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Research Article

Acceleration of Organic Compost Supply Using Microbial Consortium Formulation on Various Organic Wastes and their Effect on Sweet Corn

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ABSTRACT

Organic waste, primarily originating from agricultural sources, remains underutilized in Indonesia, despite its substantial potential as an organic fertilizer. Consequently, it is imperative to comprehend the technology capable of efficiently decomposing organic matter and yielding high-quality compost. This study aimed to investigate the impact of a microbial consortium comprising *Bacillus sp.*, *Pseudomonas sp.*, *Trichoderma sp.,* and *Aspergillus* sp. on the decomposition of organic waste derived from rice, sugarcane, corn and as well as to examine its application to sweetcorn (*Zea mays var. saccharata*). The study used a factorial randomized block design, featuring two primary factors, compost types and their respective doses. This design in total of nine treatments, each replicated three times, thus resulting in a sum of 27 experimental units. The treatments were RSC: Rice straw compost; SLC: Sugarcane leaves compost; CHC: Corn husk compost; D7.5: Compost dose of 7.5 t ha^{-1}; D15: Compost dose of 15 t ha^{-1}; D22.5: Compost dose of 22.5 t ha^{-1}. Moreover, an essential fertilizer, NPK, was applied at a rate of 200 kg/ha. The findings demonstrated a substantial impact of both compost types and doses on maize growth parameters, which encompassed plant height, leaf area, chlorophyll contentand dry weight. These effects were observed individually, without any interactions between the two factors. Furthermore, these treatments exhibited a discernible influence on corn yield. The highest to lowest yields were recorded as follows: CHC (9.29 t ha^{-1}), RSC (8.72 t ha^{-1}), and SLC (8.00 t ha^{-1}). Combining organic compost with chemical fertilizer effectively prevented nutrient loss through denitrification and evaporation, facilitating nutrient retention and controlled release over time.

Keywords: Aspergillus sp. Bacillus sp., microbial decomposers, Organic compost, Pseudomonas sp., Trichoderma sp.

Introduction

Organic waste is any leftover-organic materials from households, agriculture, and industries. Most communities rarely use organic wastes, such as rice straws, sugarcane leaves, and corn husks. Indonesia's rice production in the previous year reached 54.42 million t ha^{-1} GKG (unhusked dry rice ready for milling), while its total production was 163,668,529 million t ha^{-1} GKG in the last three years [1]. Moreover, the dry-rice stalks produced in one-time production can reach up to 55.6% of the total rice yield [2]. Similarly, the sugarcane and corn production in the last three years (2019-2021) were recorded to reach about 2,905 t ha^{-1}, while the total amount of corn production amounted to 30,055.623 t ha^{-1} in 2018 [2]. It is clear that this staggering amount of food-making process, would produce a considerable mass of waste, thereby making it necessary to bring about an effective waste management to produce essential yields, such as organic compost for fertilizer.

Naturally, the rice, corn, and sugarcane wastes require a lengthy decomposing period. This is partly due to the lignocellulose content found in the plant tissue cells. These plants have considerable lignin contents: rice with 5-25%; corn with 17%; and sugar cane with 22.09% [3-4].

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Widely recognized for their role in organic matter decomposition, *Bacillus* sp., *Pseudomonas* sp., *Trichoderma* sp., and *Aspergillus* sp. are prominent soil microorganisms. Among these bacteria, *Bacillus* sp. and *Pseudomonas* sp. are noteworthy for their possession of enzymes, including peroxidase, manganese peroxidase, hemicellulase and cellulase. These enzymes have demonstrated the remarkable ability to efficiently break down lignin-based waste materials, achieving degradation rates of up to 42% within a 24-day period [5].

The enzymes present in *Trichoderma* sp., particularly cellulase and xylanase, are renowned for their proficiency in decomposing organic agricultural residues, notably rice straw. Their capacity to hydrolyze cellulose, hemicellulose, and lignin is a well-documented attribute [6]**.** Additionally, *Aspergillus* sp. exhibits remarkable lignin degradation capabilities, achieving a substantial reduction of 44.6% within a four days under optimal conditions of pH7 and a temperature of 30°C. This fungus further demonstrates its utility by facilitating the solubilization of phosphate, a vital nutrient for plant growth [7].

