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Application of empty fruit bunches (EFB) and cow manure (CM) compost as planting medium on the growth and yield of chilli (*Capsicum annum*) treated with different fertilizer

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Abstract: Comparison of empty fruit bunches (EFB) and cow manure (CM) compost application as planting medium was conducted using four different treatments of fertilizer on growth and fruit yield of chili (*Capsicum annum*, Cilibangi-3 variety). The four fertilizer treatments were without fertilizer, chemical, organic, and both chemical and organic fertilizer. The experiment was done from August to December 2014 with three replications in the glass house, Universiti Kebangsaan Malaysia (UKM). The result showed a significant different for plant biomass (190.10 g), weight (420.17 g) and total fruits per plant (45.33) in EFB but not significant for plant height and ripening time at $p < 0.05$. While for CM, significant different occurred on the plant height (100.80 cm), weight (485.67 g) and total fruits per plant (54.67) but no significant different for plant biomass and ripening time at $p < 0.05$. Thus, different response was observed between EFB and CM planting medium. Application of EFB treated with chemical fertilizer demonstrated better growth and fruit yield, while CM was better growth and fruit yield when treated both chemical and organic fertilizers.
Keywords : Empty fruit bunches (EFB) compost, cow manure (CM) compost, chili (Capsicum annum, Cilibangi-3 variety), growth, yield.

Introduction

Composting is a biochemical process converting organic waste into a variety of products that can be used safely as organic fertilizer and soil amendment[1]. The process involves bioconversion of agro-waste to stable humus by indigenous microflora such as fungi, bacteria and actinomycetes. Several factors regulate the prevalence and succession of microbial community such as carbon nitrogen (CN) ratio, water content, pH, aeration and temperature. Several potentials of biomass is Empty fruit bunch (EFB), palm kernel cake (PKC), palm kernel shell (PKS), and mesocarpfiber (MF) as well as palm oil mill effluent (POME) in the form of liquid.

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EFB is the residue produced when palm fruits are taken from the fresh bunch in the initial process of palm oil production. For every 100 kg of oil palm, fresh fruit bunches processed will produce approximately 22-25 kg of empty fruit bunches. To avoid abundant of EFB and other palm oil biomass, the best way to dispose of EFB is to compost the residual and shredded EFB will help to accelerate the recycling organic matter process[2].EFB is also potentially used as biomass for hydrogen gas production after chemical pre-treatment[3, 4] and being used as substrate for bioremediation[5].The EFB compost has high potential to be used as an organic fertilizer due to its can improve soil organic matter content, restore the structure and soil aeration, and provide sufficient nutrients for growth [6, 7, 8, 9].While, cow manure is one of the oldest approach used as organic fertilizer. It has been used for so long in agriculture to increase crops yield. Cow manure should not be use raw because it's high in nitrogen and ammonium that can burn the plant and it may contain harmful microorganism. The term 'burn' is refers to the plant effects on the application of fresh manure causing rapidly dehydrate and the leaves are turn to and wither. On the other hand, when it turned into compost, it becomes an excellent growing medium for plants as it improves water-holding capacity of the soil, enhances organic matter in soils, and increased fruit yield and vegetative growth for the plants[10, 11].

To sustain the crops production, chemical and organic fertilizers are applied to maintain the nutritional condition of different cropping system[12]. The chemical agricultural system aims to maximize the potential yield of crops. Chemical fertilizers are easily taken up by plant to enhance the crops growth and yield and the effects are faster compared to organic fertilizer. While, organic fertilizer may contain all nutrients but low in concentration of its nutrients. The plant's nutrient uptake from the soil was also slow but sustain for a long term and so much depend on microorganism to recycle the nutrients into the environment. However, in some countries the integrated use of chemical and organic fertilizers are applied to increase the crops production[13].

