Eco. Env. & Cons. 26 (June Suppl. Issue) : 2020; pp. (S141-S144)
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ISSN 0971–765X

The effects of organic waste (water hyacinth, banana root, fishbone and chicken eggshell) as the liquid organic fertilizer on the soybean production

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(Received 10 February, 2019; Accepted 30 March, 2020)

ABSTRACT

The study aims to determine the effect of liquid organic fertilizer (LOF) to increase the production of soybean. The experiment was carried out using a one-factor randomized group design (RGD) with three replications. The LOF was generated from several types of organic waste, including water hyacinth, banana root, fishbone and chicken's eggshell. The treatments were divided into, M0= without LOF (control), M1= LOF water hyacinth, M2= water hyacinth + banana root; M3= water hyacinth + fishbone; M4 = water hyacinth + chicken eggshell; M5= water hyacinth + banana root + fishbone; M6= water hyacinth + banana root + chicken eggshell; M7= water hyacinth + fish bone + chicken eggshell, and M8= water hyacinth + banana root + fish bone + chicken eggshell. The data were analyzed using analysis of variance. The result showed that all types of LOF formulation could be used as soybean fertilizer, especially on the increasing of soybean pods formation, average volume and weight of dry soybean seeds, number of fertile pods, and decrease the empty pods formation compared to the control ($p < 0.05$). Further analysis showed that the soybean fields could produce the produce from 3.22 tons/ha – 3.99 tons/ha, and it was 42.5% higher than the control that only produce 1.87 tons/ha. In the future, the organic waste processing into the LOF could be used to increase the land productivity, prevent land degradation, as well as strive to be a solution in overcoming the organic waste issue.

Key words : *Liquid organic fertilizer, Organic waste, Pod, Soybean, Production*

Introduction

Soybean is an annual major crop in the world and prominent legumes in food security. The increase of intensity and expansion of soybean cultivation generate the increase of soybean production, especially in the dry land (Hasanah *et al.,* 2014). In the globalization era, the production technology is the most essential part in agriculture to increase productivity. Nowadays, the soybean productivity reaches 2.0 tons/ha in Indonesia, and it is lower than the other countries.

The soybean become the prominent comodity on agricultural industry in Indonesia, including to support the food security. The government provide several regulations to increase soybean productivity, such as the utilization of fertilizer. The previous study demonstrated that combination of organic and inorganic fertilizer increase the production of soybean from 2.0 – 2,5 tons/ha (Kuntyastuti *et al.,* 2008). It because the utilization of organic fertilizer increase soil permeability and reduce land dependency on the inorganic fertilizer. Further, it can be used to be a source of energy for the soil microor-

ganisms. Another study reported that organic fertilizer from *Centrosema* leaf extract improve the saplings and the plant height of *Pennisetum purpureum* (Mukhtar and I Komang, 2015).

Based on its shapes, the organic fertilizer divided into two types, that is solid and liquid organic fertilizer. Herawati *et al.,* (2019[a]) proved that the formulation of fishbone and eggshell waste as a liquid organic fertilizer (LOF) increase soybean production from 22.5% - 32.1% compared to the control. Further, because of the organic waste in Indonesia become the major issue, it is necessary to overcome these problems. This study aims to analyze the effects of LOF from the various types of organic waste as the fertilizer for the soybean crop.

Materials and Methods

Time and Place of the Study

The study was conducted from March until July 2018 at the Laboratory of Production, Faculty of Agriculture, University of Wijaya Kusuma Surabaya and the Experimental Garden of the Mojosari Agricultural Technology Research Institute, Mojokerto.

Research Design

The study was conducted using the randomized group design (RGD) with three replication, each. The groups were divided as follow:
M0= without LOF (control).
M1= LOF from water hyacinth.
M2= LOF from water hyacinth + banana root.
M3= LOF from water hyacinth + fishbones.
M4= LOF from water hyacinth + chicken eggshell.
M5= LOF from water hyacinth + banana root + fishbone.
M6=LOF from water hyacinth + banana root + chicken eggshell.
M7= LOF from water hyacinth + fish bone + chicken eggshell.
M8= LOF from water hyacinth + banana root + fish bone + chicken eggshell.

