INTERNATIONAL JOURNAL OF RESEARCH AND SCIENTIFIC INNOVATION (IJRSI)
ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue IV April 2026

Cutback Cane Point Production of Sugarcane Varieties Applied with Vermicompost

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DOI: https://doi.org/10.51244/IJRSI.2026.1304000059

Received: 04 April 2026; Accepted: 10 April 2026; Published: 29 April 2026

ABSTRACT

This study evaluated the impact of vermicompost application on the growth and cutback cane point production of two sugarcane (Saccharum officinarum L.) varieties, Phil 99-1793 and VMC 67-252 using 5, 10, and 15 t ha^{-1} in terms of germination period, germination rate, plant height, number of tillers, number of nodes per linear meter, number of internodes per linear meter, and number of cane points harvested. Results indicated that vermicompost application significantly affected germination period, plant height, number of nodes, number of internodes, and the number of cane points harvested. VMC 67-252 exhibited earlier germination compared with Phil 99-1793 at 10 t ha^{-1} and 15 t ha^{-1}, respectively, although differences among other vermicompost levels within the same variety were not significant (V_2). The same for Phil 99-1793 at 15 t ha^{-1} except after 30 DAP, that 10 t ha^{-1} was the tallest. Application of vermicompost at 15 t ha^{-1} was comparable to plants treated with inorganic fertilizer in terms of height (V_1). The greatest number of tillers produced was recorded at 15 t ha^{-1} (V_1) and 10 t ha^{-1} (V_2), comparable to inorganic fertilizer application. Varietal differences were evident, with V_1 producing more nodes like internodes. The greatest number of cane points harvested 180 DAP was obtained from Phil 99-1793, exceeding VMC 67-252. Application of 15 t ha^{-1} of vermicompost produced the greatest number of cane points harvested, with V_1 and V_2 comparable to inorganic fertilizer application.

Keywords: Sugarcane (Saccharum officinarum L.), Vermicompost, Cutback Cane Point, Organic Fertilizer

INTRODUCTION

Sugarcane (Saccharum officinarum L.) is one of the most economically important industrial crops and a major contributor to the Philippine agricultural sector (Philippine Statistics Authority, 2019; FAO, 2017). According to the Sugar Regulatory Administration (SRA), sugar remains a mainstay of the country's export commodities, contributing significantly to foreign exchange earnings and the gross value added (GVA) of the agriculture sector through the sale of sugar and molasses (Sugar Regulatory Administration, 2021; Philippine Statistics Authority, 2022). However, continuous sugarcane monocropping and intensive use of inorganic fertilizers have raised concerns regarding declining soil fertility and crop productivity (Wu et al., 2021; Lu et al., 2022). Pang et al. (2008) reported that monoculture systems can alter soil physicochemicals properties and disrupt microbial community structures, ultimately reducing sugarcane yield potential.

The extensive use of chemical fertilizers, though beneficial for short-term yield enhancement, has been shown to degrade soil structure, disturb nutrient balance, and reduce soil organic matter content (Belong et al., 2022). These changes negatively affect soil fertility and contribute to environmental issues such as waterway pollution, soil acidifications, and greenhouse gas emissions (Lal, 2015).

In response, organic farming practices, particularly the application of vermicompost improves soil physical, chemical, and biological properties, enhances nutrient availability, and promotes plant growth through beneficial microbial activity (Ancon et al., 2004) and it is recognized as a nutrient-rich organic fertilizer that enhances soil physical, chemical, and biological properties (Gopinath et al., 2010). It contains essential macronutrients (NPK), micronutrients, and beneficial microbial populations, including nitrogen-fixing bacteria and mycorrhiza fungi, along with plant growth-promoting substances. Ancon et al. (2020) noted that earthworm castings are rich in bacteria, actinomycetes, and fungi, making vermicompost an excellent soil conditioner and organic amendment for various crops.

Moreover, studies have shown that organic amendments can produce yield parameters statistically comparable to those achieved with recommended NPK levels (Singh et al., cited by Gopinath et al., 2010). In line with the Philippine government's promotion of sustainable and climate-resilient agriculture under Republic Act (RA) 10068 or the Organic Agriculture Act of 2010, RA 9003 (Ecological Solid Waste Management Act of 2000), and RA 9729 (Climate Change Act of 2009).

This study was conducted to evaluate the potential of vermicompost as an organic fertilizer for cutback cane point production in terms of germination period, germination rate, plant height, number of tillers, number of nodes per linear meter, number of internodes per linear meter, and number of cutback cane points harvested.

