Test formulation of liquid organic fertilizer on growth and result of soybean plants

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Abstract. The objective of this research is to know the result of Liquid Organic Fertilizer (LOF) formulation on growth and yield of soybean crop. The hypothesis of this research is;(1) Suspected different LOF formulations provide different growth and yields of soybean crops;(2) suspected formulations F2 (LOF water hyacinth + banana cobs) will have a better effect on the growth of soybean crop than other formulation;(3) suspected formulations F7 (LOF water hyacinth + fish bone + chicken egg shell) will have a better effect on soybean crop yield than other formulations. The research was conducted by using Randomized Block Group Design with the following treatment: F = LOF Formulation; F0: without LOF (Control), F1: LOF water hyacinth (BioEcgon, F2 = BioEcgon + banana hump, F3 = BioEcgon + bone fish, F4 = BioEcgon + chicken egg shell, F5 = BioEcgon + banana hump + fish bone, F6 = BioEcgon + banana hump + chicken egg shell, F7 = BioEcgon + fish bone + chicken egg shell, and F8 = BioEcgon + banana hump + fish bone + chicken egg shell. From each treatment repeated 3 times, so it takes 27 plots of experiments (9x3 = 27) with a plot / plot of 18 m² (3x6). The parameters observed are plant height, number of leaves and dry weight of soybean seeds / ha. The data obtained were analyzed by Analysis of Variants (Anova), if there is a real difference followed by 5% BNT test. LOF application with various formulations is expected to improve the growth of soybean crops, so it can increase the yield of soy / ha, in the long term aims to increase land productivity and can prevent land degradation, as well as one solution in overcoming the problem of organic waste.

1. Introduction
Soybean is annual major crops in the world and important legumes in food security. Increased soybean production can achieve through increased in the intensity of soybean cultivation and expansion of soybean cultivation to marginal lands such as dry land [1].

Soybeans are one of the priority food commodities in Indonesia in the agricultural revitalization program, due to the high price fluctuations that do not rule out the possibility of destabilizing the Indonesian economy. This can be a study material, that the aspect of food security that relies on its own strength is a matter that must be encouraged and realized, especially if it does not want to depend on other countries [2].

One of the main programs of the Ministry of Agriculture is the achievement of soybean self-sufficiency, which must be supported by all parties. This opens a wide open opportunity in an effort to increase production through productivity improvements, considering the productivity of soybean at the farm level is still low at around 1.29 tons / ha, whereas the available production technology can increase soybean yields 1.7 - 3.2 tons / ha [3].
Modern agricultural orientations that pursue as much production and good quality make farmers very dependent on fertilizer use. But without adequate knowledge, the use of chemical fertilizers actually causes a decrease in the quality of crop production. The correct use of fertilizer must pay attention to its impact on the environment and on the balance of the surrounding ecosystem [4].

Soil that is often given an inorganic fertilizer gradually becomes hard, difficult to be processed so that it disrupts plant growth. Herawati from the results of her research in 2001 found the metal content of berta Cd in some inorganic fertilizers containing phosphorus (P), which is about 0.1-0.7 ppm, therefore the utilization of organic fertilizer greatly helps improve soil structure, increase soil permeability and reduce land dependence on inorganic fertilizers [5].

Organic fertilizer also acts as a food source for soil microorganisms and increases the number and activity of soil microorganisms, so that the soil becomes loose [6]. Organic fertilizers derived from organic materials and based on their form are divided into two, namely solid organic fertilizer and liquid organic fertilizer (POC). From the results of Suryaningsih's research, Jajuk and Johanes, it was concluded that the administration of home-based solid waste industrial organic fertilizer combined with POC mixed goat manure and coconut fiber gave better results compared to the provision of solid waste home organic fertilizer in the bread industry. mustard greens [7].

While the results of Herawati, Indarwati and Achmadi research concluded that with the application of liquid organic fertilizers, the water hyacinth waste on soybean plants was able to increase soybean yields by 21.6% compared to without the application of Mol in water hyacinth waste [5]. Therefore, in this study POC production was developed with various formulations to improve soybean yield in an effort to achieve soybean self-sufficiency and accelerate the achievement of Indonesian food independence. In addition, it is also a solution to overcome the problem of organic waste in Indonesia.

