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UTILIZATION OF MANURE WITH RUMEN BIOACTIVATOR AS A COMPLEMENT TO INORGANIC FERTILIZER IN SOYBEAN CROPS (*Glycine max L. merrill*).

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Abstract

The demand for soybeans in Indonesia is increasing along with the increasing population growth. The average soybean demand reaches 2.3 million tons/ha, but production in Indonesia is only around 800-900 thousand tons. For this reason, one of the efforts that can be made to increase soybean production is to use organic fertilizers with advantages that are environmentally friendly. Cow rumen is one of the wastes from slaughterhouses that has not been utilized. The cow's rumen contains many bacteria that can be used as bioactivators. Cow rumen bioactivator can be used as an ingredient to accelerate the decomposition process of manure. In addition, this study also used cow blood waste from slaughterhouses. The design used was a Randomized complete block design (RCBD) with one factor, namely the type of manure (A): A0 (control), A1 (chicken manure+rumen bioactivator), A2 (goat manure+rumen bioactivator), A3 (cow manure+rumen bioactivator) repeated as many as 4 times. The results of the data analysis used Analysis of Variance's and if they were significantly different, a further test of Duncan's Multiple Range Test (DMRT) was carried out at a level of 5%. The results showed that the application of manure enriched with cow rumen bioactivator had a significant effect on plant height at 28 dap, number of leaves at 14 dap, and the number of branches at 56 dap weighing 100 plant seeds, had no significant effect on pod weight, and the number of Cipo pods planted at soybean plant (Glycine max L. Merril).

Keywords: Bioactivator, Cow Rumen, Manure, Soybean.

1. Introduction

Soybean is one of Indonesia's leading export commodities. According to FAO data (2022), Soybean is one of the food sources of vegetable protein. The need for soybeans in Indonesia always increases every year. This is due to the increasing population growth in Indonesia. The average soybean requirement reaches 2.3 million tons/year, but soybean production in Indonesia is only 1.56 tons/ha. Based on the Central Bureau of Statistics (2021), soybean production in Bengkulu has decreased, reaching only 1,187 tons, this is due to soybean production in several regions in Bengkulu Province, precisely in Mukomuko, Kaur, Rejang Lebong, Seluma, and South Bengkulu regencies. One of the causes of the decline in soybean production is cultivation techniques, namely proper and sustainable fertilization. To overcome these problems, efforts are needed to increase soybean production, one of which is by using fertilizers.

Fertilizers are additives to meet the nutrient needs of plants. Fertilizers themselves can be divided into two, namely organic fertilizers and inorganic fertilizers. Inorganic fertilizers have advantages and disadvantages. The advantage of inorganic fertilizer is that it is a high nutrient element that is easily dissolved in so that it is easy to absorb nutrients in plants. Inorganic fertilizer can increase vegetative growth and increase fruit weight in curly chili plants (Diansyah. 2017). The disadvantages of inorganic fertilizers are that they are not environmentally friendly and expensive, besides the excessive and continuous use of inorganic fertilizers can reduce soil quality and can kill organic matter in the soil and can cause long-term losses. The addition of organic matter is an effort to improve the biological, physical, and chemical properties of soil by using organic materials, one of which is by using organic fertilizers.

Organic fertilizers are fertilizers that come from the weathering or fermenatsi of organic materials that occur naturally. Organic fertilizers have several types, including liquid organic fertilizers and organic solid fertilizers. One source of organic solid fertilizer comes from crop residues (compost) and animal manure.) Organic solid fertilizers have the advantage of being able to provide macro and micro nutrients, increase water-bearing capacity, increase activation of soil organic matter, and are environmentally friendly. Organic fertilizers also have disadvantages including not being able to provide nutrients directly. Organic fertilizers require a decomposition process so that the nutrients can be absorbed by plants. To accelerate the decomposition process of manure, one of them is by using bioactivators. Rumen is one of the materials used as a bioactivator.

