



UTILIZATION OF STEVIA REBAUDIANA AGRO-INDUSTRIAL RESIDUE AND POULTRY LITTER AS A SUSTAINABLE ALTERNATIVE FOR ORGANIC FERTILIZATION IN MAIZE

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ABSTRACT

Objective: To evaluate the effects of composting *Stevia rebaudiana* associated with poultry litter on the development of maize (*Zea mays* L.), aiming to promote sustainable practices for soil fertility management and the utilization of agro-industrial residues as alternative sources of organic fertilization.

Theoretical Framework: Organic fertilization is an essential practice for agricultural sustainability, as it improves soil structure and fertility, stimulates microbial activity, and enhances nutrient cycling. Plant- and animal-based composts, when combined, exhibit synergistic effects on nutrient availability and crop yield, reducing dependence on mineral inputs and mitigating environmental impacts.

Method: The experiment was carried out in a randomized block design with nine treatments and three replications, using different proportions of *S. rebaudiana* compost and poultry litter (100:0, 75:25, 50:50, and 25:75), in addition to an unfertilized control. Plant height, number of leaves, ear length, weight, diameter, and average yield per hectare were evaluated. Data were subjected to analysis of variance (ANOVA), and means were compared using the Tukey test at a 5% probability level, employing the R statistical software.

Results and Discussion: Treatments with higher proportions of poultry litter showed significant increases in all evaluated variables, with yield gains of up to 37% compared to the control. Organic fertilization promoted nutritional balance and enhanced microbial activity, resulting in improved plant development.

Research Implications: The integration of plant and animal residues through composting proved to be an efficient strategy to increase productivity and improve soil quality.

Originality/Value: The study highlights the innovative potential of *Stevia rebaudiana* compost associated with poultry litter as a sustainable and economically viable alternative for organic fertilization.

Keywords: Zea Mays, Agricultural Sustainability, Composting, Waste Valorization.

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APROVEITAMENTO DE RESÍDUO AGROINDUSTRIAL DE STEVIA REBAUDIANA E CAMA DE FRANGO COMO ALTERNATIVA SUSTENTÁVEL DE ADUBAÇÃO ORGÂNICA NO MILHO

RESUMO

Objetivo: Avaliar os efeitos da compostagem de *Stevia rebaudiana* associada à cama de frango sobre o desenvolvimento do milho (*Zea mays* L.), visando promover práticas sustentáveis de manejo da fertilidade do solo e o aproveitamento de resíduos agroindustriais como fontes alternativas de adubação orgânica.

Referencial Teórico: A adubação orgânica é uma prática essencial para a sustentabilidade agrícola, pois melhora a estrutura e a fertilidade do solo, estimula a atividade microbiana e favorece a ciclagem de nutrientes. Compostos de origem vegetal e animal, quando combinados, apresentam efeito sinérgico sobre a disponibilidade de nutrientes e o rendimento das culturas, reduzindo a dependência de insumos minerais e mitigando impactos ambientais.

Método: O experimento foi conduzido em delineamento de blocos casualizados, com nove tratamentos e três repetições, utilizando diferentes proporções de composto de *S. rebaudiana* e cama de frango (100:0, 75:25, 50:50 e 25:75), além da testemunha sem adubação. Foram avaliadas altura de planta, número de folhas, comprimento, peso e diâmetro de espiga, e produtividade média por hectare. Os dados obtidos foram submetidos à análise de variância (ANOVA) e as médias comparadas pelo teste de Tukey a 5% de probabilidade, por meio do software estatístico R.

Resultados e Discussão: Os tratamentos com maior proporção de cama de frango apresentaram incrementos significativos em todas as variáveis analisadas, com aumento de até 37% na produtividade em relação à testemunha. A adubação orgânica proporcionou equilíbrio nutricional e aumento da atividade microbiana, refletindo em melhor desenvolvimento das plantas.

Implicações da Pesquisa: A integração de resíduos vegetais e animais na forma de compostagem mostrou-se uma estratégia eficiente para elevar a produtividade e melhorar a qualidade do solo.

