19±0.64ab
T5	4.12±0.33d	0.41±0.03ab	8.03±0.34b

CONCLUSION

Through the formulation of SBE with agriculture biomass, the physicochemical properties of SBE were improved. The balanced nutrient N, P, K content, C: N ratio, pH in SBE-based bio organic fertilizer make it able to be used as potential fertilize or soil amendment. Besides, the application of SBE-based bio organic fertilizer, there is a significant biomass growth and yield for the eggplants.

ACKNOWLEDGMENTS

The authors wish to acknowledge Universiti Kebangsaan Malaysia (UKM) for the permission to conduct this research in Master's degree and the financial support from Malaysian Palm Oil Board (MPOB) under the Graduate Students Assistantships Scheme (GSAS). Thanks also credited to my supervisors Prof. Dr. Jumat Salimon and Dr. Loh Soh Kheang for their guidance.

REFERENCES

1. E. Y.Park, A.Kato and H.Ming, *JAOCS* **81** (1), 57-62 (2004).
2. S. K. Loh, S. F. Cheng, Y. M. Choo and A. N. Ma, *American Journal of Applied Sciences* **3** (10), 2063-2067 (2006).
3. P.V. Lara and E.Y. Park, *Enzyme and Microbial Technology* **34**, 270-277 (2004).
4. C.H. Weng and Y.F. Pan, *Journal of Hazardous Materials* **144**, 355-362 (2007).
5. J.Crocker, R.Poss, C. Hartmann and S. Bhuthorndharaj, *Plant and Soil* **267**, 155-163 (2004).
6. W. Soda, A.D. Noble, S. Suzuki, R Simmons, L.Sindhusen and S.Bhuthorndharaj, *Journal of Environmental Quality* **35**, 2293-2301 (2006).
7. M.Arias-Estévez, E.López-Periago, J.C.Nóvoa-Muñoz, A. Torrado-Agrasar and J. Simal-Gándara, *Journal of Agricultural and Food Chemistry* **55**, 7541-7546 (2007).
8. H.Zulkifli and Z.M.Masnon, *Soil analysis: PORIM soil analysis manual*, Malaysian Palm Oil Board, 1993.
9. N.C.Chen, T.Kalb, N.S.Talekar, J.F. Wang and C.H. Ma,*Suggested cultural practices for eggplant*, Asian Vegetable Research & Development Centre, 2002.