METHODS

Experimental Design and Treatments

A two-factor experiment arranged in a Randomized Complete Block Design (RCBD) with three replications to minimize field variability and experimental error was used. Factor A was Sugarcane varieties: V_1 (Phil 99-1793) and V_2 (VMC 67-252); and factor B was the fertilizer (F) using different rates of vermicompost application: F_1-5 t ha^{-1} ;F_2-10 t ha^{-1} ;F_3-15 t ha^{-1}; F_4-Control 1 (no fertilizer application); F_5-Control 2 (inorganic fertilizer).

Each treatment combination was randomly assigned within blocks following the RCBD principle to ensure uniformity and statistical validity. The experiment was conducted at the experimental area of Iloilo State University of Fisheries Science and Technology-San Enrique Campus, San Enrique, Iloilo, located in the fourth district of the province of Iloilo, Panay Island, Western Visayas, Philippines.

Planting Materials and Establishment

Certified planting materials of Phil 99-1793 (V_1) and VMC 67-252 (V2) were procured from the reliable source through the Sugar Regulatory Administration (SRA). A total of 540 cane points per variety were prepared, each consisting of two-budded cane setts. The cane setts were air-dried for 24 hours and planted with 25 cm between hills by 100 cm between rows.

Data Analysis

Collected data were analyzed using the Analysis of Variance appropriate for a factorial experiment in RCBD to determine the interaction effects of sugarcane varieties and vermicompost levels. Significant differences were subjected to Duncan's Multiple Range Test using the Statistical Tool for Agricultural Research.

RESULTS

Germination Period

The germination period of sugarcane varieties was significantly influenced by both variety and rates of vermicompost. The application of 15 t ha^{-1} vermicompost to Phil 99-1793 (V_1) resulted in the earliest germination (4.70 days), while the longest period to germination was observed in plants applied with inorganic fertilizer (5.90 days). Variety 2 (VMC 67-252) generally exhibited earlier germination compared to V_1 (Phil 99-1793). A significant interaction between variety and vermicompost levels was observed, where the application of 10 t ha^{-1} vermicompost in V_2 led to significantly faster germination compared with the unfertilized plants or control group but was statistically similar to other vermicompost levels and the inorganic fertilizer treatment but statistically like other vermicompost levels with inorganic fertilizer application.

These findings confirm the positive role of vermicompost in enhancing early seedling emergence due to its rich microbial composition and readily available nutrients, which improve soil aeration and moisture retention (Gopinath et al., 2010; Erşahin et al., 2017). The findings also support the statement of Rehman, et al. (2023)

and Canellas et al. (2022) that vermicompost enhances seed germination and early seedling development because vermicompost is rich in nutrients and has the presence of plant growth regulators such as humic substances and microbial metabolites. It also supports Arancon et al's (2012) findings that vermicompost tea made from vermicompost improved germination and early growth of tomato and lettuce (Arancon et al., 2012). The result also aligned with Boguspaev et al. (2023) that vermicompost increases germination percentage and seedling vigor, corresponding to the reduction in germination period specifically when applied with vermitea or processed vermicompost into tea.

Moreover, varietal differences in germination response have been widely documented in crop science. Genetic variation among plant varieties influences their ability to utilize nutrients and respond to organic amendments, resulting in differences in germination rate and emergence. This supports the observation that VMC 67-252 (V_2) generally germinated earlier than Phil 99-1793 (V_1). The significant interaction between variety and vermicompost level observed in the study agrees with the findings that plant response to fertilization is not uniform but depends on genotype–environment interaction. In sugarcane, organic inputs such as vermicompost and its derivatives have been shown to enhance crop establishment and early growth due to improved nutrient availability and soil biological activity.

Germination Rate

For germination rate, both varieties responded favorably to vermicompost application, although differences between treatments were not statistically significant. The highest germination rates were recorded from plants applied with 10 t ha^{-1} vermicompost for both V_1 (87.96%) and V_2 (88.89%). These results suggest that vermicompost can serve as an effective alternative to inorganic fertilizer, producing comparable germination percentages. Similar trends were reported by Djajadi et al. (2020), who found that vermicompost improved early crop establishment in saline and nutrient-deficient soils.

This result further validates the findings of Arancon et al. (2004), that vermicompost significantly improves seed germination, plant growth, and yield due to the presence of humic acids and plant growth regulators. According to them, these substances stimulate physiological processes such as enzyme activation and cell division, which contribute to faster and more uniform germination.