Formulation of Liquid Organic Fertilizer (LOF)

All the organic waste was washed and mashed. All the mashed materials were formulated according to the groups with 1 :1 of proportion and inserted into the tube. Zero point five kg of sugar, coconut water, rice water and fresh water was added and mixed until it reached 50 l of volume. The LOF tube was closed and the ventilation was provided using plastic hose. The tube was fermented for 15 days. After 15 days, the mixture was filtered and it ready to used.

Soybean Cultivation and Soil Preparation

Eighteen $m^2 \times 29$ plots of field were prepared as the cultivation media. The field was prepared by the construction of drainage channels to remove the excess water. The field was left for a week under the direct sunlight.

Planting

Following the soil preparation, the basic fertilizer (carbamide, TSP, KCl and manure) was added three days before planting among the rows. Three seeds were planted inside the hole at the 40 × 15 cm of area. Further, the LOF was added once a week for six weeks. The water was given once a day in the evening. The weeding was conducted to prevent pests attack.

Harvest and Post-harvest

The harvesting was conducted after the 70% of soybean leaves become yellow and fall and 95% of the pods have hardened and browned. The yield was weighed and dried under direct sunlight for three days.

Data Analysis

The observed parameters were total pods/plants, number of filled pods/plants, number of empty pods/plants, dry weight of seeds/plots, dry weight of seeds/ha and weight of 100 seeds. All those data were analyzed using analysis of variance using SPSS version 16 with p value < 0.5.

Results and Discussion

There are significant differences in the number of fill and empty pods due to the administration of various kinds of LOF ($p \geq 0.05$). Group M8 produced higher number of fill pods compared to the M0 and M1. However, M8 did not show any differences compared to M2, M3, M4, M5, M6, and M7. In addition, group M5, M6 and M8 showed the lowest number of empty pods compared to the others. There is no significantly different regarding the total pods/plant ($p \geq 0.05$). The number of fill and empty pods, and number of total pods expressed on Table 1.

Table 1. Average number of fill and empty pods, and total pods following the administration of LOF.

Groups	Parameters		
	Fill pods/plant	Empty pods/plant	Total pods/plant
M0	95.33[a]	27.07[a]	122.40[a]
M1	128.87[b]	19.67[b]	148.53[a]
M2	166.13[c]	18.00[c]	184.13[a]
M3	160.87[c]	14.33[d]	175.20[a]
M4	153.53[c]	11.60[d]	165.13[a]
M5	157.73[c]	5.87[e]	163.60[a]
M6	150.40[c]	5.13[e]	155.53[a]
M7	162.07[c]	13.27[d]	175.34[a]
M8	173.00[c]	4.47[e]	177.47[a]

[a,b,c,d,e] different superscript on the same column showed significant differences ($p \leq 0.05$).

Table 2. Average dry seeds/plot, dry seeds/ha and per 100 of seeds after LOF administration.

Groups	Parameters		
	Fill pods/plant (kg/18 m^2)	Empty pods/ plant (ton)	Total pods/ plant (grams)
M0	3.36[a]	1.87[a]	10.25[a]
M1	5.79[b]	3.22[b]	10.69[b]
M2	6.30[c]	3.50[c]	10.88[c]
M3	6.56[c]	3.64[c]	11.18[c]
M4	6.41[c]	3.54[c]	10.76[c]
M5	7.02[c]	3.90[c]	11.31[c]
M6	6.53[c]	3.62[c]	11.11[c]
M7	7.03[c]	3.91[c]	11.00[c]
M8	7.18[c]	3.99[c]	11.09[c]

[a,b,c,d,e] different superscript on the same column showed significant differences ($p \leq 0.05$).

This results were similar to the previous study that demonstrated the utilization of eggshell powder as the fertilizer increase pods length and the number of pods/plant (Wazir *et al.,* 2018). Another study reported that 50 mL/liter of LOF improve the the number of pods, pod's length and weight compared to the control without LOF (Buton *et al.,* 2019). It proves that organic waste can be used as the LOF on the pea comodities, especially soybean. The LOF increase the production and quality of soyben, it because of the utilization of LOF increase the soil nutrient via its ability to penetrate on the soil (Herawati *et al.,* 2017).