Studies showed EFB compost contain many nutrients that can be used for growing and yielding of crops but information on the applications in the agricultural sector, especially in chili cultivation was scarce. Chili has been selected in this study due to its high economic value in Malaysia. For the year 2013, chili contributed about 23.11 million on the country export[14]. Hence, this study was to see the effect of EFB compost on the growth and yield performance of chili (*Capsicum annum*, Cilibangi-3 variety) compared to the cow manure in which may commercially use for cultivation. The results of this study may have some benefit in making EFB compost as an alternative in the planting medium for cultivation.

Materials and Methods

Site description

The experiment was set up in the glass house at Universiti Kebangsaan Malaysia (UKM), Selangor, Malaysia, located at 2.92ºN and 101.78ºE during the period of August until December 2014.

Compost material

Empty Fruit Bunch (EFB) compost was collected from Palm Compost Sdn. Bhd. at aged of 70 to 90 days of compost in June 2014. The shredded EFB was mixed with palm oil mill effluent (POME) and decanter cake when undergoing the composting process. Cow manure (CM) compost was provided by plant house complex in UKM.

Planting material

Variety of chili used in this study was Cilibangi-3 supplied by SerotechSdn. Bhd. (Serotech, MY). Polybags containing a mixture of planting medium which consists of soil, compost, and sand with ratio 3:2:1 (w/w) were prepared. Two different compositions of planting medium (cow manure and empty fruit bunches compost) were used with four treatments of fertilizers (without fertilizer, chemical fertilizer, organic fertilizer, both fertilizer) each. Chemical fertilizer containing nitrogen (15%), phosphate (15%), and potassium (15%) was used. Organic fertilizer (Agroplus, MY) with nitrogen (3%), phosphate (4%) and potassium (7%) was supplied from DUHC Technologies Sdn. Bhd. (DUHC Technologies, MY).

Experimental design

The seeds were germinated inside the tray and put under protected area for 7 days. After 7 days, the seedlings were transferred into the polybags (0.4 m × 0.4 m). Polybags were arranged according to split-plot design in a completely randomized block with three replications per treatments.

Trial plots were sown on 5 August 2014. Transferring of the seedlings was done in the evening to avoid injury to the plants. Fertilizers treatments were applied to the plants once a week during daytime. Using an irrigation system, water was dripped directly to the root zones 6 times per day. Plots were hand-weeded every week. Each of the polybags grew with chili was nearby stabbing with 0.75 m of bamboo stick where the chili trunk was tied to support plants from bent and weight of the fruits.

Plants growth and yield assessment

Throughout the study, plant growth and yield of chili were recorded. Parameters included height, total weight of the fruits per plant, total fruits per plant and ripening time. For height, measurement begins from the end of the trunk to the tallest part of the plants. The measurement was done weekly until all chili on the plant achieved ripening time and maximum height. The ripening time was calculated from the first day when the plants were transferred into the polybags until 50% or more of the fruits ripe. Total fruits per plant were calculated by counting the number of fruits on every plant. All fruits on each plant were collected and weighed for a total weight of the fruits per plant using portable weighing scale (Tanita KD-321, JP).

Statistical analysis

Analysis of variance (ANOVA) for growth and yield of chili were carried out using SPSS program version 21. Means were tested with Least Significance Difference (LSD) test. Statistical different among the treatments was attained at $p < 0.05$ level.

Results and Discussion

In the present study, compost types and treatment of different fertilizers were examined on growth by measuring height and biomass of *Capsicum annum* (Cilibangi-3 variety). Analysis of variance (ANOVA) for EFB and CM compost planting medium against different treatment of fertilizer showed height of plants was not significantly different among each treatment at $p>0.05$. However, plant biomass showed significantly different among treatment where EFB with chemical fertilizer was the highest (190.10 ±60.60 g) and the lowest was for control (EFB without any fertilizer) (77.83 ±23.59 g)(Table 2). Whilein CM, height of chilli plants were significantly different among each treatment at $p<0.05$. The highest value for CM treated with chemical fertilizer (100.80 ±1.71cm) and the lowest for control (85.67 ±5.47 cm) as shown in Table 2. Whereas for plant biomass, no significant different among the treatments at $P >0.05$ (Table 1 and Table 2).

