

Quality of Taro Leaf Compost Produced Using Various Dosages of *Trichoderma harzianum* Biostarter and Its Application on Sweet Corn

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Abstract: Taro leaves and petioles (*Colocasia esculenta*) are abundant agricultural wastes that have not been fully utilized as compost. This study aimed to determine the effects of *Trichoderma harzianum* biostarter doses on the quality of taro leaf compost and on the growth and yield of sweet corn (*Zea mays* var. *saccharata* Sturt.). The study was conducted from December 2025 to May 2026 in Tanjung Pati, Lima Pulu Kota Regency, West Sumatra, Indonesia. A Randomized Complete Block Design was used in the plant experiment, with five doses of *T. harzianum* (K1=0.5%; K2=1.0%; K3=1.5%; K4=2.0%; K5=2.5%) and five replications. The data were analyzed using analysis of variance at a 5% significance level. All treatments produced compost with quality that met the requirements of SNI 7763:2024, with N content ranging from 1.88–2.74%, P from 1.58–1.86%, K from 2.75–4.30%, C/N ratio from 9.05–13.01, pH from 6.93–8.01, and moisture content from 9.88–12.64%. The application of taro leaf compost produced at different doses of *T. harzianum* biostarter had no significant effect on any vegetative or generative growth variables of sweet corn under the conditions of the study. The yield of sweet corn with husks ranged from 22.04–24.49 tons/ha, exceeding the reported yield potential range for the variety (9.4–18.4 tons/ha). The results showed that different doses of *T. harzianum*, under the conditions tested, produced compost that met the required quality standards but did not significantly affect sweet corn growth and yield.

Keywords: Biostarter, compost, decomposer, sweet corn, *Trichoderma harzianum*

1. INTRODUCTION

Sweet corn (*Zea mays saccharata* Sturt.) is a high-value food crop with increasing market demand in Indonesia. However, national sweet corn productivity remains around 4–5 tons/ha, which is considerably lower than its yield potential of 14–18 tons/ha (Sinaga *et al.*, 2024). This gap indicates the need for improvements in cultivation practices, including enhancing soil fertility through organic fertilizers.

Compost is an organic fertilizer that can improve soil physical properties by increasing porosity and water-holding capacity, improve soil chemical properties by increasing organic matter content, nutrient availability, and cation exchange capacity, and improve soil

biological properties by increasing the activity and diversity of soil microorganisms (Goldan *et al.*, 2023). One potential raw material for compost is taro leaves and petioles (*Colocasia esculenta*), which are abundant agricultural wastes that have not been optimally utilized. Taro leaves contain 43.50% organic carbon, 5.28% total nitrogen, 0.18% phosphorus, 0.95% potassium, and a C/N ratio of 8.24 (Lestari *et al.*, 2012). In addition, taro leaves and petioles have a soft texture and a moisture content exceeding 92%, making them relatively easy to decompose (Hermita *et al.*, 2018). These characteristics indicate that taro leaves and petioles have good potential as an inexpensive, readily available, and environmentally friendly compost material.

Compost quality is strongly influenced by microorganisms that play important roles during decomposition. *Trichoderma harzianum* is a multifunctional fungus capable of producing cellulase enzymes that degrade cellulose in organic materials, thereby accelerating decomposition, while also functioning as a biological control agent against soil pathogens (Fitria *et al.*, 2021). The use of *T. harzianum* in composting has been investigated with various organic materials and at different application rates. Sakiah *et al.* (2019) used *T. harzianum* at rates of 0, 50, and 100 g during the composting of oil palm fronds. They evaluated the contents of organic carbon, nitrogen, phosphorus, and potassium, as well as the compost's C/N ratio. Other studies using different organic materials have also applied *T. harzianum* at various rates and reported different responses in the composting process and compost quality. These differences indicate that the effects of *T. harzianum* during composting may depend on the type of organic material and the compost quality parameters evaluated. However, the effects of different *T. harzianum* rates during composting of taro leaves and petioles (*Colocasia esculenta*) remain to be investigated, particularly regarding the quality of the resulting compost and plant responses following compost application. Therefore, this study evaluated *T. harzianum* rates of 0.5%, 1.0%, 1.5%, 2.0%, and 2.5% to determine their responses in taro leaf compost quality and sweet corn growth and yield. This study aimed to determine the effects of *T. harzianum* rates on taro leaf compost quality and their effects on the growth and yield of sweet corn.