Originalidade/Valor: O estudo evidencia o potencial inovador da compostagem de *Stevia rebaudiana* associada à cama de frango como alternativa sustentável e economicamente viável de fertilização orgânica

Palavras-chave: *Zea Mays*, Sustentabilidade Agrícola, Compostagem, Valorização De Resíduos.

UTILIZACIÓN DE RESIDUO AGROINDUSTRIAL DE STEVIA REBAUDIANA Y CAMA DE POLLO COMO ALTERNATIVA SOSTENIBLE DE FERTILIZACIÓN ORGÁNICA EN MAÍZ

RESUMEN

Objetivo: Evaluar los efectos del compostaje de *Stevia rebaudiana* asociado con cama de pollo sobre el desarrollo del maíz (*Zea mays* L.), con el objetivo de promover prácticas sostenibles de manejo de la fertilidad del suelo y el aprovechamiento de residuos agroindustriales como fuentes alternativas de fertilización orgánica.

Marco Teórico: La fertilización orgánica es una práctica esencial para la sostenibilidad agrícola, ya que mejora la estructura y la fertilidad del suelo, estimula la actividad microbiana y favorece el ciclo de nutrientes. Los compostos de origen vegetal y animal, cuando se combinan, presentan efectos sinérgicos sobre la disponibilidad de nutrientes y el rendimiento de los cultivos, reduciendo la dependencia de insumos minerales y mitigando los impactos ambientales.

Método: El experimento se llevó a cabo en un diseño de bloques al azar con nueve tratamientos y tres repeticiones, utilizando diferentes proporciones de compost de *S. rebaudiana* y cama de pollo (100:0, 75:25, 50:50 y 25:75), además de un testigo sin fertilización. Se evaluaron la altura de planta, número de hojas, longitud, peso y diámetro de la mazorca, y el rendimiento promedio por hectárea. Los datos fueron sometidos a un análisis de varianza (ANOVA) y las medias comparadas mediante la prueba de Tukey al 5% de probabilidad, utilizando el software estadístico R.

Resultados y Discusión: Los tratamientos con mayor proporción de cama de pollo presentaron incrementos significativos en todas las variables evaluadas, con aumentos de hasta el 37% en el rendimiento en comparación



con el testigo. La fertilización orgánica promovió el equilibrio nutricional y una mayor actividad microbiana, lo que resultó en un mejor desarrollo de las plantas.

Implicaciones de la Investigación: La integración de residuos vegetales y animales en forma de compostaje demostró ser una estrategia eficiente para aumentar la productividad y mejorar la calidad del suelo.

Originalidad/Valor: El estudio destaca el potencial innovador del compost de Stevia rebaudiana asociado con cama de pollo como una alternativa sostenible y económicamente viable de fertilización orgánica.

Palabras clave: Zea Mays, Sostenibilidad Agrícola, Compostaje, Valorización De Residuos.

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1 INTRODUCTION

The growing demand for sustainably produced food with lower levels of agrochemical residues has driven the adoption of fertilization practices that enhance soil quality while reducing environmental impacts. In this context, organic fertilization stands out as a key strategy, strengthening the soil–plant–environment relationship by increasing soil organic matter and improving soil structure and fertility (Abbas *et al.*, 2024; Liu *et al.*, 2024; Silva *et al.*, 2024).

Organic fertilizers derived from plant and animal residues have been widely used due to their efficiency in nutrient cycling, reduction of production costs, and sustainable reuse of agricultural by-products. These practices contribute to environmental conservation and improved agricultural productivity (Agbede *et al.*, 2025; Dhakal *et al.*, 2022; Kumar *et al.*, 2024). In addition to enhancing soil physicochemical and biological properties, organic amendments increase nutrient availability, promote water infiltration, and reduce the risks of erosion and leaching (Dong *et al.*, 2025; Liu *et al.*, 2024; Silva *et al.*, 2024).

Continuous application of organic compounds also stimulates beneficial microbial activity, promoting humus formation and balance in soil biota. This dynamic results in greater structural stability, moisture retention, and nutrient use efficiency (Baron *et al.*, 2018; Khan *et al.*, 2024; Lima *et al.*, 2024). Such biogeochemical processes are fundamental for developing resilient and low-impact agricultural systems, as evidenced by long-term studies that link increased organic matter to improved fertility and mitigation of soil degradation (Yagi *et al.*, 2019; Essilfie *et al.*, 2024).