Table 1. Analysis of variance (ANOVA) for EFB and CM compost planting medium against different treatment of fertilizer

Parameters	EFB compost					CM compost			
	df	***MS***	***F***	***p-value***		***df***	***MS***	***F***	***p-value***
Height of plants (cm)	11	159.08	2.14	0.17		11	179.90	7.18	0.00*
Plant biomass (g)	11	12832.33	8.92	0.01*		11	4386.20	3.86	0.06
Weight of fruits per plant (g)	11	52745.63	90.61	0.00*		11	40904.52	8.53	0.01*
Total fruits per plant	11	583.86	8.19	0.01*		11	443.42	6.49	0.02*
Ripening time (days)	11	121.44	2.80	0.11		11	53.56	2.62	0.12

* Significant difference at $p<0.05$

Table 2.Mean value forempty fruits bunches (EFB) and cow manure (CM) compost planting medium against fertilizer treatments on growth on chilli

Fertilizer treatment	Growth			
	Empty fruit bunches (EFB) compost planting medium		Cow manure (CM) compost planting medium	
	Height of plants (cm)	Plant biomass (g)	Height of plants (cm)	Plant biomass (g)
Without fertilizer (control)	83.77^{a} ±11.87	77.83^{c} ±23.59	85.67^{c} ±5.47	132.00^{a} ±29.31
Chemical fertilizer	92.73^{a} ±5.53	190.10^{a} ±60.60	100.80^{a} ±1.71	182.83^{a} ±59.73
Organic fertilizer	75.23^{a} ±8.14	73.77^{c} ±18.22	89.13^{abc} ±3.71	107.43^{a} ±6.38
Chemical and organic fertilizer	81.10^{a} ±7.74	187.97^{ab} ±34.52	100.37^{ab} ±7.32	184.40^{a} ±8.66

* $^{a-c}$mean with different alphabets in the same column indicate that there is a significant at $p < 0.05$; ± standard deviation

The yield of chilli plant was reflecting by their weight of fruit, total fruit per plant and ripening time. Table 1 shows, in EFB planting medium, the weight of fruits and total fruit per plant were significant among treatments at $p<0.05$ but not significant for ripening time (Table 1). As shown in Table 3, the weight of fruit and total fruit of EFB treated with chemical fertilizer was significantly higher when compared to other treatments, the values were 420.17 ±37.88 g and 45.33 ±14.05 fruit per plant, respectively. The lowest value was significantly observed for weight of fruits was in EFB control (135.87 ±19.51 g) and EFB treated with organic fertilizer (148.53 ±6.62). In total fruits per plant, the significantly lowest showed by control (18.67±2.52 fruits per plant) and EFB treated with organic fertilizer (14.67 ±3.06 fruits per plant). Whereas, no significantly difference among the value of ripening time for all treatments (Table 2).The yield for CM, indicated the CM treated with chemical and organic fertilizer showed significantly high in weight of fruits (485.67 ±117.80 g) and total fruits value (54.67 ±6.43 fruit per plant), respectively. The lowest value for weight per plant was CM control (225.30 ±26.33 g) and CM treated with organic fertilizer (253.57 ±55.86 g), respectively. Similar as EFB treatments, no significant different in ripening time of all treatments in CM.

