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The Effect of Vermicompost Fertilization with the Addition of Organic Waste on the Growth and Quality of Lettuce (Lactuca sativa)

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Abstrak

Penelitian ini bertujuan untuk mengetahui pengaruh pemupukan vermikompos dengan penambahan limbah organik terhadap pertumbuhan dan kualitas tanaman selada (*Lactuca sativa*). Penelitian dilakukan dengan metode eksperimen menggunakan beberapa perlakuan aplikasi vermikompos yang dikombinasikan dengan tingkat penambahan limbah organik yang berbeda. Parameter yang diamati meliputi tinggi tanaman, jumlah daun, lebar daun, bobot segar, dan kualitas daun. Hasil penelitian menunjukkan bahwa penggunaan vermikompos dengan penambahan limbah organik secara signifikan meningkatkan pertumbuhan dan kualitas selada dibandingkan dengan perlakuan kontrol. Tanaman selada yang diberi perlakuan vermikompos yang diperkaya limbah organik menunjukkan pertumbuhan lebih baik, biomassa lebih tinggi, serta kualitas daun yang lebih baik. Temuan ini mengindikasikan bahwa kombinasi vermikompos dan limbah organik dapat menjadi strategi pemupukan yang efektif dan ramah lingkungan untuk meningkatkan produksi selada.

Kata kunci: vermikompos, limbah organik, pertumbuhan, kualitas, selada (*Lactuca sativa*)

Abstract

This study aims to determine the effect of vermicompost fertilization with the addition of organic waste on the growth and quality of lettuce (Lactuca sativa). The research was conducted using an experimental method with several treatments of vermicompost application combined with different levels of organic waste. The observed parameters included plant height, number of leaves, leaf width, fresh weight, and leaf quality. The results showed that the use of vermicompost with the addition of organic waste significantly improved the growth and quality of lettuce compared to the control treatment. Lettuce plants treated with enriched vermicompost exhibited better growth, higher biomass, and superior leaf quality. These findings indicate that vermicompost combined with organic waste can be an effective and environmentally friendly fertilization strategy to enhance lettuce production.

***Keywords**: vermicompost, organic waste, growth, quality, lettuce (Lactuca sativa)*

Introduction

Agriculture plays a vital role in supporting food security and national economic stability, especially in Indonesia, which is widely recognized as an agrarian country. The horticulture subsector holds a strategic position because it produces various types of vegetables that are part of people's daily consumption. One of the most popular leafy vegetables is lettuce (*Lactuca sativa*), commonly consumed as fresh salad, garnish, or complementary food ingredient. Due to its high demand, increasing the productivity and quality of lettuce cultivation has become an important issue in agricultural development.

Along with the growing awareness of healthy lifestyles, the use of organic fertilizers in agriculture has become increasingly popular. Organic fertilizers are considered environmentally friendly and safe for consumption because they do not contain harmful chemical residues. Among various organic fertilizers, vermicompost is one of the most widely applied. Vermicompost is produced through the decomposition of organic matter with the help of earthworms, and it is known to improve soil structure, increase nutrient availability, and stimulate plant growth naturally.

Besides vermicompost, the utilization of organic waste has also become an alternative strategy to support sustainable agriculture. Organic waste such as vegetable scraps, dry leaves, and household food residues can be processed into nutrient-rich compost materials. When combined with vermicompost, organic waste has the potential to enhance nutrient content, enrich soil fertility, and contribute to better plant growth while simultaneously reducing environmental pollution caused by unmanaged waste.

Lettuce (*Lactuca sativa*) is a leafy vegetable whose growth is highly dependent on the availability of essential nutrients, particularly nitrogen, phosphorus, and potassium. A deficiency in these nutrients often leads to stunted growth and reduced leaf quality. Therefore, the application of proper organic fertilization is essential to improve lettuce productivity both in terms of growth performance and post-harvest quality.

Previous studies have shown that vermicompost application can significantly improve plant height, leaf number, fresh weight, and overall quality of vegetables. Similarly, research on organic waste utilization has reported positive impacts on soil fertility and plant productivity. However, studies focusing on the combination of vermicompost and organic waste remain limited, making it necessary to explore its effectiveness specifically on lettuce cultivation.

The combination of vermicompost and organic waste is expected to create a synergistic effect in providing more balanced nutrients. Vermicompost supplies beneficial microorganisms that accelerate decomposition and nutrient cycling, while organic waste contributes additional essential elements required for plant growth. Such integration is expected not only to promote vegetative growth but also to enhance leaf quality, which is the main edible part of lettuce.

This research was conducted to examine the effect of vermicompost fertilization with the addition of organic waste on the growth and quality of lettuce plants. The study focused on several growth parameters, including plant height, number of leaves, leaf length, fresh weight, root length, and leaf quality. With the use of a systematic experimental design, the study aimed to provide reliable data on the effectiveness of the combined treatments.