Slaughtering cattle produces waste in the form of cow's blood and rumen. One cow produces an average of 20-30 liters of cow's blood waste (Heramdi, 2017). One cow can produce about 31 liters of rumen contents (Basri & Elma, 2017). This waste if not utilized will pollute the surrounding environment. To overcome this problem, further processing is needed, which can be used as a bioactivator in cage fertilizer..

Based on the results of isolation and identification of microbes contained in rumen fluid, xylanolytic bacteria were obtained, namely: *Bacillus sp., Cellumonas sp., Lactobacillus sp., Pseudomonas sp.,* and *Acinetobacter sp,* (Lamid, 2006). The rumen is a very complex ecosystem and contains a variety of mycorrbes (Yanuarto *et al.* 2019). Application of chicken fertilizer enriched with bioactivators can increase pod weight in soybean plants (Saputra, A. 2021). According to (Melinda., S *et al.* 2021) cow manure can increase the vegetative growth of soybean plants. In the research of IK, Safitri (2021), the application of goat manure with various kinds of bioactivators can replace the use of synthetic inorganic fertilizers with standard doses in purple pulut corn plants. In addition, the use of used soil from bioactivavtor on soybean plants can reduce the use of inorganic fertilizers. Cow's blood with the addition of rumen can increase the number of leaves, plant wet weight, and plant dry weight (Vermicompost of rumen content waste can be used as a medium for earthworm cultivation (Hidayanti & Agustina. 2019). The objectives in this research are: (1) To get the best response of cow rumen bioactivator to soybean plant growth (Glycine max L. Merril); (2) To get the best response of cow rumen bioactivator to soybean plant yield (Glycine max L. Merril).

2. Materials and Methods

The research was conducted in the experimental garden of the Faculty of Agriculture and Animal Husbandry, Universitas Muhammadiyah Bengkulu from October 2022 to March 2023. The tools used were hoe, machete, paddle, hose, label paper, meter, vernier caliper, digital scale, plastic sheeting, stationery, and camera. The materials used were soybean seeds variety Demas-1, goat manure, chicken manure, and cow dung, cow rumen, cow blood, sugar, and water.

The design used is a Randomized complete block design (RCBD) with one factor, namely the type of manure A0 (Control), A1 (Chicken Manure), A2 (Goat Manure), and A3 (Cow Manure). Each treatment was repeated 4 times, in one treatment there were 4 plants so that 64 plants were obtained. Parameters observed include: Plant Height (cm), Number of Leaves (strands), Number of Branches (fruit), Weight per 100 Seeds (g), Plant Pod Weight (g). And Cipo pod weight (g). The results of the data were analyzed using Analysis of Variance (ANOVA) and then if there was a significant effect, the Duncan's Multiple Range Test (DMRT) was conducted at the 5% level.

Work Steps:

Preparation of manure with various bioactivators.

Prepare various kinds of manure that have been taken from animal farms in the Kepahyang Regency area of Bengkulu Province. The manure used is 20 kg

cow manure, 20 kg goat manure and 20 kg chicken manure.

Prepare cow's blood obtained from slaughterhouses in Bengkulu city, for one animal dung required 10 liters of cow's blood, so the need for cow's blood is as much as 30 liters of cow's blood and 3 kg of sugar for each animal dung.

Each 20 kg of manure, 1 liter of cow rumen, 10 liters of cow blood, and 1 kg of sugar that has been dissolved is mixed until flat using a hoe. After that, it was covered using a plastic tarp and allowed to stand for 14 days

Figure 1. The process of making manure enriched with cow rumen bioactivator. Chicken, goat, and cow manure were each mixed with cow rumen and cow blood.

Land and Seed Preparation. The land was cleared of plant debris and surrounding garbage and then the soil was leveled and loosened. After that, beds were made with a treatment plot size of 40 cm x 40 cm. Soybean seeds were ordered from UPBS BALITKABI.

Seed Planting. Each plot has 4 planting holes with a depth of 2 cm, each hole has a distance of 20 cm x 20 cm, each hole is planted as many as 2 pieces.