Among the crops that benefit most from organic management, maize (*Zea mays* L.) stands out for its economic importance and versatility in food, industrial, and forage production



chains (Silva *et al.*, 2024; Agbede *et al.*, 2025). Its productivity is directly related to the availability of essential nutrients such as nitrogen, phosphorus, and potassium — elements abundantly supplied by properly treated organic composts and poultry residues (Dhakal *et al.*, 2022; Kumar *et al.*, 2024; Dong *et al.*, 2025). In this regard, poultry litter has been recognized as a valuable nutrient source, capable of increasing organic matter content, improving cation exchange capacity, and enhancing plant growth and vigor (Sistani *et al.*, 2019; Yagi *et al.*, 2019).

Additionally, *Stevia rebaudiana* (Bertoni), a species with high bioeconomic potential, generates agro-industrial residues rich in organic compounds that can be reused in compost production, adding value to sustainable supply chains and reducing environmental impacts associated with improper waste disposal (Liu *et al.*, 2024; Abbas *et al.*, 2024). The combination of plant-based composts and animal-derived residues, such as poultry litter, represents a synergistic practice capable of enhancing nutrient efficiency and promoting agricultural sustainability (Essilfie *et al.*, 2024; Khan *et al.*, 2024).

Given this context, it is essential to explore strategies that integrate different composted organic sources to optimize nutrient supply, improve soil conditions, and increase crop productivity. Therefore, this study aimed to evaluate the effects of composting *Stevia rebaudiana* with poultry litter on maize growth and yield, contributing to the advancement of sustainable soil fertility management practices and the development of more balanced and environmentally efficient production systems.

2. MATERIALS AND METHODS

2.1 EXPERIMENTAL SITE

The field experiment was conducted at Sítio Cruzeiro, located in Marialva, Paraná State, Brazil (23°31'00.40" S, 51°50'00.90" W; 714 m above sea level). According to the Köppen climate classification, the regional climate is Cfa—humid subtropical—with hot summers, mean annual temperatures ranging from 17 °C to 19 °C, and annual rainfall between 1,200 and 2,000 mm, well distributed throughout the year.

The experimental area soil is classified as a dystrophic Red Latosol (Oxisol) with high natural fertility and clayey texture (EMBRAPA, 2013). The site had been managed under a no-tillage system with crop rotation of soybean (*Glycine max*) in the summer and wheat (*Triticum aestivum*) in the winter.



Prior to the experiment, soil samples were collected from the 0–20 cm layer for chemical characterization (Table 1). Analyses were performed at the Laboratório Rural de Maringá (2018).

Table 1

Chemical properties of the soil (0–20 cm layer) at the experimental site (Sítio Cruzeiro, Marialva, PR, Brazil).

P	K	Ca	Mg	H + Al	SB	CTC	V%
mg dm⁻³	----- cmol_c dm⁻³ -----			----- cmol_c dm⁻³ -----			
4,72	0,20	4,13	1,18	4,96	5,63	10,59	53,17
M.O	pH	Fe		Cu	Na⁺	Mn	Zn
g dm⁻³	CaCl₂	----- Mg/dm³ -----			----- Mg/dm³ -----		
15,84	5,10	77,96		36,36	5,33	115,20	16,31

Adapted from Laboratório Rural de Maringá, 2018.

Before setting up the treatments, 0.84 t ha⁻¹ of dolomitic limestone was applied uniformly to correct soil acidity and balance the Ca:Mg ratio, following the recommendations of EMBRAPA (2013). The amendment was incorporated by heavy harrowing to ensure homogeneous distribution before fertilization.

2.2 PREPARATION OF STEVIA REBAUDIANA COMPOST

The compost derived from Stevia rebaudiana agro-industrial residues was produced through a 75-day windrow composting process, with four manual turnings to ensure adequate aeration. To adjust the carbon-to-nitrogen (C/N) ratio, 5 kg of urea (45% N) was added per pile, improving decomposition efficiency.