Atiyeh et al. (2000) also reported that vermicompost enhances seed germination and seedling development compared to conventional compost and inorganic fertilizers. It improves soil structure, aeration, and microbial activity, leading to successful germination. These findings align with the result of the present study, where vermicompost treatments produced germination rates comparable to inorganic fertilizer.

Vermicompost was found to contain beneficial microorganisms and growth-promoting compounds that enhance early crop establishment Edwards et al. (2007. These biological properties help explain why the application of 15 t ha^{-1} vermicompost resulted in the highest germination rates in both sugarcane varieties.

In Djajadi et al. (2020) study, vermicompost application improved crop establishment and germination performance in saline and nutrient-deficient soils. Their results support the observation that vermicompost can serve as an effective alternative to inorganic fertilizer in promoting germination and to the result of Lazcano and Domínguez (2011) that vermicompost generally enhances plant growth, its effect on germination may be minimal or statistically similar to control or inorganic fertilizer and application depends on the crop species and application rate. This finding supports the present result where differences between treatments were not statistically significant. However, the results contradicted to the observation of Zaller (2007) that excessive application of vermicompost may not further improve germination and, in some cases, it may reduce germination rates due to high salt content or nutrient imbalance. This suggests the existence of an optimum level of vermicompost application, which explains why 15 t ha^{-1} performed best in the present study.

In addition, Atiyeh et al. (2001) found that different proportions of vermicompost in growth media produced varying effects, with some treatments showing no significant improvement in germination compared to the control. This variability indicates that the effectiveness of vermicompost depends on its composition, maturity, and rate of application.

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Table 1. Germination period and the germination rate (%) of sugarcane varieties applied with different rates of vermicompost

Treatment Combination	Germination Period (day)	Germination Rate (%)
V_1F_1	5.17^{ab}	86.49
V_1F_2	4.77^{b}	87.96
V_1F_3	4.70^{b}	87.03
V_1F_4	5.70^{a}	85.92
V_1F_5	5.90^{a}	87.28
V_2F_1	3.60^{b}	88.42
V_2F_2	3.53^{b}	88.89
V_2F_3	3.70^{ab}	87.03
V_2F_4	4.17^{a}	88.42
V_2F_5	3.63^{ab}	83.11

^{ab}Treatment means having the same letter superscript are not significant at 5% level of probability

Plant Height

The application of vermicompost significantly influenced the height of the two sugarcane varieties across different growth stages (15-90 DAP). For Phil 99-1793 (V_1), the tallest plants at 180 days after planting were observed in treatments applied with 10 t ha^{-1} vermicompost, reaching a height of 231.03 cm. In contrast, for VMC 67-252 (V_2), the tallest plant at the same stage was recorded under the 15 t ha^{-1} application, with a mean height of 223.35 cm but the result showed no significant results.

During the early growth stages (15–90 DAP), plants treated with 15 t ha^{-1} (V_1) and 10 t ha^{-1} (V_2) generally exhibited superior height in both varieties. However, at 30 DAP in V_1, the tallest plants were observed in the 10 t ha^{-1} treatment. Similarly, in V_2, the 15 t ha^{-1} treatment produced the tallest plants up to 45 DAP, but from 60 to 90 DAP, the 10 t ha^{-1} vermicompost application resulted in taller plants.

Statistical analysis revealed that significant differences in plant height were evident up to 90 days after planting. For V_1, the 15 t ha^{-1} application produced significantly taller plants compared to the 5 t ha^{-1} treatment but it was comparable to the 10 t ha^{-1} treatment. In V_2, the 10 t ha^{-1} rate resulted in significantly taller plants than those receiving 5 t ha^{-1}.

Overall, VMC 67-252 (V_2) were consistently taller than Phil 99-1793 (V_1) across most growth stages, indicating varietal differences in response to vermicompost application (15-75 DAP), but shorter from 90-180 DAP. The results indicate that vermicompost supports vigorous vegetative growth comparable to inorganic fertilizers. This agrees with Arora et al. (2018), that vermicompost enhances soil porosity, aeration, and microbial activity, leading to improved plant vigor and height.

The result validates the findings of Arancon et al. (2007) that vermicompost significantly increased plant growth parameters, including height, by improving nutrient uptake and stimulating physiological processes. Similarly, Atiyeh et al. (2000) found that plants grown in vermicompost-amended media exhibited greater height compared to those grown in conventional or unfertilized soil.

