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Increasing the Growth and Production of Peanut Plants (*Arachis hypogaea* L.) by applying Bokashi and Liquid Organic Fertilizer from Vegetable Waste

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ABSTRACT

Importance of using organic fertilizers to sustainably improve agricultural productivity, especially in low-fertility soils, is crucial. Peanuts (*Arachis hypogea* L.), a high-economic-value crop, require appropriate fertilization to support optimal yields. Bokashi fertilizer and liquid organic fertilizer (LOF) from vegetable waste have the potential to enhance soil fertility, microbial diversity, and crop yields. This study aims to evaluate the effects of Bokashi and LOF applications on peanut yield and soil quality. The method used is a randomized block design (RBD) with two treatment factors. The results showed that the application of Bokashi and LOF significantly increased the number of pods, seed weight, and peanut production per hectare. The best treatment was found in the combination of Bokashi and LOF at the 50 ML/L concentration, which produced the highest number of pods (24.59), the highest seed weight per plant (4.37 grams), and a yield per hectare of 0.72 tons. In conclusion, the use of organic fertilizers, especially LOF from vegetable waste, significantly improves peanut productivity and has the potential to support sustainable agricultural practices.

Keywords: Bokashi, Liquid organic fertilizer, Peanuts, Soil fertility, Sustainable agriculture

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1. INTRODUCTION

The application of Bokashi and liquid organic fertilizer from vegetable waste on peanut (*Arachis hypogea* L.) yields is crucial for understanding the potential to enhance sustainable agricultural productivity. Peanuts are a high-value crop that plays a significant role in farming systems, especially in areas with low soil fertility. The use of organic fertilizers, including Bokashi and liquid organic fertilizers, has been proven to significantly improve soil fertility and crop yields (Lang et al., 2021).

Organic fertilizers, such as Bokashi, contain microorganisms that can improve soil structure and enhance nutrient availability to plants. Studies show that applying organic fertilizers can increase peanut growth and yield, particularly when combined with Rhizobium inoculation, which aids in nitrogen fixation (Argaw, 2018). Additionally, liquid organic fertilizer from vegetable waste has shown great potential in boosting soil nitrogen, phosphorus, and potassium content, which are essential for peanut growth (Sudirja et al., 2023).

In the context of sustainable agriculture, using organic fertilizers not only improves crop yields but also contributes to long-term soil health. Research has shown that reducing chemical nitrogen fertilizer usage and adding organic fertilizers can increase photosynthesis rates and peanut yields (Zhang et al., 2023).

The combination of organic fertilizers and sound cultivation practices, such as crop rotation and proper soil management, can result in significant yield improvements. It has been found that organic fertilizers enhance soil microbial diversity, contributing to soil health and plant productivity (Liu et al., 2015). Therefore, this study aims to explore the effectiveness of applying Bokashi and liquid organic fertilizer from vegetable waste in increasing peanut yields and its impact on soil quality and microbial diversity.

Thus, this research not only focuses on improving peanut yields but also on developing sustainable and environmentally friendly farming practices. The findings of this study are expected to provide new insights into agricultural resource management and boost peanut productivity in low-fertility regions.

2. MATERIAL AND METHODS

The research was conducted in Tonasa Village, Tombolo Pao District, Gowa Regency, South Sulawesi Province, geographically located at South Latitude (SL): 5° 12' 29.74" and East Longitude (EL): 119° 55' 33.27". The research lasted for five months, from the end of the rainy season to the beginning of the dry season. The materials used in this study included local varieties of peanut seeds, Bokashi fertilizer, and liquid organic fertilizer (LOF). The tools utilized in the research were polybags, hoes, machetes, buckets, spoons, sacks, scales, measuring tape, sprayers, and writing instruments.

This experiment was conducted using a Randomized Block Design (RBD) with a two-factor factorial pattern. The first factor was Bokashi fertilizer, which had four levels: No Bokashi (Control), Bokashi 3.5 tons/ha (17.5 g/polybag). The second factor was LOF, consisting of four levels: No LOF (Control), LOF 10 ml/l water, LOF 30 ml/l water, and LOF 50 ml/l water.

