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Growth Response of Potted Pechay (*Brassica rapa* subsp. *chinensis* Var. Black Behi) as Affected by Vermicast, Chicken Manure and Goat Manure Fertilization

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ABSTRACT

This study evaluated the growth response of potted pechay (*Brassica rapa* subsp. *chinensis* var. Black Behi) to different organic fertilizers, namely vermicast, chicken manure, and goat manure. The experiment was conducted using a randomized complete block design (RCBD) with three replications under controlled pot conditions. Treatments consisted of a control (no fertilizer), vermicast, chicken manure, and goat manure applied at uniform rates. Growth parameters such as plant height, leaf count, leaf area, and plant biomass were measured and analyzed using one-way Analysis of Variance (ANOVA) and LSD for mean comparison. Results revealed that all organic fertilizer treatments significantly improved the growth performance of pechay compared to the control. Chicken manure consistently produced the highest values in plant height, leaf area, leaf number, and final biomass, indicating superior vegetative growth. Vermicast showed the second-best performance, followed by goat manure, while the control consistently recorded the lowest values across all parameters. The significant improvements were attributed to the higher nutrient availability, particularly nitrogen, phosphorus, and potassium, present in organic fertilizers, with chicken manure demonstrating the most favorable nutrient effect. Overall, the study confirms that organic fertilizers enhance the growth of pechay, with chicken manure being the most effective treatment under pot conditions. These findings support the use of organic nutrient sources as sustainable alternatives to synthetic fertilizers in vegetable production.

Keywords: *Pechay, organic fertilizers, vermicast, chicken manure, goat manure, plant growth, biomass, sustainable agriculture*

INTRODUCTION

Background of the Study

Pechay (*Brassica rapa subsp. chinensis var. Black Behi*) is a highly regarded vegetable in Asian cuisine due to its nutritious qualities, and both its edible stems and green leaves can be used in a variety of dishes (Lagon et al, 2022), making its cultivation and production of significant agricultural and economic importance. In the context of contemporary agriculture, there is a growing emphasis on sustainable and organic farming practices, with a particular focus on the use of organic fertilizers to enhance soil fertility, crop yields, and environmental sustainability. Vermicast, chicken manure, and goat manure represent valuable organic fertilizers that have gained recognition for their potential to improve crop growth.

Vermicast, a product of earthworm activity, are abundant in both macro and micronutrients, vitamins, growth-promoting hormones, and a range of enzymes including proteases, amylases, lipase, cellulase, and chitinase, along with immobilized microflora. These enzymes continue to break down organic matter even after being excreted by the earthworms. The utilization of vermicompost in agricultural production offers several advantages, including decreased water usage for irrigation, reduced pest and termite infestations, diminished weed growth, quicker seed germination and accelerated seedling growth, higher yields of fruits in vegetable crops, and increased seed production in cereal crops. Earthworms and vermicompost have the potential to enhance horticultural production without relying on agrochemicals (Ollie, 2019).

Chicken manure and goat manure are also prized organic fertilizers when properly composted. These manures are rich in essential nutrients, including nitrogen, phosphorus, and potassium, which are crucial for plant growth (Reddy, 2021). However, their use requires proper composting to avoid issues such as nutrient imbalances and odors, which can negatively impact plant health. As highlighted by Bautista et al. (2023), the impact of compost on plant growth hinges on the maturity of the compost; it can either enhance or hinder growth rates. Consequently, it is imperative not to incorporate unfinished organic materials into the soil. The application of immature compost materials leads to intense decomposition accompanied by reduced oxygen levels, elevated carbon dioxide levels, and the accumulation of volatile organic acids, ultimately resulting in suboptimal plant growth.

Given the significance of pechay as a commercial crop and the potential benefits of organic fertilizers, there is a need to assess the immediate effects of vermicast, chicken manure, and goat manure on the growth of potted pechay plants. This study specifically employs a controlled environment using potted plants to isolate and evaluate the direct impact of these fertilizers on pechay growth. By assessing factors such as plant height, leaf count, leaf size, and plant biomass, the present study aims to determine which organic fertilizer demonstrates the most favorable impact on pechay growth. While navigating the intricate landscape of sustainable agriculture, this research will contribute valuable insights into the choice of organic fertilizers and their impact on pechay growth, thus taking a step closer to ensuring a greener and more productive future for our agricultural endeavors.