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The application of organic amendments in sugarcane, such as vermicompost, promotes better vegetative growth through improved soil structure, aeration, and microbial activity, resulting in taller plants and more vigorous development. It also supports Joshi et al. (2015) that vermicompost application significantly improved plant height and biomass production due to enhanced microbial activity and nutrient mineralization.

Sinha et al. (2010) emphasized that vermicompost acts as a plant growth promoter by supplying essential nutrients and hormones, leading to increased plant height and overall vigor. In addition, Singh et al. (2008) observed that organic amendments, including vermicompost, significantly improved growth parameters such as plant height due to improved soil fertility and nutrient uptake efficiency. These findings support the present study where sugarcane height responded positively to vermicompost application, particularly at optimum levels.

Likewise, Zaller (2007) observed that increasing vermicompost levels did not always result in proportional increases in plant height, suggesting the existence of an optimum rate beyond which no additional benefit is obtained. Furthermore, Lim et al. (2010) reported that the growth response, including plant height, may vary depending on the source and maturity of vermicompost, with some treatments showing comparable results to control or inorganic fertilizer. In addition, Atiyeh et al. (2001) found that increasing vermicompost proportions in growth media did not always significantly increase plant height and, in some cases, produced similar growth to conventional media.

Moreover, Hidalgo et al. (2006) reported that plant height response to vermicompost varied widely depending on crop type and environmental conditions, with some treatments showing no significant advantage over control. Similarly, Gutiérrez-Miceli et al. (2007) observed that while vermicompost improved some growth parameters, plant height was not consistently affected across all treatments, indicating variability in plant response. These contrasting findings justify the results of the present study, indicating that while vermicompost can enhance sugarcane height, the differences among treatments may not always be significant, and the response is highly dependent on application rate, material quality, and varietal characteristics.

Table 2. Height of (cm) sugarcane varieties applied with different rates of vermicompost

Treatment	Age (DAP)						
Combination	15	30	45	60	75	90	180
V_1F_1	15.45^b	39.18^b	59.65^{ab}	90.92^a	125.83^b	153.41^b	220.87
V_1F_2	17.11^{ab}	51.04^a	62.01^a	94.32a	131.94^b	161.70^{ab}	231.03
V_1F_3	18.51^a	41.44^b	62.73^a	95.05^a	142.19	167.91^a	225.12
V_1F_4	16.07^b	38.85^b	57.44^b	80.91^b	122.61^b	138.86^b	209.52
V_1F_5	16.45^b	39.29^b	63.04^a	97.26^a	144.15^a	171.05^a	226.92
V_2F_1	28.05^a	68.95^{ab}	92.00^a	120.57^a	132.76^b	146.92^b	225.54
V_2F_2	27.65^a	71.27^a	96.57^a	124.75^a	147.01^a	164.98^a	219.05
$V2F_3$	30.36^a	73.67^a	99.98^a	124.58^a	143.60^a	160.93^a	223.35
$V2F_4$	24.86^b	61.10^b	81.87^b	100.98^b	116.82^b	132.24^c	218.22
V_2F_5	28.70^a	61.94^b	87.95^b	122.01^a	145.09^a	163.78^a	220.89

[ab]Treatment means having the same letter superscript are not significant at 5% level of probability

Number of Tillers

The number of tillers in sugarcane was significantly influenced by both variety and vermicompost application. In the present study, V_2 (VMC 67-252) generally produced the greatest number of tillers compared to V_1 (Phil 99-1793) across all treatments. Among the treatments, the application of 15 t ha^{-1} vermicompost resulted in the greatest number of tillers (V1), while the lowest numbers were observed in the unfertilized plants. However, differences among the various vermicompost levels were not statistically significant, suggesting that there may be an optimum application rate for promoting tiller formation. For V_2, a 10 t ha^{-1} application produced the greatest tillers (5.38 pc), significantly higher than those with 5t ha^{-1} and those without a fertilizer application. It was found that significant results observed from 15 to 90 days after planting, but no significant result noted after 180 DAP.

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The result revealed that tillers of those with vermicompost were almost the same as those with inorganic fertilizer. The observed increase in tiller number can be attributed to the nutrient-rich composition and biologically active substances in vermicompost, such as humic acids and growth-promoting enzymes, which stimulate shoot formation and cell division (Arancon et al., 2007; Atiyeh et al., 2000). Vermicompost also improves soil physical and biological properties, including aeration, water-holding capacity, and microbial activity, which enhance root development and promote lateral shoot emergence (Sinha et al., 2010; Joshi et al., 2015).