2.1 Research Stages

2.1.1 Preparation of Growing Media

Growing media was prepared by collecting topsoil from a garden at a depth of approximately 30 cm, which was then sieved to remove debris and weed seeds. Manure was added to the soil in a 1:1 ratio to enhance the nutrient content of the media.

2.1.2 Planting

Seeds were planted in each polybag that had been prepared a week in advance. Watering was carried out

twice daily, in the morning and afternoon. After germination, measurements were taken according to the observation parameters, starting one week after planting and continuing weekly until harvest. Three seeds were planted per polybag; if all three seeds germinated, thinning was done, and if any plants died, they were replaced with seedlings of the same age. Therefore, backup plants were grown simultaneously with the initial planting. Two plants were maintained per polybag.

2.1.3 Treatment

The soil was prepared one week before sowing the seeds. Bokashi fertilizer was applied at two levels: no Bokashi (Control) and 17.5 g/polybag. The liquid organic fertilizer (LOF) treatments were applied at the following doses: Control, 10 ml/l, 30 ml/l, and 50 ml/l. The treatments were administered twice a week.

2.1.4 Plant Maintenance

Plant maintenance activities included watering, fertilizing, and pest and disease Control. Although peanuts are drought-tolerant, they still require sufficient soil moisture during the early growth stage and the vegetative phase. Therefore, watering was done at least twice during the growing period, ensuring the soil was adequately moist. Disease Control measures were taken when plants showed signs of pest or disease infestation.

2.2 Observation Parameters

2.2.1 Number of pods per plant (pods): The number of filled pods formed on each plant in the polybag was counted.

2.2.2 Seed weight per plant (g): The seeds formed from each plant in the polybag were weighed.

2.2.3 Production per hectare (tons/ha): Seed weight per plant was converted into yield per hectare.

The Randomized Complete Block Design (RCBD) is a widely used experimental design in agricultural research, particularly for analyzing the effects of various treatments on crop yield and growth parameters. This design helps to Control variability in experimental conditions by grouping experimental units into similar blocks, allowing for more accurate comparisons of treatment effects. Common data analysis methods used with RCBD include Analysis of Variance (ANOVA), which is essential for determining the significance of differences between treatment means. For data analysis, applications such as Excel 2021 version 16 are often employed (Dacumos et al., 2021).

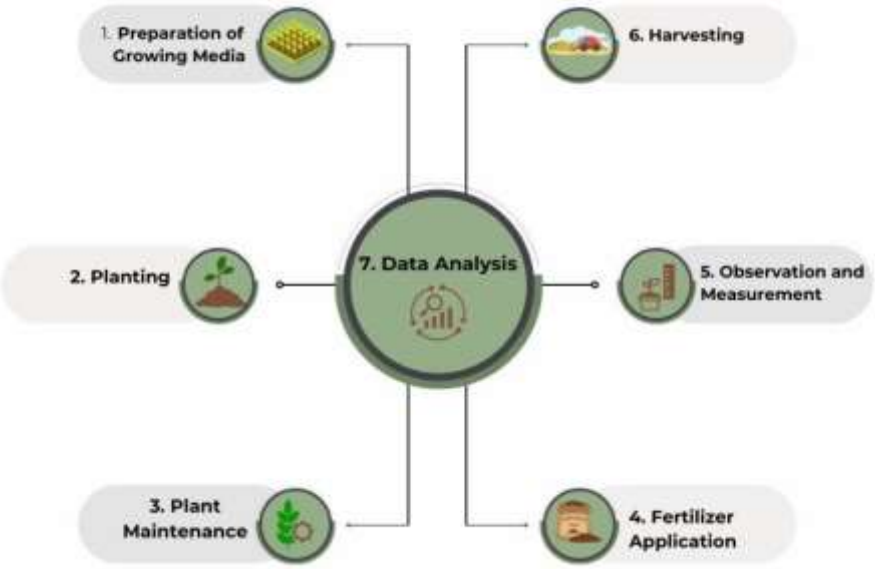

Figure 1. Research Flow Diagram

3. RESULT AND DISCUSSION

3.1 Number of Pods per Plant

Table 1. The Average Number of Pods per Plant shows the results of observations on the number of pods for various treatments and LOF concentration levels per liter of water. This table includes two treatments (Control and 3.5 Tons/ha) and four LOF concentration variations (Control, 10 ml/l, 30 ml/l, and 50 ml/l), with the average number of pods per plant displayed for each combination of treatment and concentration.