Objectives of the Study

The study aimed to evaluate the immediate effects of vermicast, chicken manure, and goat manure on the growth of potted pechay plants. Specifically, it aimed to:

1. assessed and compared the short-term growth parameters of pechay plants, including plant height, leaf count, leaf size, and biomass when treated with vermicast, chicken manure, and goat manure**.**
2. identified which organic fertilizer (vermicast, chicken manure, or goat manure) produced the most significant and favorable immediate effects on pechay growth.

REVIEW OF RELATED LITERATURE

Pechay, scientifically known as *Brassica rapa subsp. chinensis* holds significant significance in the realm of vegetable crops due to its substantial nutritional content and favorable market value. Pechay is a highly prized vegetable among Asian consumers due to its nutritious and versatile nature, with its edible petioles and green leaves being used in a variety of culinary recipes (Lagon et al., 2022). This vegetable is a significant source of vitamin C and contains notable quantities of nitrogen compounds referred to as indoles, as well as dietary fiber, which are believed to reduce the risk of various cancer types.

Moreover, pechay has been selectively bred to develop a plant with an exceptionally short life cycle of just 30-45 days (Acero, 2013, as cited by Bandera in 2020). It serves as a valuable source of revenue and a pastime, even when dealing with constrained spaces. The widely embraced method of vertical gardening using repurposed containers as the growing medium is a significant asset in Philippine society, as reported by Matejowsky in 2013 as cited by by Agloslos et al. in 2021.

Vermicompost, often referred to as worm castings or the excretions of worms, is a popular choice among gardeners and landscapers as a soil amendment. These castings originate from organic materials that serve as the worms' food source. Vermicompost consists of finely divided materials with characteristics similar to peat, offering high porosity, excellent aeration, good drainage, and the ability to retain water (Tejada et al., 2010, as cited by Bandera in 2020). Acuna (2019) asserted that vermicast serves as a more favorable substitute for chemical fertilizers by improving soil fertility without causing adverse impacts on soil and water quality.

Research has shown that vermicompost consistently provides beneficial effects on plant growth, irrespective of changes in nutrient levels and availability (Dominguez & Gomez-Brandon, 2012, as cited by Bandera in 2020). Vermicompost consists of a high proportion of nutrients readily available for plants, including nitrates, phosphates, as well as exchangeable calcium and soluble potassium, as highlighted in the study by Lim et al. in 2015 as cited by Agloslos et al. 2021.

Additionally, Theunissen et al. (2010), as referenced by Bandera in 2020, discovered that vermicompost contains various essential plant nutrients, such as nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sulfur (S), iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), and boron (B). The uptake of these nutrients has a positive impact on plant nutrition, enhances photosynthesis, increases chlorophyll content in leaves, and improves the nutrient content in different parts of the plant, including roots, shoots, and fruits.

Chicken manure is widely recognized as one of the most nutrient-dense organic fertilizers due to its high concentration of essential plant nutrients, particularly nitrogen and significant levels of phosphorus. In addition, poultry manure contains other key nutrients such as potassium and micronutrients that are vital for plant development. Beyond its nutrient content, its application improves soil fertility by increasing organic matter, which in turn enhances soil structure, aeration, water infiltration, moisture retention, and overall nutrient-holding capacity. Because of these agronomic benefits, poultry manure is considered an effective organic alternative to synthetic fertilizers and is widely used to support sustainable crop production (Babu et al., 2021).

According to Azmi et al. (2019), chicken manure contains significant levels of macronutrients and notable quantities of micronutrients like iron (Fe), manganese (Mn), copper (Cu), and zinc (Zn). The inclusion of poultry manure into the soil when cultivating tomatoes resulted in elevated levels of soil organic matter, enhanced macro and micro-nutrient content in both the soil and the leaves, and ultimately improved the growth and yield of the tomatoes. The introduction of chicken manure had a beneficial impact on soil fertility by notably increasing nitrogen (N), phosphorus (P), and exchangeable bases in the soil used for growing spinach.

Rasool et al. 2023 discovered that incorporating poultry manure into the soil yielded positive effects on maize growth and yield. The introduction of poultry manure into the soil led to enhancements in soil physical and chemical characteristics, including increased availability of phosphorus (P) and higher levels of soil organic matter. Additionally, both maize varieties exhibited significant improvements in their growth and physiological characteristics when cultivated in soil amended with poultry manure.

Goat manure is a highly effective fertilizer for herbs, vegetables, and various crops. It is renowned for its ability to enhance soil water retention and serves various purposes. It functions as a valuable soil conditioner for both new and established gardens, enhancing soil texture to promote efficient water utilization and better root oxygenation. Additionally, it provides essential nutrients to plants, contributing to improved soil structure.

