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Effects of Types of Bioactivator and Concentration of Cow-Blood Based Fertilizer on Growth of Soybean (*Glycine max* (L.) Merril.)

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ABSTRACT

Soybean productivity in Bengkulu Province is still considerably lower than national productivity does. Such low productivity could be improved by using cow's blood waste as nutrient sources. This experiment aimed to determine the effect of bioactivators and concentration of cow-blood based fertilizer on growth of soybean. A factorial experiment was arranged in completely randomized block design with two factors and three replications. The first factor was the type of bioactivators added into the cow-blood (Yeast, Stale Rice, Microorganism-Bio (M-Bio), Effective Microorganism-4 (EM-4), and Rumen). The second factor was the concentration of cow-blood based fertilizer (15%, 30%, and 45%). Results indicated that (1) there were no effects of treatment interactions between bioactivators and concentration of cow-blood based fertilizer on the growth of soybean, (2) type of bioactivators significantly affected plant height, number of leaves, number of branches, wet- and dry-weight of soybean shoots, but did not significantly affect plant height and leaf area, and (3) concentration of of cow-blood based fertilizer did not significantly affect soybean growth. This study indicated that using rumen as bioactivator for cow-blood based fertilizer had better growth performance of soybean.

INTRODUCTION

Soybean is a member of the leguminosae family, a group of plant that can fix atmospheric nitrogen (N2) through symbiotic bacteria (rhizobia) in root nodules. Legumes have been used in a crop rotation system to restore the nitrogen in the soil to support the sustainability of agriculture practices (Barnes, 2010). According to (BPS, 2018) the area of soybean cultivation in Bengkulu Province reaches only 3,987 ha with productivity of 1.1 tons/ha. Soybean production produced by Bengkulu Province is still lower than national soybean production reaching 2.5-3 ton/ha. To meet the need for soybean for Bengkulu, it must be supplied from other regions such as Java and Lampung Province.

In Bengkulu town, cow and buffaloes are slaughtered as many as 10-15 animals per day. Meanwhile, cow blood can be utilized as source of organic fertilizer and contains high nutrients such as N, P, K higher than other types of livestock. It is reported that cow's blood is sufficient to meet nutrients for plants (BPS, 2014). The total nutrient content of cow'blood consisting of N = 12.18 %, total P = 5.28 %, total K = 0.15 %, and Carbon organic 19.01 % (Abrianto, 2011). Animal based fertilizer, due to intrinsic composition, increased total tree

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biomass and carbohydrate leaves content, and led to lower soil nitrate concentration and higher P and Mg exchangeable in soil extract compared to vegetal based fertilizer (Alcantara et al., 2016].

In crop production practices, fertilizer management is an important factor, farmers are more interested to use chemical fertilizers, ultimately the effect of chemical fertilizer is not so good. The continuous uses of high level of chemical fertilizers has led to problem of soil degradation, which is proving detrimental to crop production (Khaim et al., 2013). The low nitrogen treatment conditions, using Hoagland nutrient solution had a trend towards producing more favorable physiological outcomes on soybeans (Onor et al., 2014).

The processing of materials, helped by microbes, are able to transform complex components into simpler forms through fermentation. Fermentation can improve certain properties of ingredients such as younger digestible, more resistant stored and can eliminate the toxic compounds contained therein. Fermentation can also increase the protein content of the material because the body itself contains 19-38% (Jamarun and Zulkarnain, 2010). Activator is a material that can be used to accelerate and streamline composting process. Cow rumen is one of potential activator by breeding its microorganisms (Isnaini, 2006). Cow rumen activator at a concentration of 60 % and dose 20 tons/ha of sugar palm waste compost is the most effective treatment for sweet corn cultivation in coastal sandy soil (Larasati et al., 2017).

The steps to make cow's blood fertilizer are by mixing cow's blood with Effective Microorganism-4 (EM-4), stale rice or yeast, its aims to accelerate the fermentation. According to (Adhiati, 2011), M-Bio is the result of high technology that contains colonies of cow rumen microbes isolated from nature to help decompose the structure of feed tissue that is difficult to decompose. Based on the description above has been done research the role of fermentation and concentration of cow blood bioactivator with various sources of microorganisms. In this line with the research by (Larasati et al., 2017) states that sugar palm waste an industrial waste that need an activator like cow rumen to cut composting time. Microorganisms that overhaul organic material is a biological activator that grows natural or deliberately inoculated to accelerate composting and quality improvement of compost. It also depends on the number and types of microorganism (Darmayanti, 2015). This experiment aimed to determine the effect of bioactivators and concentration of cow-blood based fertilizer on growth of soybean.