Table 1. Average Number of Pods per Plant

	Liquid Organic Fertilizer (ml/l of Water)					
Bokashi	Control	10 ml/l	30 ml/l	50 ml/l	Average	BNT 0.05
Control	5.33	7.33	9.50	8.50	7.67±0.78[a]	2.50
3.5 Tons/ha	7.50	24.59	20.34	22.04	8.92±3.30[a]	
Total	12.83±0.77[a]	31.92±6.10[b]	29.84±3.83[b]	30.54±4.79[b]		

Note: Average values followed by different letters in the same row (a, b) and column are significantly different at the 0.05 level of significance in the BNT test.

Based on the data presented in the table, the application of liquid organic fertilizer (LOF) has a significant effect on the number of pods per plant. The treatment without LOF (Control) resulted in a lower number of pods, ranging from 5.33 to 9.50 pods per plant, with an average of 7.67 pods. In contrast, the treatment with LOF (3.5 tons/ha) showed better results, with the number of pods ranging from 7.50 to 24.59, and an average of 8.92 pods. This indicates that the use of LOF positively impacts the number of pods produced. The use of LOF derived from bamboo leaves and banana fronds can also raise community awareness about environmentally friendly fertilizers, ultimately positively affecting crop yields. (Mulyanti et al., 2022). Research on mung beans indicates that, although LOF made from rice wash and potato peels does not significantly affect growth, it can enhance the number of primary branches and has the potential to increase the number of pods per plant. (Taher et al., 2022).

Additionally, variations in LOF concentration also had differing effects on the number of pods. At the Control concentration (Control), the average number of pods was only 4.96, while at concentrations 10 ml/l, 30 ml/l, and 50 ml/l, the average number of pods increased to 7.75, 10.13, and 9.59, respectively. The highest increase was observed at concentration 10 ml/l in the 3.5 tons/ha treatment, where the number of pods reached 24.59. Statistical analysis revealed no significant differences between control treatments at concentrations 30 ml/l and 50 ml/l, as well as 3.5 tons/ha treatments at concentrations 30 ml/l and 50 ml/l. however, 3.5 tons/ha at concentration 10 ml/l showed a significantly different result compared to other treatments. The application of LOF made from rice wash and potato peels did not affect plant growth and yield. (Afrida & Nafrisa, 2023).

3.2 Seed Weight per Plant

The average observation results for seed weight per plant indicate that the interaction between Bokashi and LOF did not significantly affect seed weight. Similarly, Bokashi treatments did not have a significant impact on seed weight. However, the LOF treatment did show a significant effect on seed weight.

Based on the data in Table 2 regarding the Average Seed Weight per Plant, there is a clear impact of LOF treatment on seed weight. The Control treatment (without LOF application) resulted in a lower average seed weight of 2.00 grams, while the 3.5 tons/ha treatment (with LOF application) yielded a higher average seed weight of 2.51 grams.

This indicates that the application of LOF can enhance seed weight per plant. The use of organic fertilizers,

whether applied alone or in combination with mineral fertilizers, can improve plant growth and yield, including seed weight. (Afa et al., 2023). The combination of organic fertilizers can enhance the availability of nutrients required for optimal plant growth. (Hasnelly et al., 2023).

Table 2. Average Seed Weight per Plant

Liquid Organic Fertilizer (ml/l of Water)						
Bokashi	Control	10 ml/l	30 ml/l	50 ml/l	Average	BNT 0.05
Control	0.96	2.05	2.17	2.80	2.00±0.33[a]	0.39
3.5 Tons/ha	0.87	3.00	1.78	4.37	2.51±0.66[a]	
Total	1.83±0.03[a]	5.05±0.34[c]	3.95±0.14[b]	7.17±0.56[d]		

Note: Average values followed by different letters in the same row (a, b) and column are significantly different at the 0.05 level of significance in the BNT test.