Supporting these findings, Ramesh et al. (2012) reported that sugarcane treated with organic amendments, including vermicompost, produced significantly higher tiller numbers compared to controlled treatments, indicating improved vegetative growth. Similarly, Ghosh et al. (2011) observed that the application of vermicompost enhanced tiller proliferation in cereals and tuber crops, attributing the effect to improved nutrient availability and root growth.

Furthermore, Kumar et al. (2014) reported that organic amendments positively influenced shoot and tiller formation in field crops by stimulating microbial activity and releasing plant growth regulators. Nonetheless, the response of tiller number may vary depending on environmental conditions, the source and maturity of vermicompost, and varietal characteristics, which can explain why some differences were not statistically significant (Lazcano & Domínguez, 2011; Lim et al., 2010; Gutiérrez-Miceli et al., 2007; Zaller, 2007).

Overall, these results indicate that vermicompost positively influences sugarcane tiller production, particularly at 15 t ha^{-1}, while varietal differences and environmental factors contribute to variations in growth response.

Table 3. Number of tillers of sugarcane varieties applied with different rates of vermicompost

Treatment Combination	Number of Tillers (pc)
V_1F_1	4.80^b
V_1F_2	5.06^a
V_1F_3	5.30^a
V_1F_4	4.50^b
V_1F_5	5.56^a
V_2F_1	4.45^b
V_2F_2	5.38^a
V_2F_3	5.14^a
V_2F_4	3.72^c
V_2F_5	5.98^a

^{ab}Treatment means having the same letter superscript are not significant at 5% level of probability

Number of Nodes and Internodes Per Linear Meter

The number of nodes and internodes per linear meter showed significant results on different vermicompost levels, but varietal differences were evident. For V_1, the greatest number of nodes was recorded in plants applied with 15 t ha^{-1} vermicompost, both V_1 (7.89 pc) and V_2 (7.87 pc). The number of internodes was greater in Phil 99-1793 (4.26 pc per linear meter than those in VMC 67-252 (4.25 pc).

The result confirmed the findings that vermicompost has a positive impact on the growth of plants. According to Arancon et al. (2004), vermicompost contains plant growth regulators such as auxins, gibberellins, and cytokinin, which stimulate cell division and elongation, thereby increasing both node formation and internode length similar to the report of Atiyeh et al. (2000) that plants grown in vermicompost-amended media exhibited enhanced shoot development, including increased stem elongation and more developed node structures, due to improved nutrient uptake and microbial activity. It also agrees with the statement of Lazcano and Domínguez (2011) that vermicompost improves soil physical properties and nutrient mineralization, leading to better root development and subsequent shoot growth.

According to them, vermicompost enhances nutrient availability and supports the formation of more nodes and promotes longer internodes, contributing to overall plant vigor. It also conforms to the findings of Joshi et al. (2013) that organic amendments like vermicompost significantly improve vegetative traits, including stem length and node number, due to the slow release of essential macro- and micronutrients.

The result contrast to the findings that the effect of vermicompost on internode elongation may vary depending on application rate and environmental conditions in the area where the study was conducted. The excessive nutrient availability may lead to compact growth with shorter internodes due to hormonal imbalance or reduced light penetration in dense canopies. Atiyeh et al. (2002) noted that while vermicompost enhances plant growth, optimal concentrations are necessary, as very high application rates may not proportionally increase morphological traits such as internode length.

Similarly, recent research demonstrated that vermicompost application significantly increased total tiller numbers under different moisture conditions, indicating its strong role in improving vegetative growth even under stressful environments.

The increase in tiller number can be attributed to the presence of essential nutrients, humic substances, and plant growth hormones such as auxins and cytokinins in vermicompost, which enhance cell division and root development, ultimately promoting shoot proliferation.

However, some studies suggest that the effect of vermicompost on growth parameters, including tillering, may vary depending on the rate of application and environmental conditions. Vermicompost improves overall plant growth, certain studies have shown that optimal growth parameters may still be achieved with balanced fertilization, indicating that vermicompost alone may not always produce the highest yield or tiller number compared to integrated nutrient management (Joshi et al., 2013). Additionally, excessive or imbalanced application may not proportionally increase growth due to nutrient saturation or poor aeration.