This study aims to determine the results of Liquid Organic Fertilizer (POC) formulations on the growth and yield of soybean plants.

2. Research method

2.1. Place and time
The research was conducted at the Production Laboratory of the Faculty of Agriculture, Wijaya Kusuma University, Surabaya and the Experimental Garden of the Agricultural Technology Study Center of Mojosari, Mojokerto. This research starts from March to July 2018.

2.2. Materials and tools
The materials needed are divided into 2, namely materials for POC production with various formulations (organic waste of banana weevils, fish bones, water hyacinth, eggshells, granulated sugar, coconut water, rice water, well water and starter (POC) and materials during planting in the field (Dering variety of soybean seeds, Urea, TSP, KCl, manure, and POC fertilizer according to treatment, meter, insulation etc.) and for in the field (hoe, brood, cetok, bucket, sprayer, camera etc.).

2.3. Research methods
The research was carried out with a Randomized Block Design method with the treatment of POC (F) formulations.

F0: Water
F1: POC water hyacinth (BioEcgon)
F2: BioEcgon + banana weevil
F3: BioEcgon + fishbone
F4: BioEcgon + chicken eggshells
F5: BioEcgon + banana weevil + fishbone
F6: BioEcgon + banana weevil + chicken eggshells
F7: BioEcgon + fishbone + chicken eggshells  
F8: BioEcgon + banana weevil + fishbone +  
Chicken eggshells  

From the treatment repeated 3 times, so it takes 27 (9 x 3) experimental plots.

2.4. Research implementation

2.4.1. Liquid organic fertilizer making and harvesting (POC)

- Preparing all the ingredients and tools then cleaning and chopping small amounts of all organic waste, putting it in a POC bath according to the treatment after that, adding all the ingredients needed, namely 1/2 kg sugar, coconut water, rice water and well water approximately 50 litters until teren dam, just stirred until smooth.  
- Closing tightly like the POC, and given an air outlet by inserting a plastic hose connected with mineral bottle waste that already contains water.  
- Left to smell like alcohol or tape for 15 days. (2 weeks).  
- POC is harvested by filtering and then put in jerry cans that have been prepared, and ready to be applied to the land according to the treatment.

2.4.2. Planting and maintenance of soybean plants

a) Land preparation: Preparation of land in the form of tillage to increase production [8]. Making drainage channels is also needed to accelerate the removal of excess water and to prevent an increase. After that the land is left for one week so the pests and diseases die in the sun. Preparation of experimental plots that will be used for planting soybeans is 3 x 6 m² = 18 m² x 27 experimental plots, divided into 3 arrays, each of which contains 9 plots.  

b) Planting and fertilization: After the soil is finished processing then planting with soybean spacing of 40 cm x 15 cm is done [5], followed by fertilization. Fertilizers used are Urea, TSP and KCl as well as manure, which is given during processing around three days before planting by dispersing between rows. After planting, it is continued by giving POC as liquid fertilizer according to the treatment, which is given once a week for six times.

c) Soybean plant maintenance: Watering in the dry season is carried out once a day in the morning or evening, from planting to before harvest. The next stage is weeding that is done mechanically. At the time of weeding, the pest is taken if there is an attack [9]. Other maintenance is by controlling pests and diseases, which is done by using seeds that are virus free; sanitation; crop rotation; by uprooting, throwing or burning attacked plants in a distant place; take and destroy eggs or caterpillars that attack plants; and other natural ways.

2.4.3. Harvest and postharvest: Harvest time is determined not only by age, 70% of leaves have yellowed and fall off and the pods have hardened and browned [10], also by the number of pods that turn yellow brown (less 95% of the pods have changed color and leaves still left in the plant around 5-10%). After harvesting the plants, then weighing the yields is in accordance with the parameters / parameters observed. Only after that is drying done by drying directly in the sun for about 3 days.

2.5. Variable

Observations were made one week after the application of the POC formulation in the field, while the observed parameters / parameters included: number of leaves / plants, plant height, and dry weight of seeds / ha.