Composting is the biological breakdown of organic matter with the help of microorganisms that use organic matter as an energy source (Isyaturriyadhah *et al.*, 2023). Natural composting takes a relatively long time, so adding a biostarter is needed to accelerate decomposition (Trivana & Pradhana, 2017). *Trichoderma harzianum* is known to degrade cellulose, hemicellulose, and lignin through extracellular enzymes, thereby breaking down complex organic matter into simpler compounds available to plants (Norhikmah *et al.*, 2022).

Good-quality compost has a low C/N ratio, indicating maturity, sufficient macronutrient content, a neutral pH, and appropriate moisture content (Putri *et al.*, 2022). Based on SNI 7763:2024, good solid compost has a minimum organic C of 15%, a maximum C/N ratio of 25, a pH of 4–9, a moisture content of 8–25%, and a combined macronutrient content (N+P₂O₅+K₂O) of at least 2%. The application of compost to sweet corn can improve soil conditions and support both vegetative and generative growth (Ramadhani *et al.*, 2023). A planting spacing of 70 cm × 25 cm is the standard commonly used in sweet corn cultivation to optimize the plant population per unit area (Prakoso & Khakim, 2024).

2. METHOD

The study was conducted from December 2025 to May 2026 at the Padang Rajo field in Tanjung Pati, Harau District, Lima Puluh Kota Regency, West Sumatra Province. Compost quality testing was conducted at the Testing Laboratory of BRMP Tropical Fruit Crops, Solok.

Preparation of Taro Leaf Compost

The compost was made from taro leaves and petioles (7 kg), chicken manure (2 kg), rice husks (0.6 kg), dolomite lime (0.1 kg), molasses (40 ml), and rice bran (0.3 kg), with a total composition of 10 kg per treatment. The five *T. harzianum* biostarter dose levels tested were: K1=0.5%, K2=1.0%, K3=1.5%, K4=2.0%, and K5=2.5% of the compost material composition (modified from the Organic Fertilizer SOP, 2025). The taro leaves and petioles were chopped before being mixed with the other materials. Composting was carried out for 28 days using sacks as fermentation containers, covered with a tarpaulin, with weekly turning to maintain aeration. The compost was considered mature when its color changed to a dark, blackish-brown resembling soil, and its odor became earthy.

Compost Quality Testing

Compost quality was assessed descriptively through temperature observations (*soil thermometer*) on days 7, 14, 21, and 28 of composting. Laboratory analysis was carried out for the contents of N, P, K, organic C, C/N ratio, pH, and moisture. The results of the analysis were compared with the compost quality standard of SNI 7763:2024. Observation of the *T. harzianum* colony population in the soil was carried out using the stepwise dilution (*serial dilution*) method up to 10^{-3} on *Potato Dextrose Agar* (PDA) medium, which was incubated for 4 days (Khalili *et al.*, 2020).

Testing on Sweet Corn Plants

The effect of the compost on sweet corn of the Exotic variety was tested using a Randomized Block Design (RBD) with 5 treatments and 5 replications (25 experimental units). The compost was applied at a uniform dose of 10 tonnes/ha (6 kg/plot) one week before planting, with a planting spacing of 70 cm × 25 cm (Prakoso & Khakim, 2024). Inorganic fertilization was carried out with Urea at 300 kg/ha, SP-36 at 150 kg/ha, and KCl at 100 kg/ha. The vegetative variables observed were plant height, leaf length, leaf width, number of leaves, and stem diameter at 14–49 DAP. The generative variables were husked and dehusked ear weight, ear diameter, ear length, and production (tonnes/ha). At 57 DAP, the second ear was removed, and at 62 DAP, the leaves below the ear were pruned to optimize the filling of the main ear (Hermanto *et al.*, 2021). Harvesting was carried out at 76 DAP. The data were analyzed using analysis of variance at the 5% significance level.

3. RESULT AND DISCUSSION

Quality of Taro Leaf Compost

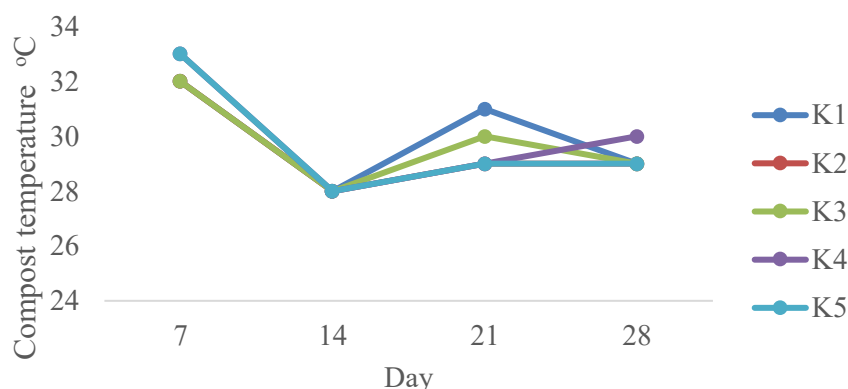
The laboratory analysis results for taro leaf compost with various doses of the *T. harzianum* biostarter are presented in Table 1.