These findings indicate that varietal characteristics play a more dominant role in determining nodal; and Internodal development than fertilizer level. Vermicompost contributes positively by improving soil nutrient balance and stimulating auxin-like growth responses (Rehman et al., 2023). The excessive or imbalanced application may not proportionally increase growth due to nutrient saturation or poor aeration.

Table 4. Number of nodes and internodes of sugarcane varieties applied with different rates of vermicompost

Treatment Combination	Number of Nodes Per Linear Meter (pc)	Number of Internodes Per Linear Meter (pc)
V_1F_1	6.94^{b}	3.67^{b}
V_1F_2	7.16^{ab}	3.77^{ab}
V_1F_3	7.89^{a}	4.26^{a}
V_1F_4	6.66^{b}	3.44^{b}
V_1F_5	7.69^{a}	4.13^{a}
V_2F_1	6.99^{b}	3.66^{b}
V_2F_2	7.58^{ab}	4.06^{b}
V_2F_3	7.87^{ab}	4.25^{ab}
V_2F_4	6.48^{b}	3.32^{b}
V_2F_5	9.68^{a}	5.45^{a}

^{ab}Treatment means having the same letter superscript are not significant at 5% level of probability

Number of Cane Points Harvested

The number of cane points harvested varied significantly across treatments. In Phil 99-1793 (V_1), the highest number of cane points harvested (551,200 pc/ha) was produced by plants treated with 15 t ha^{-1} vermicompost, followed by 10 t ha^{-1} (492,400 pc/ha and the lowest among those applied with vermicompost were those with 5 t ha^{-1} but higher from those without fertilizer application. Those applied with 15 t ha^{-1} produced higher than those applied with inorganic fertilizer, while the lowest was observed in the unfertilized plants. For VMC 67-252 (V_2), the 15 t ha⁻¹ vermicompost application produced the highest number of cane points harvested (549,600 pc/ha) but lower than those with inorganic fertilizer, although plants applied with inorganic fertilizer still had slightly higher yields. Statistical analysis showed that differences between vermicompost applications were significant, indicating that the higher the levels, the higher yield comparable to the chemical inputs for V_2, 15 t ha⁻¹ vermicompost application produced a higher yield compared with inorganic fertilizer.

These results support the findings of Rehman et al. (2023), who emphasized that vermicompost enhances plant productivity by supplying balanced nutrients, beneficial microorganisms, and growth hormones while improving soil structure and mitigating abiotic stress. The comparable performance of vermicompost to inorganic fertilizer underscores its potential as a sustainable soil amendment for sugarcane production.

Table 5. Number of cane points harvested of sugarcane varieties applied with different rates of vermicompost

Treatment Combination	Cane Point Harvested/ha (pc)
V_1F_1	474,800^{b}
V_1F_2	492,400^{ab}
V_1F_3	551,200^{a}
V_1F_4	452,800^{b}
V_1F_5	535,200^{a}
V_2F_1	479,200^{b}
V_2F_2	526,800^{ab}
V_2F_3	549,600^{ab}
V_2F_4	438,800^{c}
V_2F_5	694,000^{a}

^{ABC} Treatment means having the same letter superscript are not significant at 5% level of probability

CONCLUSION

The performance of sugarcane is significantly influenced by both variety and vermicompost application rate, as shown by the differing responses of VMC 67-252 and Phil-99-1793 across measured growth parameters.

VMC 67-252 exhibited superior early growth performance, particularly in terms of germination period, germination rate, and number of tillers, when applied with 10 t ha⁻¹ of vermicompost, indicating that moderate application rates are optimal for its establishment and vegetative propagation.

In contrast, Phil-99-1793 demonstrated better performance in plant height, number of nodes, number of internodes, and cane point harvested when applied with 15 t ha⁻¹ of vermicompost, suggesting that higher application rates favor its structural growth and yield components.

The results indicate that optimal vermicompost rates are variety-specific, where 10 t ha⁻¹ is more suitable for enhancing early growth traits of VMC 67-252 sugarcane variety, while 15 t ha⁻¹ is more effective in maximizing the growth and yield potential of Phil-99-1793.

ACKNOWLEDGMENT

The researcher would like to express sincere gratitude to the Administration of the Iloilo State University of Fisheries Science and Technology-San Enrique Campus for the invaluable support extended throughout the conduct of this study.

Special thank is extended to Mr. Jodel D. Lacsao, Research Assistant for his dedication and support in the completion of this study.

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