The phosphorus content from the LOF has potential effects on the soybean. It is supported by the previous study that demonstrated the high concentration of phosphorus synergictly increase the number of pods/plant from several species of leguminous plant (Islam *et al.,* 2016). Further, the high concentration of potassium inside the LOF significantly influences on the number of fill and empty pods/plant (Khanam *et al.,* 2016).

In addition, all treatment groups produced the higher produce compared to the control. However, the M8 showed the highest production on the dry soybean seeds per plot, per ha and per 100 of seeds ($p \leq 0.05$). Based on the results, the utilization of LOF increase the dry seeds production until 42.5% compared to the control (Table 2).

The potential effects of LOF on the soybean production is caused by the nitrogen content inside that promote and accelerate the seeds germination (Suryantini and Henny, 2015; Ahmad *et al.,* 2017). The various concentration of nitrogen, phosphorus and potassium on the soil increase the development of soybean pods and seed formation as well as the other species of legume (Perkasa and Utomo, 2016). Herawati *et al.,* (2019[b]) described that the organic waste such as water hyacinth, fishbone, eggshell and banana root has the average content of nitrogen (0.12%), phosphorus (0.10%), potassium (0.85%), C/N ratio (9.4) and the number of microbes at 1.1×10^4 CFU. Further, the existence of bacteria inside the LOF supports the convertion of nutrient in the soil into more degradable molecule that promote the plant growth (Nguyen *et al.,* 2018). The LOF formulation from seaweed promote the cation exchange capacity (CEC) from 156 to 190 me/100 grams (Hisani *et al.,* 2015). The high CEC (>20 me/100 grams) inside the LOF potentially increase the absorption of nutrient among the seed plants, increase the soil ability to maintain its humidity, and facilitate the bacterial growth that generate the loose soil.

The LOF administration on the soybean planting period produce the higher yield compared to the control. Based on its analysis showed that the LOF increase the production from 15% until 42.5% or from 2.8 tons/ha until 3.99 tons/ha. This study not only useful as the fertilizer on the plants but also as the strategy to reduce environmental stress, especially during post-harvest period and changes in the weather (rainy to dry season and vice versa) (Hammed *et al.,* 2019). It is supported by the previous study that proved the utilization of liquid organic fertilizer and biopesticides produce heavier apple than the control (Leksono and Bagyo, 2014).

Conclusion

Based on the results, it can be concluded that water hyacinth, banana root, fishbone and chicken eggshell could be used as the liquid organic fertilizer. All those liquid organic fertilizer has a potential effects on the formation of the soybean pods and seeds volume, increase the number of fill pods and decrease the number of empty pods. Further, the liquid organic fertilizer improve the soybean seed weight, that positively effects on the yield production until 42.5%.

References

Ahmad, T., Syed, T.S., Farid, U., Fazal, G. and Umair, A. 2017. Effect of organic fertilizers on growth and yield of coriander. *International Journal of Agriculture and Environmental Research (IJAAER).* 3(1) : 116-120. https://www.researchgate.net/publication/321051277

Buton, L.J., Mirja, O., M. Bula, Firman, G.D., Nur, F.A., Usman, U., La Husni, B. M. Chairul, B.U., Husen, B. Kumiati, T. and A. Yusdianti, T. 2019. The effect of nasa liquid organic fertilizer concentration and planting distance to growth and production of beans. *International Journal of Scientific & Technology Research* (IJSTR). 8(9) : 2277-8616.

Hammed, T.B, Elizabeth, O., Q. and Ana, G.R.E.E. 2019. Enhancing growth and yield of crops with nutrientenriched organic fertilizer at wet and dry seasons in ensuring climatesmart agriculture. *International Journal of Recycling of Organic Waste in Agriculture. https://doi.org/10.1007/s40093-019-0274-6*

Hasanah, Y., Tengku, Hapsoh, and Hamidah, 2014. Growth analysis of soybean varieties at dry land with application of nitrogen sources. *International Journal of Scientific and Technology Research*. ISSN 2277-8616.