MATERIALS AND METHODS

This research was conducted in the Field Experiment of Faculty of Agriculture, University of Muhammadiyah Bengkulu from May to August 2018, with altitude of 20 m. This research was conducted by using completely randomized design with two factors. The first factor was the type of bioactivators added into the cow-blood (Yeast, Stale Rice, Microorganism-Bio (M-Bio), Effective Microorganism-4 (EM-4), and Rumen). The second factor was the concentration of cow -blood based fertilizer (15%, 30%, and 45%).

The experiment was replicated three times to obtain 5x3x3=45 experimental units. Soybean growth responses were observed in terms of plant height, leaf number, leaf area, fresh and dry weight of plant. The data obtained were analyzed using Analysis of Variance with $\alpha = 5$ %. Data showing significant effect among treatments were tested using Duncan's Multiple Range Test with $\alpha = 5$ %.

RESULTS AND DISCUSION

Soil Analysis

The results of soil analysis were shown in Table 1. In general, macronutrient content is low and it is not sufficient for soybean growth. However, nutrient content can be increased with added cow's blood fertilizer that has been fermented with various sources of microorganisms.

Nutrient Analysis

Results indicated that nutrient contents of cow's blood added with bioactivators had the highest N content (0.37%), the followed by Stale rice (0.33%), EM-4 (0.29%), M-Bio (0.29%) and Yeast (0.26) (Table 2). In addition, P content in Yeast was the highest (5.24 ppm),

Tabel 1. Soil Analysis

No	Analysis	Value	Criteria
1	Organic materials		
	Carbon	4.16	medium
	Nitrogen	0.11	low
2	P Bray (ppm)	9.68	Very low
3	K-dd	1.39	Very low
4	Ca-dd	7.24	medium
5	Mg-dd	1.10	medium
6	KTK	17.55	medium
7	Al^{+3}	1.43	medium
8	H^{+}	0.11	medium
9	pH H_2O	5.20	acid
10	Texture		
	Sand (%)	68.61	
	Dust (%)	12.77	
	Clay (%)	17.44	

Note :Soil Analysis (Agriculture Faculty, Bengkulu University, 2016)

followed by EM-4 (4.61 ppm), M-Bio (3.66 ppm), Rumen (3.52 ppm) and the lowest P content was in stale rice (1.95 ppm). Result also indicated that that the highest K (mg/100 g) contents was in Stale rice (1.84), followed by M-Bio (1.58), Rumen (1.38), EM-4 (1.21) and yeast (1.12). It appeared that microorganisms have their respective roles in the reshuffle of cow's blood.

Cow's Blood Bioactivator

Bioactivator type has significant effect on number of leaf, number of branches, area of leaf, wet and dry weight of soybean (Table 3). It appeared that the number of leaf, there was showed that a significant effect between the Rumen and Yeast but not significantly effect with EM-4, Stale rice and M-Bio. For the number of branches it was seen that Rumen treatment has significant effect with EM-4, Yeast, M-Bio and Stale rice. However, the leaf of area of soybean did not significantly affect between Rumen treatment, Stale Rice, EM-4 and M-Bio, but significant effect with yeast. While the dry and wet weight variables showed not significant affect between Rumen treatment, Stale Rice, EM-4 and M-Bio but significant effectwith yeast.This is caused that the five types of bioactivators in cow's blood have macro nutrients N, P and K are almost identical (Table 2), so the effect is not significant. Although the effect is notsignificant, but based on visual observations the soybean plants added with rumen bioactivator showed the highest number of leaf, number of branches, leaf area, wet weight and dry weight of soybean plant. Plant dry weight of the results of photosynthesis, nutrients uptake and water absorption. Plant dry weight could indicate plant productivity because 90 % of photosynthesis products are in the dry weight form (Garnerd et al., 2008).