Table 3. Mean value for empty fruits bunches (EFB) and cow manure (CM) compost planting medium against fertilizer treatments on yield on chilli

Fertilizer treatment	Yield					
	Empty fruit bunches (EFB) compost planting medium			Cow manure (CM) compost planting medium		
	Weight of fruits per plant (g)	Total fruits per plant	Ripening time (days)	Weight of fruits per plant (g)	Total fruits per plant	Ripening time (days)
Without fertilizer (control)	135.87^{c} ±19.51	18.67^{b} ±2.52	102.00^{a} ±9.17	225.30^{c} ±26.33	25.33^{b} ±7.51	105.67^{a} ±1.15
Chemical fertilizer	420.17^{a} ±37.88	45.33^{a} ±14.05	108.00^{a} ±6.92	310.90^{ab} ±38.69	41.67^{ab} ±13.20	102.00^{a} ±5.29
Organic fertilizer	148.53^{c} ±6.62	14.67^{b} ±3.06	95.67^{a} ±4.04	253.57^{c} ±55.86	36.67^{ab} ±1.15	108.33^{a} ±7.23
Chemical and organic fertilizer	274.10^{b} ±21.66	32.33^{ab} ±8.50	109.67^{a} ±5.03	485.67^{a} ±117.80	54.67^{a} ±6.43	112.00^{a} ±0.00

*$^{a-c}$ mean with different alphabets in the same column indicate that there is a significant difference at $p < 0.05$; ± standard deviation

The above results explained were in agreement with [6]who reported the application of compost and different fertilizer treatments could induce various effects of plant growth due to the interaction between biological activity, nutrient uptake, and physical state or degree of mineralization of the organic matter. However, the report was based on cauliflower growth and no report found in chili.EFB planting medium for control (without fertilizer) did not differ significantly in height of plant in all fertilizer treatments. This suggested that EFB compost was able to increase the height of the chili plants. This result was consistent with the study of [15]on oil palm trees which found that the use of EFB compost was helpful for the plant growth. The use of EFB compost directly to the soil can produce complete nitrogen (N) mineralization and improve soil quality for the growth of palm oil. For the CM medium (Table 2), it showed that the use of fertilizers, especially chemical fertilizers, could significantly increase the plant height of chili. This finding was similar with[16]who reported application of inorganic fertilizer with cow dung gives a significant impact on the height of chili. [17]also reported that combination of CM compost with chemical fertilizers successfully increased the sugarcane tree.

Chemical fertilizer treatments have indeed given significant effects on fruit biomass, weight of fruit per plant and total fruit per plant, obviously on chiligrown in EFB planting medium (Table 3). The possible reasons of increasing value on those parameters were due to chemical fertilizer able to serve as ready nutrients and more preferred to be absorbed by the plant root leading to increase in plant biomass and fruits yield. In addition, the major factor affecting crop yields is nitrogen (N), phosphate (P) and potassium (K) availability which are high in chemical fertilizer (NPK, 15:15:15) studied here. N nitrogen is responsible for increased yield and quality, and as nitrogen rates increase, so does yield. Nitrogen assimilation into amino acids is the building block for protein in the plant. It is a component of chlorophyll and is required for several enzyme reactions. P is a major component in plant DNA and RNA. P is also critical in root development, crop maturity and seed production. N and P are yield-limiting nutrient in agriculture production [18]. While K increases water use efficiency, needed in development and quality of fruit and the reduction of disease [19]. This finding was similar to findings reported by [20]who described that the compost may slow in improving retention and releasing of nutrient into the soil for efficient plant uptake. Thus, integration of compost and chemical fertilizer for plant growth lead to chemical fertilizer absorption of nutrients at exchange sites. However, when a combination of chemical and organic fertilizer was treated on the chili plants surprisingly the value of weight of fruits per plant and total fruit per plant were decreasing in EFB compared to CM. Those results were inconclusive.

While in CM planting medium, the combination of chemical and organic fertilizers increased the weight of fruits per plant and total fruit per plant, doubling in value compared to its control (CM medium without fertilizer). The combination of both fertilizers demonstrated a good effect on fruits production in CM compost medium. The report on the effects of combination fertilizer between chemical and organic in CM is not being elucidated by other researchers. However, [21] have described that balanced carbon-nitrogen ratio rejuvenating the soil structure and this might increase the synthesis of carbohydrates which ultimately promoted greater fruit yield.