Table 1. Analysis result for taro leaf compost with various doses of the biostarter *Trichoderma harzianum*

Treatment	N (%)	P (%)	K (%)	Organic C (%)	C/N Ratio	pH	Moisture Content (%)
K1 (0.5%)	2.04	1.73	3.35	25.12	12.31	8.01	10.20
K2 (1.0%)	1.88	1.86	2.75	24.45	13.01	7.61	9.88
K3 (1.5%)	2.74	1.58	4.30	25.85	9.43	7.51	12.64
K4 (2.0%)	2.55	1.69	3.62	23.08	9.05	6.93	11.61
K5 (2.5%)	2.05	1.84	3.06	23.51	11.47	7.39	10.44
SNI Min	Min 2 (N+P+K)			Min 15	Max 25	4–9	8–25

Note: Min = minimum; Max = maximum; – = not required for the individual element (N+P₂O₅+K₂O at least 2% combined); SNI = Indonesian National Standard 7763:2024

The compost temperature during composting ranged from 28 to 33°C. On day 7, the temperature reached 32–33°C in all treatments, indicating that *T. harzianum* was actively decomposing the organic matter. The temperature decreased gradually to 28–30°C by day 28, indicating that the compost had entered the maturation phase (Figure 1). The change in color from the original color of the materials to a dark, blackish-brown, together with the change in odor to an earthy smell at the end of composting, indicated compost maturity.

**Figure 1.** Rate of temperature change in taro leaf compost (*Colocasia esculenta*) during the composting process with various doses of the biostarter *Trichoderma harzianum*

The population of *Tharzianum* in the soil was observed after harvest. Soil samples were collected at a depth of 10 cm, with 500 g of soil collected from each treatment. A 1 g soil sample was used to enumerate *T. harzianum* using the serial dilution method. The soil sample was placed in a test tube containing 9 mL of sterile distilled water and homogenized. Subsequently, 1 mL of the suspension was transferred into another test tube containing 9 mL of sterile distilled water to obtain a 10⁻¹ dilution. Serial dilution was continued until a 10⁻³ dilution was obtained. A 1 mL volume of the 10⁻³ dilution was inoculated onto sterile Potato Dextrose Agar (PDA) medium. The medium was incubated for 4 days at room temperature. Colonies suspected to be *T. harzianum* were identified morphologically based on colony characteristics, particularly the formation of green colonies. Molecular identification was not performed. The population was calculated from the number of colonies in the 10⁻³ dilution and expressed as Colony Forming Units per milliliter (CFU/mL) (Figure 2).

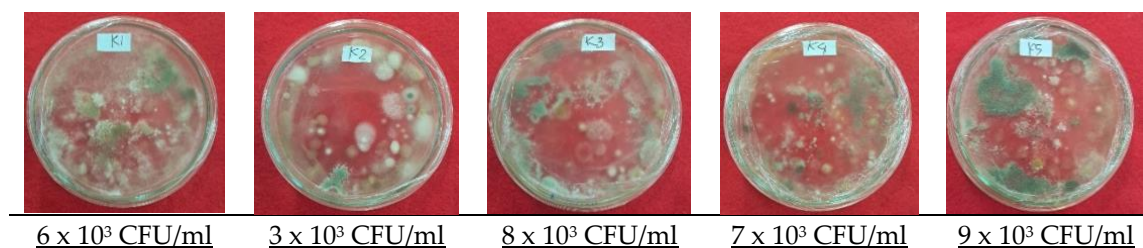


Figure 2. Results of the observation of *Trichoderma harzianum* colonies in the soil after the application of taro leaf compost

Table 2. Analysis results for soil nutrients before and after the application of taro leaf compost with various doses of the biostarter *Trichoderma harzianum*