Application. The application of manure with various bioactivators was done one week before planting at a dose of 300 g/plant. For the control treatment (N, P, and K), N fertilizer used urea 25 kg/ha, P fertilizer used SP36 100 kg/ha, and K fertilizer used KCL 100 kg/ha.

Plant Maintenance. Plant maintenance includes watering in the morning, thinning when the plants are two weeks old after planting, replanting to replace dead seedlings, pest and weed protection using synthetic pesticides. Weeding is done once every 2 weeks.

Harvesting is done at the age of 85 dap The characteristics of soybeans that are ready for harvest are that many leaves have turned yellow, fallen off, and dried, the pods are evenly brownish yellow in color and the stems have dried up.

3. Results and Discussion

Based on the analysis of variance, the application of manure enriched with cow rumen bioactivator has a significant effect on plant height, number of leaves, and number of branches as well as the weight of 100 plant seeds, the weight of pods per plant and the number of cipo pods on soybean plants.

The results of the analysis of variance table of manure enriched with cow rumen bioactivator can be seen in the table below:

Table 1. Effect of applying various types of manure enriched with bioactivator on soybean

Parameters	Manure with Cow Rumen Bioactivator
Plant Height (cm)	6,85 **
Number of leaves (strands)	11,18**
Number of branches (fruit)	3,70 *
Weight of 100 Plant Seeds (g)	4,17 *
Plant Pod Weight (g)	0,95 tn
Number of Cipo Pods Per Plant (fruit)	0,48 tn

*Description: * : significant effect, ** : very significant effect*

The results of the analysis of variance showed that the provision of manure enriched with cow rumen bioactivator had a significant effect on the vegetative growth of soybean plants so it was necessary to conduct further tests using the *Duncan's Multiple Range Test* (DMRT) method

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Table 2. DMRT further test of manure enriched with cow rumen bioactivator on soybean plant growth.

Treatment	Plant Height (cm)	Number of leaves (strands)	Number of branches (fruit)
A0 (Control)	6,33 a	0,92 a	5,63 b
A1 (Chicken manure)	5,71 b	0,63 b	6,75 a
A2 (Goat manure)	6,31 a	0,90 a	6,63 a
A3 (Cow manure)	6,67 a	0,96 a	6,33 ab

Descriptions: Numbers followed by the same letter in the same column are not significantly different by DMRT test at 5% level.

The results showed that the provision of manure enriched with cow rumen bioactivator had a significant effect on the vegetative growth of soybean plants. This is thought to be because the bioactivator-enriched manure contains macronutrients that meet the optimal growth of soybean. This is in accordance with the results of the soil analysis laboratory that the enriched manure has a high content of N, P, and K. Macro nutrients are elements that are needed in large quantities (Abdoellah and Pujiyanto, 1992), in this case the manure plus bioactivator contains high macro nutrients so as to increase the growth of soybeans.

In addition, the number of bacteria in the rumen is quite a lot, so the rumen can potentially be used as a mixture of solid organic fertilizer. Rumen contents are waste produced by slaughterhouses that can be utilized as bioactivators so as to accelerate the decomposition process of organic matter contained in nutrients so as to increase the availability of nutrient absorption in the process of soybean plant growth, especially in the process of photosynthesis. According to Joko (2014) cow rumen is very useful for the processing of manure or compost, and can improve the level of soil fertility, microorganisms contained in the contents of the cow rumen can increase the fermentation of waste and increase the availability of nutrients in the soil. In addition, cow rumen contents waste can be used as local microorganisms (LOM) with a mass of 75 g of rumen contents waste containing 92 x 104 bacteria and the identified bacteria are Bacillus subtilus and Lactobacillus Licheniformis (Hudha, 2020).

Along with the increase in the process of photosynthesis, the absorption of water and the formation of carbohydrates will also increase, thereby increasing the fresh weight of the plant. The increase in plant fresh weight is in line with cell enlargement and elongation associated with plant fresh weight (Alfred et al. 2017).