The effect of varying LOF concentrations is also evident from the data. at LOF concentration control (without LOF), the average seed weight was 0.78 grams, the lowest among all treatments. Concentrations 10 ml/l (2.18 grams), 30 ml/l (2.03 grams), and 50 ml/l (2.80 grams) showed a gradual increase in seed weight. The highest seed weight increase was observed in the 3.5 tons/ha treatment with LOF concentration 50 ml/l, reaching 4.37 grams. these results indicate that higher concentrations of LOF, especially at 50 ml/l, provide better results in increasing seed weight per plant. The application of organic fertilizers can enhance nutrient accumulation in seeds, which is crucial for plant growth and development. (Sánchez-Navarro et al., 2020).

Statistical analysis revealed no significant differences among several treatments, such as between 10 ml/l and 30 ml/l. however, there was a significant difference between treatments 50 ml/l and control. This indicates that higher concentrations of LOF, particularly at 50 ml/l, have a significant impact on increasing seed weight. Organic fertilizers can enhance seed quality by increasing protein and carbohydrate content, which contributes to the increase in seed weight. (Galland et al., 2017). However, the results from the application of organic fertilizers are not always significant. Therefore, while there is potential benefit, outcomes may vary depending on specific conditions and the type of variety used. (Soares et al., 2023).

3.3 Production per Hectare

The average observation results for production per hectare indicate that Bokashi treatments and the interaction between Bokashi and LOF did not significantly affect production per hectare. However, LOF treatments did have a significant impact on production per hectare.

Table 3. Numbers of Shoot

Liquid Organic Fertilizer (ml/l of water)						
Bokashi	Control	10 ml/l	30 ml/l	50 ml/l	Average	BNT 0.05
Control	0.16	0.34	0.34	0.37	0.30±0.04[a]	0.19
3.5 Tons/ha	0.14	0.5	0.29	0.72	0.41±0.11[a]	
Total	0.16±0.01a	0.34±0.06a	0.34±0.02a	0.37±0.12b		

Note: Average values followed by different letters in the same row (a, b) and column are significantly different at the 0.05 level of significance in the BNT test.

Based on the data in Table 3 showing the Average Production per Hectare, it is evident that the LOF treatment impacts peanut production. The treatment without LOF (Control) resulted in a lower average production of 0.30 tons/ha. In contrast, the treatment with LOF (3.5 Tons/Ha) showed an increase

in production to an average of 0.41 tons/ha. This indicates that the application of LOF has a positive effect on peanut production per hectare. The use of organic fertilizers can enhance soil nutrient availability and crop yields, particularly in sustainable agricultural systems. (Glenda et al., 2016; Ma et al., 2022).

Additionally, there is a variation in production based on LOF concentration. At concentration Control (without LOF), the production per hectare was the lowest, at 0.30 tons/ha. In contrast, concentrations 10 ml/l, 30 ml/l, and 50 ml/l showed a gradual increase in production, with 50 ml/l reaching 0.46 tons per hectare. The 3.5 tons/ha treatment at concentration 50 ml/l yielded the highest production, at 0.72 tons per hectare, indicating that higher LOF concentrations, especially at 50 ml/l, provide better results. Organic fertilizers can enhance soil microbial diversity and activity, contributing to increased soil fertility. (Yan et al., 2023).

Statistical analysis indicates that not all treatment combinations resulted in significant differences. There were no significant differences between treatments 10 ml/l and 30 ml/l. However, LOF concentration 50 ml/l showed a significant difference compared to control, highlighting that higher LOF doses can significantly improve production. Peanuts have the ability to enhance soil quality through nitrogen fixation, which can increase nitrogen availability for subsequent crops in rotation or intercropping, thereby improving overall plant production. (Franke et al., 2018; Ruelle et al., 2019). LOF contains essential nutrients that enhance peanut plant growth. The higher the POC concentration (75%), the better the results, such as plant height, number of branches, and seed weight (Ardian et al., 2023).

4. CONCLUSION

Based on the analysis, the optimal treatment for increasing peanut yield is the application of Liquid Organic Fertilizer (LOF) at concentration 50 ml/l in the 3.5 tons/ha treatment. This treatment provided the best results across all observed aspects. Specifically, it yielded the highest number of pods per plant, at 22.04 pods, the highest seed weight per plant, at 4.37 grams, and the highest production per hectare, at 0.72 tons. Therefore, it can be concluded that the 3.5 tons/ha treatment with LOF concentration 50 ml/l is the most effective in enhancing peanut productivity compared to other treatments.

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