2.6. Data processing

Observation data obtained by measuring and calculating the growth of soybean plants directly in the field in this study, processed using a Variety of RAK pattern analysis, to find out whether there are
significant differences between treatments. If there are real differences, then proceed with the Smallest Significant Difference Test (BNT 5%). While the data from the results of the analysis of chemical content is made histogram.

3. Results and discussion

3.1. Number of leaves / plants
In the number of leaf parameters there was a significant difference between the treatments at 28-56 HST. In table 1 can be seen where the treatment formulation of POC BioEcgon + banana hump + chicken eggshell (F6) has an average number of leaves that are more than other treatments, although not significantly different from F5 (BioEcgon + banana weevil + fishBone).

Table 1. Average number of leaves (Stalks) due to the different treatment forms of POC at different age of observation.

| Treatment | dap (day after planting) | 7    | 14    | 21    | 28    | 35    | 42    | 49    | 56    |
|-----------|--------------------------|------|-------|-------|-------|-------|-------|-------|-------|
| F0        | 1.9                      | 3.87 | 4.20  | 5.77  | 8.27  | 10.07 | 12.4  | 17.33 |       |
| F1        | 2.0                      | 4.20 | 4.53  | 6.27  | 8.93  | 12.33 | 17.53 | 24.60 |       |
| F2        | 2.0                      | 3.87 | 5     | 6.73  | 9.73  | 12.47 | 19.33 | 27.47 |       |
| F3        | 2.0                      | 3.93 | 4.87  | 6.87  | 9.07  | 14.20 | 18.33 | 24.87 |       |
| F4        | 2.0                      | 3.87 | 4.8   | 6.53  | 9.0   | 14.07 | 20.8  | 29.13 |       |
| F5        | 2.0                      | 3.93 | 5     | 6.87  | 9.93  | 14.53 | 20.13 | 31.87 |       |
| F6        | 2.0                      | 3.93 | 4.8   | 6.4   | 9.47  | 14.60 | 21.07 | 32.60 |       |
| F7        | 2.0                      | 4.07 | 4.87  | 6.73  | 9.93  | 12.80 | 17.93 | 29.33 |       |
| F8        | 2.0                      | 4.13 | 4.87  | 6.47  | 9.73  | 15.00 | 20.93 | 29.07 |       |
| BNT 5%    | TN                       | TN   | 0.24  | 0.37  | 0.42  | 1.64  | 2.15  | 2.27  |       |

Note: The numbers followed by the same letter in the same column are not significantly different in the 5% BNT test.

Table 1, it can be seen that there is no significant difference in the parameters of the number of leaves of observation age 7-14 days in the POC formulation treatment, but at the age of observation 21 - 56 days there is a significant difference. At age 21 hst F5 produced the highest number of leaves which were significantly different from F0 and F1, although not significantly different from F2, F3, F4, F6, F7, and F8. Whereas at the end of the growth observation that was 56 days after treatment, F6 treatment (BioEcgon + banana weevil + chicken eggshell) produced the highest number of leaves that were not significantly different from the treatment of F5 (BioEcgon + banana weevil + fishbone), but significantly different compared to other treatments.
Figure 1. Trunk diagram of the average number of leaves (stalks) due to the treatment of various POC formulations in different age of observation.

3.2. Plant height
Table 2, it can be seen that there is no significant difference in height parameters of plant observation age 7-14 days in the POC formulation treatment, but at the observation age of 21-56 days there is a significant difference. At the age of observation 21 hst F2 gave the best plant height although not significantly different from F3, F6, and F7. While at the end of the observation age of plant height 56 treatments of formulation F5 (BioEcgon + banana weevil + fishbone) gave the best plant height which has an average plant height of 70.12 cm, although not significantly different from F7 treatment (BioEcgon + fishbone + chicken eggshells).