The final chemical composition of the S. rebaudiana compost is presented in Table 2.



Table 2

Chemical composition of the Stevia rebaudiana compost used in the experiment.

K ₂ O	CaO	MgO		N total	P ₂ O ₅	Rel. C/N	C
----- % -----							
1,37	5,63	1,21		1,38	0,80	35:1	48,92
pH	Organic Matter	Moisture		Fe	Cu	Mn	Zn
CaCl ₂	%	65°C	110°C	----- Mg kg ⁻¹ -----			
3,44	89.04	35,88	64,81	10.468,05	563,46	1.966,67	602,16

Adapted from Laboratório Rural de Maringá, 2018.

2.3 POULTRY LITTER CHARACTERISTICS

The poultry litter was composed mainly of sawdust residues from a broiler house that had housed four production cycles. After removal, the material was heaped and moistened weekly for two months to stabilize decomposition. Subsequently, it was used as an organic nutrient source in the field trial (Table 3).

Table 3

Chemical characteristics of the poultry litter used in the experiment.

K ₂ O		CaO	MgO	N total	P ₂ O ₅	Rel.C/N	C	pH
----- % -----								CaCl ₂
6,93		16,84	1,25	2,39	0,18	16:1	39,19	6,70
Moisture		Organic Matter		Fe	Cu	Mn	Zn	
65 °C	110 °C*	%		----- Mg kg ⁻¹ -----				
16,51	30,33	71,33		45.869,97	1.114,4	1.835,18	4.547,26	

Adapted from Laboratório Rural de Maringá, 2018.

2.4 EXPERIMENTAL DESIGN AND TREATMENTS

The experiment was arranged in a randomized complete block design (RCBD) with nine treatments and three replications, totaling 27 plots (15 m² each, 3 × 5 m). Four combinations of *S. rebaudiana* compost and poultry litter were tested at two application rates (10 and 20 t ha⁻¹), plus an unfertilized control (T9). Treatments:

T1 – 100% *S. rebaudiana*, 10 t ha⁻¹

T2 – 100% *S. rebaudiana*, 20 t ha⁻¹



- T3 – 75% *S. rebaudiana* + 25% poultry litter, 10 t ha⁻¹
T4 – 75% *S. rebaudiana* + 25% poultry litter, 20 t ha⁻¹
T5 – 50% *S. rebaudiana* + 50% poultry litter, 10 t ha⁻¹
T6 – 50% *S. rebaudiana* + 50% poultry litter, 20 t ha⁻¹
T7 – 25% *S. rebaudiana* + 75% poultry litter, 10 t ha⁻¹
T8 – 25% *S. rebaudiana* + 75% poultry litter, 20 t ha⁻¹
T9 – Control (no organic fertilization)

2.5 CROP MANAGEMENT

Maize sowing was carried using the hybrid AGROESTE 1777 VT PRO 3, characterized by early maturity, broad adaptability, and high yield potential (Agroeste, 2018). The sowing density was 44,444 plants ha⁻¹, with 0.90 m between rows and four plants per linear meter.

Seeds were treated with imidacloprid 600 FS® (750 mL 100 kg⁻¹ of seed). Pest and disease control consisted of two foliar insecticide applications with Galil SC® (250 mL ha⁻¹) at the V1 and V3 stages, and two fungicide applications with Abacus HC® (380 mL ha⁻¹) at the V6 and V10 stages, following manufacturer recommendations.

2.6 EVALUATIONS AND DATA ANALYSIS

Plant growth was evaluated in two stages. The first assessment, conducted 45 days after emergence (V7–V8), included plant height and number of leaves. The second evaluation, performed at harvest, measured ear length, ear diameter, ear weight, and grain yield per hectare. A total of 1,080 ears were analyzed (40 ears per treatment), harvested manually, shelled, and weighed with moisture corrected to 21%.

The data were subjected to analysis of variance (ANOVA), and treatment means were compared using the Tukey test ($p \leq 0.05$). Statistical analyses were conducted using the R software (version 4.3.0).