Furthermore, according to Reddy (2021), goat manure is a rich source of vital plant nutrients such as nitrogen (N), phosphorus (P), and potassium (K). As per the findings of Gichaba et al. (2020), the utilization of goat manure leads to a substantial elevation in soil pH, organic matter levels, total nitrogen, available phosphorus, exchangeable potassium, as well as the concentrations of calcium and magnesium in the soil. Additionally, it enhances the cation exchange capacity status of the soil.

METHODOLOGY

Experimental Design and Treatment

This study employed a randomized complete block design (RCBD) with three replications and ten samples per replication. The research focused on pechay (*Brassica rapa* subsp. *chinensis* var. Black Behi) and involved various treatment groups in a pot experiment. The pot size used in the experiment was 20 cm in diameter and 16.5 cm in height. The treatment groups consisted of the following:

- T0: Control Group
- T1: Vermicast / 900 grams per pot
- T2: Chicken manure / 900 grams per pot
- T3: Goat manure / 900 grams per pot

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Preparation of Materials

The Pechay (*Brassica rapa* subsp. *chinensis* var. Black Behi) were bought from Pacifica Agrivet Supplies - Monkayo Branch. The vermicast, composted goat manure, and chicken manure were bought from Octa-M Farm.

Seedling Production

Pechay seeds were placed in the seedling trays, which were filled with garden soil. Two seeds were sown in each slot or hole, after which they were gently covered with a thin layer of garden soil, followed by thorough watering.

Preparation of the Greenhouse

The greenhouse was established in an area that received ample sunlight, was relatively flat, and had good drainage. The greenhouse's dimensions were approximately 800 centimeters in length and 400 centimeters in width, and it was positioned 100 centimeters above the ground. Plastic pallets served as the foundation, and a UV polyethylene plastic film was utilized as the covering.

Preparation of Potting Mixture/Treatment Application

To make a potting mixture for each treatment group, the following guidelines were followed:

T0 (Control Group): This group served as the control and received no special treatments.

T1 (Vermicast): For the vermicast treatment, the potting soil was enriched with high-quality vermicompost (worm castings) at a proportion of 30% or 900 grams of vermicast for every 3 kg of potting soil. The mixture was blended well to ensure uniform distribution of vermicast throughout the potting soil.

T2 (Chicken Manure): To create the chicken manure treatment mix, the potting mix was combined with well-composted chicken manure at a ratio of 30% or 900 grams of chicken manure for every 3 kg of potting soil. The materials were mixed thoroughly to ensure even incorporation of the chicken manure.

T3 (Goat Manure): For the goat manure treatment, well-rotted goat manure was integrated into the potting soil at a ratio of 30% or 900 grams of goat manure for every 3 kg of potting soil. The mixture was blended thoroughly to ensure uniform distribution of the goat manure within the potting soil.

All treatments were fully decomposed prior to application**.**

Transplanting of the Pechay Sprouts

Pechay seedlings were transplanted once they had developed a minimum of 3 true leaves. Transplantation was conducted in the early morning, at approximately 6:00 AM, when the temperature was milder, to reduce moisture loss through transpiration and expedite recovery. Each pechay seedling was placed into an individual pot containing potting mix to a depth of two (2) inches, with one pechay plant per pot.

Water Management

Irrigation was conducted during the early morning and late afternoon periods.

Weed management

The weeds near the base of the plants were removed. Any weeds that were observed were gently pulled out by hand. The entire root system was removed to prevent regrowth.

Pest Management

The potential pests were eliminated manually on a weekly basis without the use of any pesticides.

Data Gathered

The following parameters were collected and recorded:

Plant Height – Measured from the base to the apex of the pechay plant in centimeters (cm), recorded at 7 days after transplanting (DAT) and every 7 days until harvest (15 samples per treatment, 5 sample per replication).

Leaf Count – All leaves per plant were counted through visual inspection, recorded at 7 DAT and every 7 days until harvest (15 samples per treatment, 5 samples per replication).

Leaf Size – The largest leaf per plant was measured in length and width to compute leaf area (cm^2), recorded at 7 DAT and every 7 days until harvest (15 samples per treatment, 5 samples per replication).
Plant Biomass – Above-ground plant parts were harvested, rinsed, drained, and weighed in grams (g).