Table 2. Average plant height (CM) due to the treatment of various POC formulations in various observation ages.

| Treatment | dap (day after planting) |
|-----------|--------------------------|
|           | 7 | 14 | 21 | 28 | 35 | 42 | 49 | 56 |
| F0        | 5.37 | 10.93 | 13 | d | 17.87 | e | 25.57 | c | 35.07 | d | 46.07 | d | 60.20 | d |
| F1        | 5.80 | 11.57 | 14.2 | c | 19.53 | cd | 28.27 | d | 38.80 | c | 51.67 | c | 63.80 | c |
| F2        | 6.03 | 12.97 | 15.53 | a | 20.73 | ab | 29.4 | cd | 40.73 | b | 51.87 | c | 65.60 | bc |
| F3        | 6.07 | 12.37 | 15.27 | ab | 21.73 | a | 32.0 | a | 42.47 | a | 54.4 | b | 66.07 | bc |
| F4        | 5.67 | 12.10 | 14.67 | bc | 20.27 | bc | 28.3 | d | 38.80 | c | 53.8 | bc | 66.53 | bc |
| F5        | 5.97 | 11.77 | 15 | bc | 20.93 | ab | 30.9 | ab | 41.33 | ab | 57.87 | a | 70.12 | a |
| F6        | 5.83 | 11.77 | 15.4 | a | 20.27 | bc | 29.7 | bcd | 38.27 | c | 54.27 | b | 66.60 | bc |
| F7        | 5.73 | 12.37 | 15.2 | ab | 20.87 | ab | 30.37 | bc | 38.60 | c | 54.73 | b | 67.47 | ab |
| F8        | 5.80 | 12.17 | 14.5 | c | 19 | de | 29.6 | bcd | 40.33 | b | 55.87 | ab | 65.73 | bc |
| BNT 5%    | TN | TN | 0.63 | 1,165 | 1.47 | 1.34 | 2.3 | 2.8 |

Description: The numbers followed by the same letter in the same column are not significantly different from the BNT 5 test.
Figure 2. Stem diagram of average plant height (cm) due to the treatment of various forms of POC at different age of observation.

3.3. Dry seed weight / Ha
In table 3 it can be seen that there is a significant difference in the potential results due to the treatment of POC formulations. In the POC formulation treatment, F8 gave better seed / ha dry weight than control (F0) and F1 formulation treatment, although it was not significantly different from the other formulation treatments (F7, F5, F4, F6, F4 and F2).

One of the best ways to use organic waste eggshells is to make it fertilizer. Eggshells are rich in calcium. The skin can be destroyed and spread on the ground so that it becomes a fertilizer containing calcium. So also with fish bone waste is the waste produced by fish which is rich in calcium, phosphorus and selenium. Utilization of bone as a source of food calcium is one of the efforts in order to meet food calcium needs while increasing the economic value of fish bone waste.

Table 3. Average seed dry weight/ Ha (tons) due to POC formulation treatment.

| Treatment | BK Seed/Ha (ton) |
|-----------|-----------------|
| F0        | 1.87 c          |
| F1        | 3.22 b          |
| F2        | 3.50 ab         |
| F3        | 3.64 ab         |
| F4        | 3.54 ab         |
| F5        | 3.90 a          |
| F6        | 3.62 ab         |
| F7        | 3.91 a          |
| F8        | 3.99 a          |

BNT 5% 0.57

Note: The numbers followed by the same letter in the same column are not significantly different in the 5% BNT test.
According to Kaya, the protein content of catfish bone reaches 22.22% and besides protein in bone meal catfish also contains high phosphorus [11]. According to Poedjiadi phosphorus is one of the constituent elements of proteins in addition to carbon, hydrogen, oxygen, nitrogen, and sulphur [12]. The high phosphorus content found in the bones of catfish as a constituent of protein components can spur growth.

4. Conclusion

- From the results of this study, it can be concluded: There was a significant difference in the parameters of plant growth in the number of leaves and plant height, as well as the parameters of the production of seeds / ha for the treatment of POC formulations.
- In the parameter, the number of leaves 56 dap treatment of POC formulation of water hyacinth + banana hump + chicken eggshell (F6) had an average number of leaves that were more than other treatments, although not significantly different from F5 (water hyacinth + banana hump + bone fish).
- At the end of the observation, 56 days after planting, the high parameters of POC formulation treatment for water hyacinth + banana hump + fish bones (F5) had higher average plant height than other treatments, although not significantly different from F7 (water hyacinth + fish bones + chicken eggshell).
- On BK production parameters seeds / ha there is a real difference between treatments, where POC F8 formulation treatment has an average of seeds / ha BK which is more than the treatment of F0 and F1, although not significantly different from other treatments.

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