3 RESULTS AND DISCUSSION

The evaluation of the experimental data revealed the effects of applying organic composts based on Stevia rebaudiana residues and poultry litter on maize growth and yield. Overall, the results demonstrated good statistical consistency among the evaluated variables,



indicating the reliability of the experiment. According to Tables 4 e 5, the coefficients of variation (CV) showed low variability for leaf number, ear length, ear weight, ear diameter, and grain yield, and moderate dispersion only for plant height, following the criteria proposed by Pimentel-Gomes (1985).

These values reflect adequate experimental precision and homogeneity among replications, ensuring the validity of the treatment comparisons. Similar patterns of experimental stability were reported by Abbas *et al.* (2024) and Agbede *et al.* (2025) when evaluating maize response to organic composts and poultry litter, respectively, which also confirmed the consistency of plant responses to different organic formulations.

For plant height (PH), measured at 45 days after emergence (V7–V8 growth stage), no significant differences were detected among treatments according to Tukey's test at 5% probability (Table 4). Nevertheless, treatment T8 (25% *Stevia rebaudiana* + 75% poultry litter; 20 t ha⁻¹) exhibited the highest numerical mean plant height compared with the control treatment (T9). This greater vegetative growth is likely associated with the nitrogen and potassium supplied by the poultry litter, which play key roles in cell elongation and photosynthesis (Essilfie *et al.*, 2024). Similar results were reported by Dhakal *et al.* (2022) and Dong *et al.* (2025), who observed that organic fertilizers enriched in N increased aboveground biomass and early vigor in maize plants.

Table 4

Mean number of leaves and plant height of maize subjected to different treatments at 45 days after emergence.

<i>Treatments</i> ¹	<i>Plant height (cm)</i> ²	<i>Number of leaves</i>
T1	58,13 a	6,66 d
T2	59,43 a	7,61 c
T3	70,56 a	8,61 b
T4	76,43 a	8,66 b
T5	78,43 a	8,72 b
T6	89,86 a	9,44 a
T7	75,33 a	8,05 c
T8	91,53 a	10,11 a
T9	66,56 a	8,05 c
CV %	14,89	7,57

¹Treatments: T1 – 100% *S. rebaudiana*, 10 t ha⁻¹; T2 – 100% *S. rebaudiana*, 20 t ha⁻¹; T3 – 75% *S. rebaudiana* + 25% poultry litter, 10 t ha⁻¹; T4 – 75% *S. rebaudiana* + 25% poultry litter, 20 t ha⁻¹; T5 – 50% *S. rebaudiana* + 50% poultry litter, 10 t ha⁻¹; T6 – 50% *S. rebaudiana* + 50% poultry litter, 20 t ha⁻¹; T7 – 25% *S. rebaudiana* + 75% poultry litter, 10 t ha⁻¹; T8 – 25% *S. rebaudiana* + 75% poultry litter, 20 t ha⁻¹; T9 – Control (0% organic fertilization). ²Means followed by the same letter in the column do not differ significantly according to the Tukey test ($p \leq 0.05$).



Regarding the number of leaves (NL), treatments T8 (25% *Stevia rebaudiana* + 75% poultry litter; 20 t ha⁻¹) and T6 (50% *Stevia rebaudiana* + 50% poultry litter; 20 t ha⁻¹) exhibited the highest mean values (10.11 and 9.44, respectively), standing out from the other treatments evaluated (Table 4). The increase in leaf number observed in these treatments indicates an expansion of the photosynthetically active area, a key condition for assimilate production and allocation throughout the crop cycle (Taiz & Zeiger, 2013; Khan *et al.*, 2024).

As described by Gomes (2010), greater leaf emission enhances the efficiency of the source–sink relationship, contributing to improved grain filling. Furthermore, recent studies have shown that the addition of active organic matter, such as that provided by poultry litter, enhances photosynthetic activity and enzymatic metabolism in maize plants, thereby improving vegetative vigor and physiological performance (Liu *et al.*, 2024; Lima *et al.*, 2024).