Organic composts play a important role in enhancing soil functions, ameliorating soil texture and physical attributes, and fostering the proliferation of soil microorganisms [8]. These improvements in soil quality can lead to heightened nutrient absorption efficiency by plants [9]. Therefore, the present investigation is directed toward assessing the optimal compost types and application rates conducive to the growth and yield optimization of sweet corn.

Material and Methods

The research was carried out in a field experiment at Universitas Brawijaya, located in Jatimulyo, Malang City, East Java, Indonesia, from June 2020 to March 2021.

The materials used were starter liquid decomposers, including four main microorganisms: *Bacillus sp., Pseudomonas sp., Trichoderma sp*., and *Aspergillus sp*, whileorganic wastes included rice straws, corn husks, and sugarcane leaves.

Research design

The study was conducted using a factorial randomized block design (FRBD) featuring two distinct factors. The first factor, made of various compost types, denoted as RSC: rice straw compost, CHC: corn husk compost, and SLC: sugarcane leaf compost. The second factor pertained to the compost application rate, including $D_{7.5}$: 7.5 t ha^{-1}, D15: 15 t ha^{-1}, and D22.5: 22.5 t ha^{-1}. This design resulted in a total of nine unique treatment combinations, each replicated three times, yielding a grand total of 27 treatment units.

Compost preparation

Each organic material (rice straws, corn husks, and sugarcane leaves), each weighing 400 kg, was mechanically chopped into particles ranging from 7.5 to 10 cm using a chopping machine. The size reduction method suggested by Azim et al. [10], enhanced microbial infiltration into the cellular structure of the materials. The composting process was carried out under anaerobic conditions within a greenhouse using a rectangular tarpaulin measuring 1 x 3 meters. Microbial solution application was conducted on a weekly basis at a concentration of 15 ml per liter, administered through a 16-liter water sprayer in two applications.

Various physical and chemical characteristics were monitored daily throughout the composting process until the compost reached maturity. These parameters were temperature (°C), pH, compost color, and compost texture [11]. Temperature and pH were quantified using a digital thermometer and pH meter, respectively. Texture assessment was performed manually [11]. Additionally, compost color was assessed by visual comparison with standardized color charts.

Subsequently, the chemical properties of the matured compost, including pH, (N) total nitrogen, (P) available phosphorus, (K) exchangeable potassium, carbon-to-nitrogen (C/N) ratio, and organic carbon content (C-Organic), were analyzed. pH was determined with a pH meter, total N was quantified through Kjeldahl analysis, available P and exchangeable K were assessed using the Olsen method, and C-Organic content was measured via spectrophotometry [12].

Land preparation

The experimental area covered 600 m^2. The Beds comprised 27 plots with plot size is 3x 5.5 m. Sterilization was conducted before planting by cleaning weeds, making ditches, and removing waste.

Planting method

The plant spacing was 70x25 cm. Organic fertilizers (compost) were applied a week before planting in addition toplant protection and treatments such as spraying pesticides, weeding, and watering. The plants were also administered with NPK fertilizer (16:16:16), 30% dosage at 14 DAP and 70 dosage 30 DAP. Ultimately, the cornswere harvested at age 65 DAP, at the final stage of the generative phase marked by the ripening seeds in the cob [13].

Soil analysis

The sample of soil was collected before fertilizer was applied to the field. The first was collected randomly on the 0-15 cm depth surface area, while at the last stage of harvesting, soil samples were collected randomly but nearby the canopy of corn leaves [14].

The chemical characteristics of the soil were analyzed by measuring the pH in both H_2O and KCl solutions using a digital pH meter (at a ratio of 1:2.5 for soil to solution). Additionally, organic C was determined via the Walkley and Black method, total N through the Kjeldahl method, and available P using the Olsen method [15].