Table 3. DMRT test of manure enriched with cow rumen bioactivator on soybean yields.

Treatment	**Weight per100 seeds (g)**	**Weight of filled pods per plant (g)**	**Number of cipo pods per plant (g)**
A0 (Control)	11,44 b	110,96	13,27
A1 (Chicken manure)	11,96 a	130,96	11,83
A2 (Goat manure)	11,75 a	125,67	13,13
A3 (Cow manure)	11,79 a	112,56	11,85

Descriptions: Numbers followed by the same letter in the same column are not significantly different by DMRT test at 5% level.

This is due to the optimum conditions in the provision of nutrients needed by soybean plants in the production process. High plant growth activity results in higher productivity. High photosynthetic activity and growth rate will increase the yield of photosynthate which is then stored as plant production (pods).

Pods on soybean plants are strongly influenced by environmental factors, one of which is the type of manure given, namely the nutrients N, P, and K contained in the content of manure, besides that it can improve the physical, chemical and biological properties of the soil.

The addition of organic matter can increase soil aggregation so that it can increase water holding and binding (Sumarni, 2018). Root nodule formation can be influenced by moisture and water availability (Kumlasari et al, 2013). The formation of root nodules will increase the activity of Rhizobium bacteria in fixating N needed by plants in increasing metabolism for photosynthesis. According to Triadiati *et al* (2013) root nodules are very

effective in providing nitrogen to plants as the formation of carbohydrates as a result of photosynthesis which is then stored in the form of pods or fruit.

The activity of rhizobium in the process of optimal N fixation can indirectly increase the yield of photosynthesis and then the results of the process are translocated into soybean seeds (Hendriyanto et al, 2017). In addition, there is Phosphate content in manure which functions to produce seeds and mature pods. According to Mahadianoor *et al* (2017) phosphate content in the soil can increase the weight of seeds and the number of pods.

4. Conclusions

The results showed that utilization of manure with rumen bioactivator as a complement to inorganic fertilizer can increase soybean growth. The best results in soybean production is with rumen bioactivator as a complement to inorganic fertilizer.

References

[1] Alfred KM., Agus S., Yoseva S. 2017. plication of solid Bio-Slurry organic fertilizer on Pakchoy (Brassica chinensis L.) plants. JOM Faperta 4 (2): 1-11.

[2] Abdoellah, S. dan Pujiyanto, 1992. Beberapa Metode Penentuan Jenis dan Dosis Pupuk untuk Kakao dan Kopi, Prosiding Simposium Optimalisasi Kesuburan Tanah, Jember.

[3] Central Bureau of Statistics. 2018. Food Crop Production of Bengkulu Province.. https://www.bps.go.id/statictable/2019/04/10/2055/nilai-produksi-dan-biaya-produksi-per-musim-tanam-per-hektar-budidaya-tanaman-padi-sawah-padi-ladang-jagung-dan-kedelai-2017.html. Accessed on March 18, 2022.

[4] Basri & Elma. 2017. Potential and Utilization of Cow Rumen as Bioactivator.

[5] Damayanti, V., Oktiawan, W., & Sutrisno, E. (2017). Effect of vegetable waste addition on C-organic and total Nitrogen content in vermicomposting rumen waste from slaughterhouse cattle (Doctoral dissertation, Diponegoro University).

[6] Diansyah, A. (2017). Growth and production response of curly chili (Capsicum annuum L.) to compost and inorganic fertilizer application in polybags. Journal of Indonesian Horticulture, 8(3), 203-208.

[7] Hendriyanto, M. F., Suharjono and S. Rahayu. 2017. Application of Rhizobium inoculation and sp-36 fertilizer on soybean seed production and quality. Agriprima Journal. 1 (1): 84 - 94.

[8] Hermadi, H A. 2017. Earning Rupiah from Livestock Waste. Airlangga University.. https://www.unair.ac.id/site/article/read/1071/mendulang-rupiah-dari-limbah-ternak.html. Accessed on March 20, 2022.