The EFB and CM treated with organic fertilizer did not show much different in value when compared to its control in term of height, biomass, weight of fruit per plant, total of fruit per plant and ripening time (Table 2 and Table 3). Organic fertilizer brings a number of advantages which they attributed to positive action on soil characteristics of water holding capacity, cation exchange, and microbial activity. However, organic fertilizer is low in nitrogen content which affecting the crop yields as demonstrated here. It has been reported that the major factor attributed of increasing yields is depended on the nitrogen followed by phosphate and potassium [22].The role of compost in the planting medium help in increasing the nutrient holding capacity in the soil. Compost can reduce the nutrient release rate from the soil and increase the soil's ability to maintain nutrients for plants used[23, 24].

Conclusion

In conclusion, the different planting medium of compost (EFB and CM) treated with different treatment of fertilizers would give a different response of fruit yields and plant growth as demonstrated in this study. Fertilizers treatment on EFB planting medium have significant different to the plant biomass, weight of the fruits and total fruits per plant, but it did not affect plant height and ripening time. While in CM, fertilizer treatments did not affect plant biomass and ripening time but had significant different on the plant height, weight of the fruit and total fruits per plant. It was also found that the application of EFB compost was better

against chemical fertilizer while CM compost when treated with both fertilizers. Thus, the EFB and CM compost are potentially being used as planting media for chili cultivation.

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References

1. Oviasogie, P.O., Odewale, J.O., Aisueni, N.O., Eguagie, E.I. and Brown, G.Production , utilization and acceptability of organic fertilizers using palms and shea tree as sources of biomass. African Journal of Agriculture Research,2013, 8(27): 3483–3494.
2. Astimar, A.A. and Wahid, M.B. Supply Outlook of Oil Palm Biomass in Malaysia. *Proceedings of the Seminar on Ecomat Research and Promotion; Towards Enrichment of the Environment*, hlm. 24–25. Beijing, China: Malaysian Palm Oil Board, 2007.
3. Poh S. C., Jamaliah, M. J., Shuhaida, H., Swee S. L., Sahilah, A. M., Osman, H., Mohd Tusirin, M. N. Enhancement of batch biohydrogen production from prehydrolysate of acid treated oil palm empty fruit bunch. International Journal of Hydrogen Energy, 2013, 38(22), 9592-9599.
4. Mansor, M. F., Jahim, J. M., Mumtaz, T., Rahman, R. A. and Sahilah A. M. Development of a methane-free, continuous biohydrogen production system from palm oil mill effluent (Pome) in cstr . Journal of Engineering Science and Technology, 2016, 11 (8): 1174-1182. Scopus
5. Mohammad H., Sahilah, A. M., PalsanSannasi, A., Wong, K. K., Salmijah, S. Enhanced crude oil hydrocarbon degradation by self-immobilized bacterial consortium culture on sawdust and oil palm empty fruit bunch. Annals of Microbiology, 2014, 1-9.
6. Farahzety, A.M. and Aishah, H.S. Effects of organic fertilizers on performance of cauliflower (*Brassica oleracea* var. botrytis) grown under protected structure. Journal Tropical Agriculture and Food Science,2013, 41(1): 15–25.
7. Nurani, D., Parmiyatni, S., Purwanta, H. and Angkoso, G. 2007. Increase in pH of Peat Soil By Microbial Treatment. Proceedings of The International Symposium and Workshop on Tropical Peatland. Carbon-Climate-Human Interaction on Tropical Peatland, hlm. 27–31. Yogyakarta: EU CARBOPEAT and RESTORPEAT Partnership between GadjahMada University, Indonesia and University of Leicester, United Kingdom.
8. Wira, A.B., Razi, I.M. and Jamil, Z.A. Composts as additives in coconut coir dust culture for growing rockmelon (Cucumismelo l.). Journal of Tropical Agriculture and Food Science,2011, 39(2): 229–237.
9. Aishah, E., Sahilah A.M, Wan Aida, W.M, Safiyyah, S., Norhidayu, M, RulAisyah, M.R. Antioxidant content of Tomatoes (*Lycopersiconesculentum* cv MT1) treated by different type of Pesticide, Fertilizer and growth medium in Compost. International Journal of ChemTech Research. 2018, 11 (5); 387-393.
10. Uka, U., Chukwuka, K. and Iwuagwu, M. Relative effect of organic and inorganic fertilizers on the growth of okra. Journal of Agricultural Sciences, 2013, 58(3): 159–166.
11. Ullah, M.A., Islam, M.S, Islam, M.A. and Haque, T. Effects of organic manures and chemical fertilizers on the yield of brinjal and soil properties. Journal of the Bangladesh Agricultural University, 2008, 6(2): 271–276.
12. Liu, C., Sung, Y., Chen, B. and Lai, H. Effects of nitrogen fertilizers on the growth and nitrate content of lettuce (Lactucasativa L.). International Journal of Environmental Research and Public Health, 2014, 11(4): 4427–4440.
13. Sarkar, A.K., Mathur, B.S., Lal, S. and Singh, K.P. Long-term effects of manure and fertilizers on important cropping systems in sub-humid, red and laterite soils. Fert. News, 1989, 34(4): 71–80.
14. Federal Agricultural Marketing Authority (FAMA) of Malaysia. 2014. Main statistical marketing, FAMA, 2014, Selangor.
15. Zaharah, A.R. and Lim, K.C. Oil palm empty fruit bunch as a source of nutrients and soil ameliorant in oil palm plantations. Malaysian Journal of Soil Science, 2000, 4: 51–66.
16. Malawadi, M., Shashidhara, G. and Palled, Y. Effect of secondary and micronutrients on yield, nutrient uptake and quality of chilli. Karnataka Journal of Agricultural Sciences, 2010, 17(3).