Data observation

Plant growth and crop yield were comprehensively assessed. The parameters included plant height (cm), leaf area (cm^2 $plant^{-1}$), chlorophyll index, and plant dry weight (g $plant^{-1}$), with observations made at four intervals (15, 30, 45, and 60 days after planting-DAP). Additionally, the evaluated crop yield was based on parameters such as corn cob length, diameter, and total crop yield per treatment.

Plant height measurements were taken using a ruler, with a range up to 100 centimeters [16]. Leaf area assessments were conducted using a Leaf Area Meter (LAM). The diameter of the corn fruit was measured using a vernier caliper.

For dry weight measurements, the corn plants were dried in an oven until reaching their maximum drying limit, followed by weighing using digital scales. The final crop yield evaluations, which encompassed corn cob length, diameter, and total yield per treatment, were carried out on the 65th DAP [17].

Data analysis

The collected data were subjected to standard statistical analysis. Initially, an Analysis of Variance (F test) was used at the 5% significance level to determine whether there were significant differences among the data. In cases where the F test identified such differences, further analysis was conducted using the Least Significant Difference (LSD) test at the 5% significance level. This approach allowed for detailed comparisons and insights into the observed variations within the data.

Results and Discussion

Temperatures (℃)

An initial increase in temperature was observed in rice straw compost on day seven, followed by corn husk and sugarcane leaf compost (Figure 1). By days 35 to 49, the temperature of rice straw compost had already reduced to around 30°C, demonstrating a relatively rapid decline. This trend was mirrored in corn husk and sugarcane leaf compost, which exhibited a sharp temperature decrease by the sixth week. This rise in temperature can be attributed to the microbial activity that consumed oxygen, generating energy through the production of CO_2, heat, and water vapor. Additionally, heat evolved from the compost's core caused surface water evaporation. Once the temperature peak was reached, it gradually stabilized. The ascending temperature during composting serves as an indicator of microbial activity, with higher microbial populations leading to elevated temperatures [18].

The temperature in the compost heaps of rice straw, corn straw, and dry sugarcane leaves can vary due to variations in the organic matter composition. Rice straw typically possesses a high C/N ratio, which leads to slower decomposition and lower heat generation in the compost. On the other hand, corn straw and dried sugarcane leaves exhibit a higher nitrogen content, accelerating microbial activity and resulting in higher temperatures within the compost heaps [19].

pH

The pH levels across all compost types initially decreased and then stabilized within the range of pH 7-8 (Figure 2). This pH reduction is primarily attributed to the oxidation of enzymatic inorganic compounds during the composting process. Notably, compounds such as NH^{4+} and H_2S undergo conversion to NO_3 and $S0_4^{2-}$ while generating H^+ cations as part of the decomposition process [20].