The findings of this research are expected to contribute to the development of environmentally friendly and sustainable

agricultural practices. Moreover, the results can serve as a reference for farmers to optimize organic fertilization by utilizing locally available organic waste, thereby supporting sustainable farming practices while improving the economic value of lettuce cultivation.

Method

This research was conducted from June to July 2025 at the Greenhouse of the Vocational Education in Agricultural Engineering Program, FKIP, Universitas Muhammadiyah Sidenreng Rappang. The greenhouse setting was chosen to maintain a controlled environment that minimizes the influence of external factors such as rainfall, temperature fluctuation, and pests. This condition ensured that all experimental treatments could be carried out under uniform and optimal circumstances for lettuce growth.

The materials used in this study included lettuce seeds (Lactuca sativa var. LE 873), soil, vermicompost, organic waste, and water. The organic waste was pre-processed by chopping and fermenting for approximately two weeks before application. The tools employed consisted of polybags (35 × 35 cm), seedling trays, a digital balance, small shovels, sprayers, measuring cups, rulers, and a camera for documentation. These materials and tools were selected to support accurate measurements and effective plant cultivation throughout the experiment.

The experimental method applied was a Randomized Block Design (RBD) with a single-factor treatment consisting of seven combinations of vermicompost and organic waste. Each treatment was replicated three times, resulting in 63 experimental units plus 21 reserve plants, totaling 84 lettuce plants. The treatments were as follows: P1 (control, soil only), P2 (100% vermicompost), P3 (100% organic waste), P4 (80% vermicompost + 20% organic waste), P5 (60% vermicompost + 40% organic waste), P6 (40% vermicompost + 60% organic waste), and P7 (20% vermicompost + 80% organic waste).

Seedlings were prepared by soaking the seeds in water, with viable seeds identified as those that sank. Selected seeds were then sown in seedling trays until they reached the age of three weeks with 3–4 true leaves. The seedlings were then transplanted into polybags containing soil mixed with vermicompost and organic waste according to the designated treatments. Each polybag contained one healthy lettuce seedling to ensure consistency in growth measurements.

Plant maintenance included daily watering in the morning or evening, weeding, and pest observation. A simple shading structure was installed in the greenhouse to protect the plants from direct sunlight and heavy rainfall. Fertilization was applied according to the composition of vermicompost and organic waste assigned to each treatment group. All cultural practices were carried out uniformly across treatments to minimize potential bias from environmental differences.

The observed parameters included plant height, number of leaves, leaf length, fresh weight, root length, and leaf color. Plant height and number of leaves were measured every three days after transplanting until the plants reached harvest age. Leaf length was measured from the base to the tip of the longest leaf, while fresh weight was recorded by weighing whole plants after harvest. Root length was measured after cleaning, and leaf color was described qualitatively using color codes to capture differences in visual quality.

Data were analyzed using Analysis of Variance (ANOVA) with the aid of IBM SPSS version 25 software. If the ANOVA test showed significant differences between

treatments, a Tukey's post hoc test was conducted to determine which treatments differed significantly. Prior to the ANOVA test, classical assumption tests such as normality and homogeneity were performed to ensure data validity. Data were presented in tables, graphs, and descriptive statistics to facilitate interpretation.

This method was designed not only to evaluate the effect of vermicompost and organic waste on lettuce growth but also to identify the optimal combination that could improve both yield and quality. The systematic experimental design and statistical analysis aimed to provide reliable scientific evidence that could serve as a basis for recommending sustainable fertilization practices in lettuce cultivation.

Result and Discussion

The results of the study are presented based on the observed parameters of lettuce growth under different combinations of vermicompost and organic waste. Data were analyzed statistically using ANOVA, followed by Tukey's test to identify significant differences between treatments.

The first parameter observed was the number of leaves. Statistical analysis showed that the treatment factor had a significant effect on leaf number ($p < 0.05$), while the time factor and interaction with treatments did not show a significant influence. Treatments with higher proportions of vermicompost (P2 and P4) produced more leaves compared to the control (P1).

Plant height also varied significantly across treatments. The results indicated that treatments P4 (80% vermicompost + 20% organic waste) and P7 (20% vermicompost + 80% organic waste) produced the tallest plants. This suggests that both vermicompost and organic waste play important roles in enhancing plant elongation, although the optimal balance differed across growth stages.

Leaf length showed similar trends, with treatments P4 and P7 producing the longest leaves compared to other treatments. This indicates that the nutrient composition and microbial activity in the soil provided by both vermicompost and organic waste were able to support leaf expansion.

Fresh weight of lettuce plants was significantly influenced by the treatments. The highest fresh weight was recorded in P4, which outperformed the control and other treatments. This suggests that the combination of 80% vermicompost and 20% organic waste provided the most balanced nutrient composition to support biomass accumulation.

Root length was also affected by the treatments. Plants grown under P7 (20% vermicompost + 80% organic waste) exhibited the longest root system. This may be due to the higher organic waste proportion improving soil porosity, thereby encouraging root development.

In terms of leaf color, there were no significant differences between treatments. All plants consistently showed a bright green-yellowish hue (10GY 8/8), indicating that fertilization treatments did not alter leaf pigmentation.