Statistical Analysis

The data gathered was analyzed using the one-way Analysis of Variance (ANOVA), to identify significant differences between the treatment groups and the control group. To further assess the mean, the Least Significant Difference (LSD) was used for comparisons

RESULT AND DISCUSSION

Plant Height

Table 1: Plant height of Pechay as Affected by Vermicast, Chicken Manure and Goat Manure Fertilization

Treatment	PLANT HEIGHT			
	7 DAT**	**14 DAT****	**21 DAT****	**28 DAT***
T_o – Control	4.43 $_c$	7.50 $_b$	10.02 $_c$	12.19 b
T_1 – Vermicast	8.25 $_a$	12.37 $_a$	15.97 $_b$	21.45 a
T_2 – Chicken Manure	6.55 $_b$	13.14 $_a$	20.88 $_a$	24.51 a
T_3 – Goat Manure	6.81 $_b$	12.06 $_a$	15.98 $_b$	19.25 a
Pr (> F)	**0.0020**	**0.005**	**0.0042**	**0.0128**
CV (%)	**9.77**	**7.18**	**13.12**	**15.76**

** highly significant at 1% level, *significant at 5% level, ns- not significant, Same letter superscript means not significant

The application of organic fertilizers significantly affected the plant height of pechay at all observation periods. At 7 DAT, vermicast (T1) produced the tallest plants (8.25 cm), while the control (T0) had the shortest height (4.43 cm). At 14, 21, and 28 DAT, chicken manure (T2) consistently recorded the highest plant heights of 13.14 cm, 20.88 cm, and 24.51 cm, respectively. Vermicast (T1) and goat manure (T3) also performed better than the control throughout the study.

The significant differences among treatments indicate that organic fertilizers enhanced pechay growth by supplying essential nutrients needed for vegetative development. Among the treatments, chicken manure showed the best performance, possibly due to its high nitrogen content that promotes rapid plant growth. These findings are consistent with the study by Azmi et al. (2019), which reported that chicken manure improves soil fertility and plant growth due to its rich nutrient composition.

Leaf Count

Table 2: Leaf Count of Pechay as Affected by Vermicast, Chicken Manure and Goat Manure Fertilization

Treatment	LEAF COUNTS			
	7 DAT	**14 DAT***	**21 DAT**	**28 DAT***
T_o – Control	5.60	7.13 b	7.67	7.93 b
T_1 – Vermicast	6.40	8.53 a	9.00	9.47 a
T_2 – Chicken Manure	6.47	8.87 a	9.33	10.80 a
T_3 – Goat Manure	6.07	8.40 a	9.20	9.76 a
Pr (> F)	**0.1137**	**0.0317**	**0.1457**	**0.0205**
CV (%)	**6.41**	**6.67**	**9.34**	**8.04**

** highly significant at 1% level, *significant at 5% level, ns- not significant, Same letter superscript means not significant

The application of organic fertilizers influenced the leaf count of pechay at different growth stages. At 7 DAT and 21 DAT, no significant differences were observed among treatments. However, at 14 DAT and 28 DAT, fertilized plants significantly produced more leaves than the control treatment. Chicken manure (T2) consistently recorded the highest leaf counts with 8.87 leaves at 14 DAT and 10.80 leaves at 28 DAT, followed by goat manure (T3) and vermicast (T1). The control (T0) produced the lowest leaf counts throughout the study.

The results indicate that organic fertilizers enhanced leaf development by supplying essential nutrients necessary for vegetative growth. Among the treatments, chicken manure showed the best performance, likely due to its high nitrogen content which promotes leaf formation and plant vigor. These findings support the study of Babu et al. (2021), which stated that chicken manure is rich in nutrients essential for plant growth and development.

Leaf Area

Table 3: Leaf Area of Pechay as Affected by Vermicast, Chicken Manure, and Goat Manure Fertilization

Treatment	LEAF AREA			
	7 DAT*	**14 DAT****	**21 DAT****	**28 DAT***
T_o – Control	6.05 b	24.97 c	42.49 c	49.25 c
T_1 – Vermicast	11.66 a	56.35 b	109.17 ab	147.44 ab
T_2 – Chicken Manure	13.18 a	77.40 a	133.48 a	169.93 a
T_3 – Goat Manure	11.92 a	56.10 b	83.10 b	101.69 bc
Pr (> F)	**0.0148**	**0.0006**	**0.0010**	**0.0115**
CV (%)	**17.82**	**12.92**	**15.17**	**25.99**

** highly significant at 1% level, *significant at 5% level, ns- not significant, Same letter superscript means not significant

The application of organic fertilizers significantly affected the leaf area of pechay at all observation periods. At 7 DAT, chicken manure (T2) produced the largest leaf area (13.18 cm^2), followed by goat manure (T3) with 11.92 cm^2 and vermicast (T1) with 11.66 cm^2, while the control (T0) recorded the smallest leaf area of 6.05 cm^2. Similar trends were observed at 14, 21, and 28 DAT, where chicken manure consistently obtained the highest leaf area values of 77.40 cm^2, 133.48 cm^2, and 169.93 cm^2, respectively. In contrast, the control treatment consistently produced the lowest leaf area throughout the study.