The integrated analysis of plant height and leaf number indicates that treatments receiving higher inputs of active organic matter promoted both vertical growth and leaf development. Treatment T8, which showed the greatest plant height, also recorded the highest leaf number, while T6 exhibited a similar pattern, suggesting a direct relationship between vegetative vigor and nutrient availability from the combination of *Stevia rebaudiana* and poultry litter. These findings reinforce that increased supply of nitrogen and potassium enhances meristematic activity and expands the photosynthetically active area, thereby promoting greater vegetative development in maize (Liu *et al.*, 2024; Lima *et al.*, 2024).

After evaluating the vegetative characteristics, the reproductive parameters were analyzed, as they represent key components of the productive potential of maize. Among these attributes, ear length, ear weight, and ear diameter stand out, as they directly reflect the efficiency of biomass accumulation and the plant's capacity for kernel formation and grain filling (Table 5).



Table 5

Mean values of ear length, ear weight, ear diameter, and grain yield of maize plants subjected to different treatments.

Treatments ¹	Ear length (cm)	Ear weight (g)	Ear diameter (mm)	Grain yield (kg ha ⁻¹)
T1	15,40 c	171,33 b	44,96 b	5264,76 b
T2	15,50 c	178,33 b	45,73 b	5564,76 b
T3	16,46 b	194,33 b	46,70 a	6136,97 a
T4	17,00 b	215,33 a	47,40 a	6731,41 a
T5	16,90 b	206,00 a	47,53 a	6759,19 a
T6	17,63 a	213,33 a	48,06 a	7024,03 a
T7	17,23 a	208,66 a	47,73 a	6749,93 a
T8	17,70 a	214,66 a	48,00 a	7013,63 a
T9	13,46 d	142,00 c	44,33 c	4425,14 c
CV %	2,44	5,49	1,55	5,92

¹Treatments: T1 – 100% *S. rebaudiana*, 10 t ha⁻¹; T2 – 100% *S. rebaudiana*, 20 t ha⁻¹; T3 – 75% *S. rebaudiana* + 25% poultry litter, 10 t ha⁻¹; T4 – 75% *S. rebaudiana* + 25% poultry litter, 20 t ha⁻¹; T5 – 50% *S. rebaudiana* + 50% poultry litter, 10 t ha⁻¹; T6 – 50% *S. rebaudiana* + 50% poultry litter, 20 t ha⁻¹; T7 – 25% *S. rebaudiana* + 75% poultry litter, 10 t ha⁻¹; T8 – 25% *S. rebaudiana* + 75% poultry litter, 20 t ha⁻¹; T9 – Control (0% organic fertilization). ²Means followed by the same letter in the column do not differ significantly according to the Tukey test ($p \leq 0.05$).

Ear length (EL) showed expressive increases in treatments T6 (17.63 cm), T7 (17.23 cm), and T8 (17.70 cm), which consistently outperformed the control (13.46 cm) (Table 5). These increases correspond to approximately 23.65%, 21.88%, and 23.95% gains relative to the control, indicating that a balanced supply of nitrogen and potassium, combined with a higher input of active organic matter, promoted reproductive elongation. Ear length is a critical yield component, as shorter ears typically present fewer kernel rows and therefore lower yield potential (Fancelli Neto, 2004). According to Yagi *et al.* (2019), adequate N and K availability, together with improvements in soil physical and biological properties, enhances ear length and diameter due to the prolongation of photosynthetic activity and greater biomass accumulation.

Regarding ear weight (EW), the highest values were observed in treatments T4 (215.33 g), T6 (213.33 g), T7 (208.66 g), and T8 (214.66 g), all superior to the control (142.00 g) (Table 5). The increase in ear weight is closely linked to proper potassium nutrition, which is essential for osmotic regulation, stomatal function, and carbohydrate transport—all key processes directly influencing grain mass accumulation (Taiz & Zeiger, 2013; Abbas *et al.*, 2024). Among treatments, T8—characterized by the highest proportion of poultry litter—provided elevated N and K availability, resulting in denser ears with greater reserve deposition, a response also



reported by Agbede *et al.* (2025) in systems fertilized with organic residues of high biological activity.