17. Bokhtiar, S.M. and Sakurai, K. Effects of organic manure and chemical fertilizer on soil fertility and productivity of plant and ratoon crops of sugarcane. Archives of Agronomy and Soil science,2005, 51(3): 325–334.
18. Ball, J. Back to Basics:The Roles of N, P, K and Their Sources. The Samuel Roberts Noble Foundation. 2007.
19. Palanivell, P., Susilawati, K., Ahmed, O. H. and Majid, N. M. Compost and crude humic substances produced from selected wastes and their effects on Zea mays l. nutrient uptake and growth. The Scientific World Journal, 2013, 1-15.
20. Malik, A., Chattoo, M., Sheemar, G. and Rashid, R. Growth, yield and fruit quality of sweet pepper hybrid SH-SP-5 (Capsicum annuum L.) as affected by integration of inorganic fertilizers and organic manures (FYM). Journal of Agricultural Technology, 2011, 7(4): 1037–1048.
21. Prasad, R. Integrated nitrogen management for sustained productivity, health and the environment. National Symposium Resource Conservation and Agriculture Productivity (PAU, Ludhiana, Nov. 22-25, 2004), extended summary, pg. 299–300.
22. Hepperly, P., Lotter, D., Ulsh, C. Z., Seidel, R. and Reider, C. Compost, manure and synthetic fertilizer influences crop yields, soil properties, nitrate leaching and crop nutrient content. Compost Science & Utilization, 2009, 17(2): 117–126.
23. Zai, A. K. E., Horiuchi, T. and Matsui, T. Effects of compost and green manure of pea and their combinations with chicken manure and rapeseed oil residue on soil fertility and nutrient uptake in wheat-rice cropping system. African Journal of Agricultural Research, 2008, 3(9): 633–639.
24. Hasan, M. Effect of rhizobium inoculation with phosphorus and nitrogen fertilizer on physic-chemical properties of the groundnut soil. Environment & Ecosystem Science, 2018, 2(1): 04-06.

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