According to (Saraswati, 2013)], the use of microbial fertilizer combined with organic fertilizer is a must in soybean production. This application is able to improve the physical, chemical and biological properties of the soil improve the efficiency of N, P and K fertilizer and increase the efficiency of organic material reshuffle in the soil. Results indicated that the

Table 2. Nutrient i.e. elements of cow's blood added with bioactivators

No	Nutrient and Moisture Contents				
	Bioactivator	N (%)	P (ppm)	K mg/100g	Moisture (%)
1	Yeast	0.26	5.24	1.12	20.14
2	Stile Rice	0.33	1.95.	1.84	11.95
3	M-Bio	0.29	3.66	1.58	14.61
4	EM-4	0.29	4.61	1.21	18.40
5	Rumen	0.37	3.52	1.38	16.44

Note : Nutrient Analysis (Balai Pegkajian Teknologi Pertanian Bengkulu, 2016)

Table 3.The effect of cow's blood added with bioactivator on growth

No	Bioactivator	Observation				
		Number leaf (sheet)	Branch Number(unit)	Leaf Area (cm2)	Fresh weigh (g)	Dry weight (g)
1	Yeast	24.11b	1.33b	461.1b	18.00b	4.04b
2	Stile Rice	27.44ab	1.77b	636.99a	23.66a	5.51a
3	M-Bio	27.88ab	1.66b	612.32a	22.77a	5.00ab
4	EM-4	26.33ab	1.77b	671.51a	20.77ab	5.61a
5	Rumen	31.88a	2.55 a	719.71a	25.33a	5.83a

Note : Numbers followed by different letters in the same column indicate significant different (P<5 %)

Table 4. Effect of cow-blood based fertilizer on soybean

No	Concentration (%)	Observation				
		Leaf number (sheet)	Branch number (unit)	leaf Area (cm^2)	Fresh weight (g)	Dry weight (g)
1	15	30.5	1.64	660.43	22.72	5.48
2	30	27.22	1.77	649.12	23.55	5.26
3	40	27.11	1.68	583.99	21.50	5.04

treatment of bioactivator, yeast, stale rice, m-bio, EM-4, and MOL showed their influence, because inter bioactivators have not shown any significant effect but bioactivator with yeast has real effect.

Cow's blood concentration

Results indicated that concentration of cow's blood fertilizer has no significant effect on leaf number, branch number, leaf area, wet and dry weight of soybean plant (Table 4). Such insignificant effects were presumably attributed to low nutrient contents of deployed bioactivators (Table 2), where N nutrients was classified medium (0.29 - 0.37%), P element is very low (1.95 - 4.24 ppm) and the K element is very low (1.12 - 1.84 mg / 100 g ground). It seemed that N, P and K on organic fertilizer liquid are still lacking to increase the growth of soybean.

This study only used manure with a ratio 1:4 and without the use of inorganic fertilizers. This is in line with (Ernawati *et al*., 2015), that cow's blood is potentially to be used as friendly organic fertilizer and can increase growth of vegetable. According to (Oki *et al*., 2017) the treatment of cow's blood can increased seed dry weight of 100 grains of soybeans. The different results reported by (Rojer *et al*.,2017), that the treatment cow's blood added with rumen bioactivator can increase growth and yield production of Anjasmoro varity soybean. The organic fertilizer of cow's blood can increased plant growth and yield production of sallot (Miraza *et al*., 2013). The fertilization with the right concentration with the right concentration wiil give optimal result in plans, if the influence of other factors such as temperature, light, etc. are in the optimal condition (Kelik, 2010).

Treatments Interaction

Result indicated that thee was no significant interaction effects between various kinds of cow's blood added with bioactivators and its concentration on soybean growth. It was assumed that the level concentration of cow's blood and nutrient of soil before treatment is low.

Certain limitations are applicable to our study. First, we did not evaluate the effect of various kinds of cow's blood added with bioactivators on soil. Second, we did not evaluate the effect treatment on yield. Future research should focus on the cow rumen bioactivator under different concentrations of cow's blood and its impact on overall plant growth and yield.

CONCLUSIONS

The were no interaction effects of bioactivators added into the cow's blood and the concentration of cow-blood based fertilizer on soybean growth. Type of bioactivator for blood-based fertilizer significantly affected, number of leaves, number of branches, wet and dry weight, but not plant height and leaf area.of soybean. The concentration of cow blood added with bioactivators has no significant effect in soybean growth. Cow blood added with Rumen as bioactivator showed better growth of leaf number, area leaf, branch number, fresh weight, and dry weight of soybean.

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