For ear diameter (ED), significant differences were observed among treatments, with T6 (48.06 mm), T7 (47.73 mm), and T8 (48.00 mm) achieving greater values than the control (44.33 mm) (Table 5). These increases (~7.6–7.8%) indicate improved row formation and enhanced grain structuring, both strongly associated with final yield (Fancelli Neto, 2004). Recent studies show that higher soil microbial activity—stimulated by the incorporation of organic compounds—enhances phosphorus availability and intensifies physiological processes associated with ear filling (Dong *et al.*, 2025; Essilfie *et al.*, 2024). Zancarano *et al.* (2012) further support that the interaction between high-potential hybrids and efficient organic management leads to increased grain mass deposition and greater final ear weight.

Grain yield (GY) further reflected the positive effects of the organic fertilization strategies adopted. All fertilized treatments outperformed the control, with the highest yields observed in T6 (7,024.03 kg ha⁻¹) and T8 (7,013.63 kg ha⁻¹). These values correspond to increases of 36.99% and 36.90% relative to the unfertilized treatment, confirming that the combined application of Stevia rebaudiana compost and poultry litter substantially enhances nutrient availability and photosynthetic efficiency. According to Fancelli & Dourado Neto (2008) and Sistani *et al.* (2019), such improvements are directly linked to the sustained activity of photosynthetically active leaves, which ensures continuous carbohydrate production and contributes to higher biomass allocation to reproductive structures. This mechanism has been widely documented in recent studies, which emphasize the importance of maintaining foliage health throughout the crop cycle as a determinant of grain yield (Liu *et al.*, 2024).

The superior performance of treatments containing poultry litter can be attributed to the high nitrogen content inherent to this residue. Nitrogen is a structural component of chlorophyll and plays a crucial role in CO₂ assimilation and carbohydrate synthesis (Ferreira *et al.*, 1997). Coelho & França (2001) highlight that maize has a high N demand between stages V6 and V8, which explains the lower performance of T1, T2, and T9—treatments that did not receive sufficient nitrogen inputs. Similar responses have been reported by Dhakal *et al.* (2022) and Yagi *et al.* (2019), who demonstrated strong correlations between organic fertilization and increased yield in tropical soils, particularly when nutrient-rich amendments such as poultry litter are incorporated.

Overall, organic fertilization—especially the combination of plant-derived compost and animal-derived residues—improved the physical, chemical, and biological properties of the soil. These improvements promoted microbial activity, enhanced the gradual release of



nutrients, and strengthened the functioning of the soil–plant system (Santos et al., 2001; Meneses, 1993; Hallmann *et al.*, 1997; Lazarovits & Nowak, 1997). Such findings align with current reviews emphasizing the effectiveness of composting and organic fertilizers in sustainable maize production systems (Khan *et al.*, 2024; Dong *et al.*, 2025; Liu *et al.*, 2024).

Thus, the integration of *Stevia rebaudiana* compost with poultry litter proved to be an efficient and sustainable strategy for improving the agronomic performance of maize, resulting in higher plant height, enhanced leaf area, strengthened yield components, and ultimately superior grain yield.

4 CONCLUSION

This study demonstrated that the combined application of *Stevia rebaudiana* compost and poultry litter promoted significant improvements in vegetative development, reproductive components, and maize productivity under tropical conditions. Based on the evaluation of nine fertilization treatments at 45 days after emergence and at harvest, it was verified that the treatments with higher proportions of poultry litter—especially T6 (compost + a higher proportion of poultry litter) and T8 (compost + the highest proportion of poultry litter)—resulted in marked increases in plant height, leaf emission, and ear length, weight, and diameter, which were reflected in higher grain yield.

These results can be attributed to the increased availability of essential nutrients, particularly nitrogen and potassium, supplied by the organic inputs characterized by high microbial and biochemical activity. Such properties enhanced vegetative vigor, expanded photosynthetic capacity, and improved ear formation and grain filling, confirming the efficiency of integrating organic residues as a nutritional management strategy.

Overall, the findings indicate that the combination of *S. rebaudiana* compost and poultry litter represents a sustainable and effective alternative for improving soil fertility and increasing maize productivity. This integrated organic approach offers practical relevance for farmers seeking to enhance crop performance through environmentally responsible practices.

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