Parameter	Initial soil	Final soil				
		K1	K2	K3	K4	K5
pH	5.70	5.32	5.25	5.24	5.62	4.93
Organic C (%)	5.40	10.8	11.1	10.7	10.6	11.0
Total N (%)	0.43	0.48	0.51	0.50	0.51	0.49
P Bray 2 (ppm)	22.6	12.6	13.5	13.0	26.2	11.9
Exchangeable K (cmol/kg)	0.93	1.08	0.78	0.89	1.10	0.68

The results of the soil nutrient analysis before and after the application of taro leaf compost are presented in Table 2. The soil organic C content increased from 5.40% (initial condition) to 10.6–11.1% after harvest. The soil pH decreased slightly from 5.70 to 4.93–5.62. Total N increased from 0.43% to 0.48–0.51%, while available P ranged from 11.9–26.2 ppm and exchangeable K from 0.68–1.10 cmol/kg after harvest.

Vegetative Growth of Sweet Corn

The analysis of variance showed that the application of taro leaf compost at various doses of the *T. harzianum* biostarter had no significant effect on plant height, leaf length, leaf width, number of leaves, or stem diameter of sweet corn at 49 DAP; therefore, no further tests were performed (Table 3).

Table 3. Average vegetative growth of sweet corn treated with taro leaf compost at various doses of the biostarter *Trichoderma harzianum* at 49 DAP

Treatment	Plant Height (cm)	Leaf Length (cm)	Leaf Width (cm)	Number of Leaves (leaves)	Stem Diameter (mm)
K1 (0.5%)	215.68	100.93	10.46	10.72	25.39
K2 (1.0%)	213.53	103.39	10.43	10.60	26.49
K3 (1.5%)	211.66	102.60	10.19	10.68	26.04
K4 (2.0%)	216.67	105.13	10.54	10.88	27.29
K5 (2.5%)	218.30	105.75	10.43	10.96	27.79
F calculated	ns	ns	ns	ns	ns

Note: ns = not significantly different at the 5% level, so no further test was performed

Generative Growth and Production of Sweet Corn

The analysis of variance showed that the application of taro leaf compost at various doses of the *T. harzianum* biostarter had no significant effect on any of the generative variables or on sweet corn production (Table 4).

Table 4. Average generative growth and production of sweet corn treated with taro leaf compost at various doses of the biostarter *Trichoderma harzianum*

Treatment	Husked Ear Weight (g)	Dehusked Ear Weight (g)	Husked Ear Length (cm)	Dehusked Ear Length (cm)	Husked Ear Diameter (mm)	Dehusked Ear Diameter (mm)	Husked Production (ton/ha)
K1 (0.5%)	428.36	303.08	34.04	21.56	54.21	47.72	23.25
K2 (1.0%)	406.04	293.88	33.36	21.10	53.32	46.43	22.04
K3 (1.5%)	439.00	310.48	34.58	21.52	54.81	48.06	23.83
K4 (2.0%)	451.12	307.60	35.81	21.86	55.48	48.80	24.49
K5 (2.5%)	427.28	303.88	35.64	21.76	54.25	47.30	23.20
F calculated	ns	ns	ns	ns	ns	ns	ns

Note: ns = not significantly different at the 5% level, so no further test was performed

Discussion

Quality of Taro Leaf Compost

The analysis showed that the taro leaf compost in all treatments met the requirements of SNI 7763:2024. The total combined macronutrient content (N+P₂O₅+K₂O) ranged from 6.49–8.62%, far exceeding the minimum requirement of 2%. The low C/N ratio (9.05–13.01) indicates that the compost had undergone good decomposition. Putri *et al.* (2022) stated that a low C/N ratio indicates that the organic matter has reached optimal maturity. The compost pH (6.93–8.01) and moisture content (9.88–12.64%) also met the SNI 7763:2024 standard (pH 4–9; moisture content 8–25%).

The rise in temperature at the beginning of composting (32–33°C on day 7) and its gradual decline to 28–30°C by day 28 show that *T. harzianum* actively decomposed the organic matter in all treatments. Fitria *et al.* (2021) stated that *T. harzianum* can accelerate the breakdown of organic matter through the production of the *cellulase* enzyme. The uniformity of the temperature pattern across treatments indicates that all biostarter doses tested were sufficient to optimize the decomposition process, resulting in relatively uniform compost quality.