[9] Hudha, M. I. (2020). UTILIZATION OF SAPI RUMEN CONTENT AS LOCAL MICROORGANISM (MOL). journal ATMOSPHERE, 1(1), 30-36.

[10] Hidayati, N., & Agustina, D. K. (2019). Physical quality of compost with cow rumen contents and its application on corn germination. (Indonesian Journal of Animal Science), 21(2), 76-84.

[11] Joko. 2014. Benefits of Rumen for Organic Farming. https:Organikilo.Co/2014/10/Manfaat-Limbah-Rumen-Untuk –Pertaniian-Organik.Html. Accessed on March 20, 2022.

[12] Kumalasari, I. D., Astuti, E. D., & Prihastanti, E. (2013). Root nodule formation of soybean (Glycine max (L) Merrill) plants with straw treatment at different incubation periods. Journal of Science and Mathematics Diponegoro University, 21, 103-107.

[13] Mahdiannoor N., Istiqomah, Syahbuddin. 2017. Growth and yield of two varieties of Soybean (Glycine Max L.) with Biofertilizer. Ziraa'ah 42 (3): 257-266.

[14] Melinda, S. (2021). The Effect Of Cow State Fertilizer with Various Bioactivations and Cow Broth Feeding On The Growth and Production Of Soybean (Glycine Max L. Merril). Nabatia, 9(1).

[15] Podesta, F., Harini, R., Fitriani, D., & Suryadi, S. (2020). Relationships Between Nutrient Of Land And Cow's Blood Added With Bioactivators On Performance of Soybean (Glycine max (L.) Merr.). Akta Agrosia, 23(2), 67-71.

[16] Safitri, I. K., Podesta, F., Fitriani, D., Suryadi, S., & Harini, R. (2021). Effect of Goat Manure with Various Bioactivators and Doses of Cow Broth on the Growth and Yield of Purple Pulut Corn (Zea mays var. ceratina Kulesh). AGRIUM: Jurnal Ilmu Pertanian, 24(1), 55-62.

[17] Saputra, A., Podesta, F., Fitriani, D., Suryadi, S., & Harini, R. (2021). INFLUENCE OF BIOACTIVATORS ON CHICKEN LOTS AND TRICHODERMA PLANTING ON GROWTH AND RESULTS OF Soybean (Glycine Max L. Merril). Journal of Agricultural Discourse, 17(1), 35-43.

[18] Sumarni, T. & Ramadhan, A. F. N., (2018). Response of shallot plants (Allium ascalonicum L.) to manure and inorganic fertilizer (NPK). Journal of Plant Production, 6(5), 815-822.

[19] Setia, A. A., Fiana, P., Yukiman, A., Ririn, H., & Suryadi, S. (2020, August). Analysis of Soybean (Glycine max L. Merril) Plant Growth on Soil Used Bioactivator and Trichoderma with a Combination of Inorganic Fertilizer Doses. In Prosiding Seminar Nasional Agriculture Faculty UNS (Vol. 4, No. 1, pp. 205-212).

[20] Triadiati, N. R. Mubarik and Y. Ramasita. 2013. oybean plant growth response to acid tolerant Bradyrhizobium japonicum and fertilizer application in acid soil. Indonesian Journal of Agronomy. 4(1): 24 - 31.

[21] Trirahmah, Z., Podesta, F., & Yasin, U. (2020). NFLUENCE OF BIOACTIVATORS AND MICORIZA SPECIALTY AND ANORGANIC PUPIL COMBINATION ON GROWTH AND RESULTS OF Soybean (Glycine max L. Merril) PLANT. Agriculture, 15(1, July).

[22] Yanuartono, Y., Nururrozi, A., Indarjulianto, S., & Purnamaningsih, H. (2019). The role of protozoa in ruminant digestion and the impact on the environment. TERNAK TROPIKA Journal of Tropical Animal Production, 20(1), 16-28.