Herawati, J., Indarwati, and Ernawati, 2017. Effect of basic fertilizer doses and liquid organic fertilizer concentration on soybean yield. *Journal of Agricultural Biotechnology and Sustainable Development*. 9(6) : 45-53, November 2017.DOI: 10.5897 / JABSD2017.0300. Article Number: 816739566816. ISSN 241-2340.

Herawati, J., Indarwati, R. Widya, L. Tunik, and Noerhartati, E. 2019[a]. Analysis of the chemical properties of various liquid organic fertilizers and their effects on soybean plant growth. *IOP Conf. Series: Earth and Environmental Science.* 259 (2019) *012003.* doi: 10.1088/1755-1315/259/1/012003.

Herawati, J., Indarwati, Tatuk, T. and Ristani, W.I. 2019[b]. Utilization of fish and eggshell waste as liquid fertilizersin an effort to reduce environmental pollutionand improve soybean yield. *Pollution Research Paper. 38. August Suppl Issue; Page No. (S132-S138).* ISSN 0257 – 8050.

Hisani, W., Kaimuddin, and Syamsuddin, G. 2015. Increasing the production of soybean (*Glycine max* L) by using mulch of rice straw and appliying poc (liquid organic fertilizer) from seaweed (*Gracilaria* sp.) And cattle's urine. *Journal of Biology, Agriculture and Healthcare*. ISSN 2224-3208 (Paper) ISSN 2225-093X (Online). 5(14) : 2015. www.iiste.org

Islam, M.A., Amru, N.B., Md. Motior, R. and Mohd Sofian, A. 2016. Effects of organic fertilizers on the growth and yield of bush bean, winged bean and yard long bean. *An International Journal Brazilian Archives of Biology and Technology*. http://doi.org/10.1590/1678-4324-2016160586

Khanam, M., Islam, M.S., Ali, M.H., Imtiaz, F.C. and Masum, S.M. 2016. Performance of soybean under different levels of phosphorus and potassium. *Bangladesh Agron. Journal.* 19 (1) : 99-108. https://www.researchgate.net/publication/308960810

Kuntyastuti, H., Sri, Ayu D.L. and Sutrisno, 2018. Effects of organic fertilizer and plant spacing on early-medium maturity soybean. *Journal of Degraded and Mining Lands Management ISSN: 2339-076X (p); 2502-2458* (e): 5(3) : 1171-1179 DOI:10.15243/jdmlm.2018.053.1171.

Leksono, U.S. and Bagyo, Y. 2014. The effect of bio and liquid organic fertilizer on weight and quality of apple. *International Journal of Agronomy and Agricultural Research (IJAAR) ISSN: 2223-7054 (Print) 2225-3610 (Online)* 5(5) : 53-58. http://www.innspub.net.

Mukhtar, M. and I Komang, A. 2015. The effect of liquid extract organic fertilizer of centrosema (*Centrosema pubescens*) leaf sheats on the growth and biomass production of elephant grass (*Pennisetum purpureum*). *Proceeding of International Seminar "Improving Tropical Animal Production for Food Security. Universitas Halu Oleo, Kendari, Southeast Sulawesi, Indonesia*.

Nguyen Thi, H.N., Ng Lee, C. and Nuntavun, R. 2018. The effects bio-fertilizer and liquid organic fertilizer on the growth of vegetables in the pot experiment. *Chiang Mai J. Sci.* 45(3) : 1257-1273. http://epg.science.cmu.ac.th/ejournal/Contributed Paper.

Perkasa, A. Y. and Utomo, T.W. 2016. Effect of various levels of npk fertilizer on the yield attributes of soybean (*Glycine max* L.) Varieties. *Journal of Tropical Crop Science.* 3(1), *February 2016* www.j-tropicalcrops.com

Suryantini and Henny, K. 2015. Effect of nitrogen fertilization on soybean production under two cropping patterns. *Journal of Experimental Biology and Agricultural Sciences*. 3(3): 2320–8694. http://www.jebas. org.

Wazir, A., Zishan, G. and Manzoor, H. 2018. Comparative study of various organic fertilizers effect on growth and yield of two economically important crops, potato and pea. *Agricultural Sciences*. 9 : 703-717. https://doi.org/10.4236/as.2018. 96049.