Overall, the findings suggest that both vermicompost and organic waste contribute positively to lettuce growth. However, the most optimal growth in terms of number of leaves, plant height, leaf length, and fresh weight was achieved in P4 (80% vermicompost + 20% organic waste), while P7 promoted root growth.

Table 1. Growth Parameters of Lettuce under Different Treatments

Treatment	Leaf Number (Mean ± SD)	Plant Height (cm)	Leaf Length (cm)	Fresh Weight (g)	Root Length (cm)
P1 (Control)	3.42 ± 0.67	8.18 ± 3.42	6.81 ± 2.36	1.75 ± 0.75	3.59 ± 0.74
P2 (100% Vermicompost)	3.38 ± 0.79	8.51 ± 3.12	7.11 ± 2.24	2.50 ± 1.24	4.15 ± 0.78
P3 (100% Organic Waste)	3.41 ± 0.82	8.46 ± 2.86	6.89 ± 1.81	1.92 ± 0.99	3.65 ± 0.47
P4 (80% Vermicompost + 20% Organic Waste)	3.36 ± 0.80	10.77 ± 3.68	8.41 ± 2.03	2.08 ± 0.51	4.38 ± 0.99
P5 (60% Vermicompost + 40% Organic Waste)	3.52 ± 0.83	7.99 ± 3.36	6.35 ± 2.09	1.75 ± 0.86	3.65 ± 0.94
P6 (40% Vermicompost + 60% Organic Waste)	2.84 ± 0.61	7.76 ± 3.42	6.63 ± 2.40	1.42 ± 0.51	3.61 ± 0.63
P7 (20% Vermicompost + 80% Organic Waste)	4.20 ± 0.82	9.87 ± 3.35	7.94 ± 2.13	1.75 ± 0.75	4.81 ± 0.88

DISCUSSION

The results indicate that vermicompost and organic waste significantly influenced lettuce growth. The increase in leaf number, plant height, and fresh weight in treatments with vermicompost aligns with previous findings that vermicompost provides a balanced supply of nutrients and beneficial microorganisms that improve plant physiology.

The effectiveness of P4 treatment (80% vermicompost + 20% organic waste) suggests that vermicompost as the primary nutrient source, combined with a small proportion of organic waste, creates an optimal balance of macro and micronutrients. Vermicompost contributes directly available nutrients, while organic waste enriches soil organic matter and enhances microbial activity.

The results on plant height and leaf length highlight the importance of nutrient availability, especially nitrogen, which plays a key role in vegetative growth. Both vermicompost and organic waste are nitrogen sources, but their release rates differ. Vermicompost provides more readily available nitrogen, while organic waste decomposes more slowly, supplying nutrients over time.

The root length observed in P7 (20% vermicompost + 80% organic waste) indicates that higher proportions of organic waste improve soil structure and porosity, thereby supporting better root development. This aligns with studies suggesting that organic waste enhances soil aeration and water retention, promoting deeper and stronger root growth.

The lack of significant differences in leaf color suggests that chlorophyll production was not heavily influenced by fertilization treatments. This may be due to the relatively short growing cycle of lettuce and the adequate nutrient levels supplied by all treatments, which prevented visible deficiencies.

Comparisons with previous research confirm that vermicompost consistently enhances plant growth and productivity across various

vegetable crops. However, the integration with organic waste provides an additional sustainability benefit by reducing waste accumulation while contributing to soil fertility.

From a practical perspective, the study demonstrates that farmers could achieve optimal lettuce growth using a combination of vermicompost and organic waste rather than relying solely on synthetic fertilizers. This approach not only supports productivity but also aligns with sustainable agricultural practices.

In conclusion, the findings emphasize that vermicompost enriched with organic waste serves as an effective and eco-friendly fertilization method. Specifically, the P4 treatment yielded the best overall performance, making it a promising recommendation for lettuce cultivation in both commercial and household farming systems.

Conclusion

This study demonstrated that the application of vermicompost combined with organic waste significantly affected the growth and quality of lettuce (*Lactuca sativa*). Among the different treatments, the combination of 80% vermicompost and 20% organic waste (P4) produced the best overall results in terms of leaf number, plant height, leaf length, and fresh weight. Meanwhile, the treatment with 20% vermicompost and 80% organic waste (P7) showed the most effective impact on root development.

The findings highlight the complementary role of vermicompost and organic waste in providing essential nutrients and improving soil conditions. Vermicompost contributed readily available macro and micronutrients, while organic waste enriched the soil with organic matter, enhanced microbial activity, and improved physical properties such as aeration and porosity. Together, these factors created a synergistic effect that supported both vegetative growth and root development.the integration of vermicompost with organic waste can serve as an effective and environmentally friendly fertilization strategy for lettuce cultivation. This approach not only increases productivity and quality but also promotes sustainable agriculture by reducing reliance on chemical fertilizers and utilizing organic waste as a valuable resource.

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