The significant differences among treatments indicate that organic fertilizers enhanced leaf expansion and vegetative growth of pechay. The superior performance of chicken manure may be attributed to its high nitrogen and nutrient content, which promotes cell division, chlorophyll formation, and photosynthetic activity. Vermicast and goat manure also improved leaf area compared to the control, demonstrating their effectiveness as organic nutrient sources. According to Azmi et al. (2019), chicken manure contains substantial amounts of macro- and micronutrients that improve plant growth and soil fertility. Likewise, Dominguez and Gomez-Brandon (2012) reported that vermicompost positively influences plant growth by improving nutrient availability and soil conditions.

Plant Biomass

Table 4: Plant Biomass of Pechay as Affected by Vermicast, Chicken Manure, and Goat Manure Fertilization

Treatment	PLANT BIOMASS At Harvest**
T_o – Control	60.00 d
T_1 – Vermicast	95.33 b
T_2 – Chicken Manure	111.33 a
T_3 – Goat Manure	71.33 c
Pr (> F)	**0.0000**
CV (%)	**12.56**

** highly significant at 1% level, *significant at 5% level, ns- not significant, Same letter superscript means not significant

Organic fertilizer application significantly affected the plant biomass of pechay at harvest. Chicken manure (T2) produced the highest mean biomass (111.33 g), followed by vermicast (T1) with 95.33 g. Goat manure (T3) recorded 71.33 g, while the control (T0) had the lowest biomass of 60.00 g. The results showed a highly significant difference among treatments (Pr > F = 0.0000), indicating strong treatment effects on final yield performance.

The higher biomass observed in fertilized treatments suggests improved nutrient availability, particularly nitrogen, which is essential for vegetative growth and dry matter accumulation. Chicken manure showed superior performance, likely due to its higher nutrient concentration that enhances overall plant productivity. These findings are consistent with of Babu et al. (2021), who reported that poultry manure improves plant growth and yield due to its rich nitrogen, phosphorus, and potassium content. Overall, the results confirm that organic fertilizers, especially chicken manure, significantly enhance biomass production in pechay.

CONCLUSION

The study concludes that the application of organic fertilizers significantly improves the growth performance of potted pechay. All treated plants exhibited better vegetative growth than the control, indicating that organic amendments supply essential nutrients needed for plant development. Among the treatments, chicken manure consistently produced the best results in terms of plant height, leaf number, leaf area, and biomass. This superior performance is attributed to its high nutrient content, particularly nitrogen, phosphorus, and potassium, which are essential for vigorous vegetative growth. Vermicast also showed positive effects, especially during early growth stages, likely due to its balanced nutrient composition and beneficial microbial activity. Goat manure improved plant performance but was comparatively less effective than the other organic fertilizers. Overall, the findings confirm that organic fertilizers enhance soil fertility and pechay productivity, with chicken manure being the most effective treatment under the conditions of the study.

RECOMMENDATION

Based on the findings of the study, it is recommended that chicken manure be used as the primary organic fertilizer in pechay production due to its consistently superior effects on plant growth and biomass accumulation. Vermicast may also be integrated, particularly during early growth stages, to support seedling establishment and enhance soil biological activity. It is further recommended that all animal manures, including chicken and goat manure, be properly composted prior to application to prevent potential phytotoxic effects and nutrient imbalances. Future research should explore the optimization of application rates, including levels lower or higher than 900 g per pot, to determine the most efficient dosage for growth performance. Additionally, similar studies should be conducted under open-field conditions to validate pot experiment results and improve their practical

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applicability. Long-term studies assessing the effects of repeated organic fertilizer application on soil fertility and productivity are also encouraged. It is recommended that future research expand to other leafy vegetables such as lettuce, mustard, and spinach to broaden the applicability and relevance of the findings. Finally, it is recommended that future studies provide a documentation of experimental conditions, including soil physicochemical properties and greenhouse temperature, to improve replicability and interpretation of results. The inclusion of nutrient composition analyses of vermicast, chicken manure, and goat manure would also strengthen the explanation of observed treatment differences. Finally, incorporating an assessment of economic feasibility and practical recommendations for farmers would enhance the study's relevance and applicability in real-world production systems.

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