The detection of colonies suspected to be *Trichoderma harzianum* in the soil after compost application indicates that *Trichoderma* colonies could still be detected at the time of sampling after harvest. The population ranged from 3×10^3 to 9×10^3 CFU/mL, with the lowest population observed in K2 at 3×10^3 CFU/mL and the highest in K5 at 9×10^3 CFU/mL. Differences in the number of colonies detected among treatments indicate variation in the soil *Trichoderma* population after compost application. *Trichoderma* is a group of soil fungi found in environments rich in organic matter. Therefore, the results indicate that colonies suspected to be *T. harzianum* could still be detected in the soil after compost application. However, these results cannot be used to conclude whether *T. harzianum* can adapt to or survive in soil over the long term, colonize plant roots, or provide effective biological control against pathogens, as these parameters were not assessed in this study.

The significant increase in soil organic C after harvest (from 5.40% to 10.6–11.1%) demonstrates that taro leaf compost can improve soil organic matter content (Goldan *et al.*, 2023). The decrease in soil pH from 5.70 to 4.93–5.62 is thought to be caused by the continued decomposition of organic matter, which produces organic acids in the soil (Halawa *et al.*, 2022). The soil N, P, and K contents, which remained in the medium-to-very-high categories after harvest, indicate that taro leaf compost with the *T. harzianum* biostarter can maintain nutrient availability throughout the plant growth period.

Vegetative Growth of Sweet Corn

The absence of significant differences among treatments in vegetative growth is thought to be caused by several factors. First, the compost dose applied to all plants was uniform (10 tonnes/ha), so that although the biostarter doses differed, the amount of nutrients entering the soil from the compost was relatively the same. Second, the time lag between the completion of the composting process and the application of the compost to the field, caused by land preparation, is thought to have allowed all composts from treatments K1–K5 to undergo complete decomposition; in addition, the laboratory analysis showed that the macronutrient contents among treatments were relatively close, with a uniform C/N ratio (9.05–13.01) indicating that all composts had reached optimal maturity. Third, the initially high soil fertility (organic C 5.40% [very high category]; exchangeable K 0.93 cmol/kg [high category]) meant that the additional nutrients from the compost did not have a statistically significant impact. Irawan *et al.* (2021) stated that a high soil organic matter content plays an important role in supplying nutrients to plants independently.

Although not significantly different, treatment K5 tended to show the highest average values for several vegetative parameters. This is thought to be related to the highest number of *T. harzianum* colonies in the soil in treatment K5 (9 colonies). Primayanti *et al.* (2025) reported that the application of *T. harzianum* can enhance root and stem growth in corn plants, thereby enabling more efficient water and nutrient uptake.

Generative Growth and Production of Sweet Corn

The absence of significant differences in the generative variables is consistent with that in the vegetative variables. The same factors (uniformity of compost dose, uniformity of compost quality, and high initial soil fertility) also contributed to the absence of significant differences among yield components. Husked sweet corn production ranged from 22.04–24.49 tonnes/ha across all treatments, suggesting that taro leaf compost with *T. harzianum* biostarter at all doses was still able to support optimal sweet corn production.

The achievement of production above the potential of the variety cannot be separated from the agronomic practices applied, namely the removal of the second ear at 57 DAP and the pruning of the leaves below the ear at 62 DAP. Hermanto *et al.* (2021) stated that removing leaves that are no longer photosynthesizing effectively allows all of the photosynthate to be focused on filling the main ear. The phosphorus content of the compost (1.58–1.86%) contributes to seed formation and filling (Furqoni, 2025), while potassium (2.75–4.30%) promotes the translocation of photosynthate to the ear (Hasanah *et al.*, 2021).

A limitation of this study is that the compost dose applied to the plants was held uniform across all treatments. Hence, differences in compost quality resulting from the biostarter doses were not proportionally reflected in the plants. Further research is recommended to vary the compost dose applied to the field to more clearly observe the effects of the treatments on sweet corn growth and production. In terms of cost efficiency, the lowest biostarter dose ($K_1=0.5\%$) was already sufficient to produce good-quality compost with a husked production of 23.25 tonnes/ha, making it more cost-efficient and recommendable to farmers.

4. CONCLUSIONS

Under the conditions of this study, taro leaf and petiole compost produced using 0.5–2.5% *Trichoderma harzianum* biostarter met the evaluated compost quality criteria. Differences in biostarter dose did not significantly affect the vegetative growth, yield components, or husked yield of sweet corn when all compost treatments were applied at 10 t/ha together with the same inorganic fertilizer regime. Husked yield ranged from 22.04 to 24.49 t/ha. The 0.5% biostarter treatment was the lowest dose tested that produced compost meeting the evaluated quality criteria; however, an economic analysis and a treatment without *T. harzianum* are required to establish its economic advantage and the specific contribution of the biostarter.

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