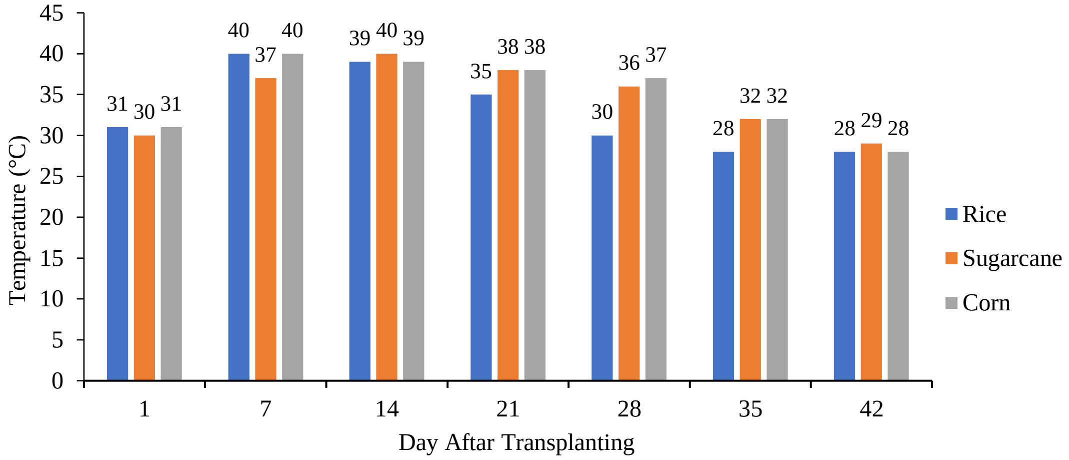

Figure 1. Temperature changes during composting of organic waste per week

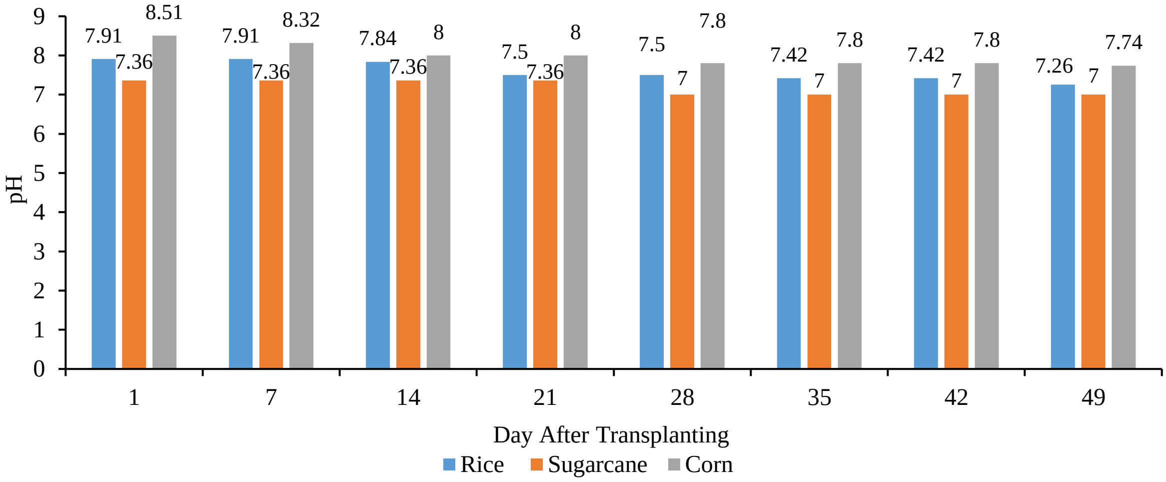

Figure 2. pH changes during composting

Furthermore, microorganisms involved in decomposition actively generate organic acids as metabolic by-products. These organic acids play the important role in lowering the pH within the compost. The fluctuations in pH observed in composts composed of rice straw, corn stover, and dried sugarcane leaves can be attributed to the original composition of the organic matter used and the intricate interactions between microorganisms and chemical processes within the composting system [21].

Compost colors

In general, the composting process will gradually change the color of the compost to blackish brown (Table 1). This occurred due to the ongoing transformation of organic matter and the formation of humus substances [22]. Based on the observation, the rice and corn compost were the first to experience color change on day 50. This indicated that the compost reached maturity in terms of color characteristics. Meanwhile, the sugarcane compost started changing from deep brown to dark brown on day 60. In the composting process, microorganisms transformed the carbon chain (C) from a complex form to the simple one. With this process, each composted organic material also lost its pigment thus, it became blackish due to its chemical constituents [7].

Compost textures

The observations revealed that significant texture changes occurred in the rice straw and corn husk composts by day 20 of composting (see Table 2). In contrast, the sugarcane leaf compost exhibited no notable textural change by day 10. However, by day 30, the texture of the sugarcane compost began to transform subtly, progressing to

Table 1. Color changes during composting of organic wastes as a result of the addition of microbial decomposers

Compost Organic Matter	Days					
	10	20	30	40	50	60
Rice	LB	DEB	DEB	DEB	DAB	DAB
Sugarcane	LB	B	DEB	DEB	DAB	DAB
Corn	LB	B	B	B	DAB	DAB

Note: LB= light brown; DEB= deep brown; B= Brown; DAB= dark brown.

Table 2. Texture changes during composting of organic wastes due to microbial decomposers

Compost Organic Matter	Days					
	10	20	30	40	50	60
Rice	N	C	F	VF	VF	VF
Sugarcane	N	N	F	F	F	VF
Corn	N	F	VF	VF	VF	VF

Note: N= normal; C= crumb; F= fine; VF= very fine.

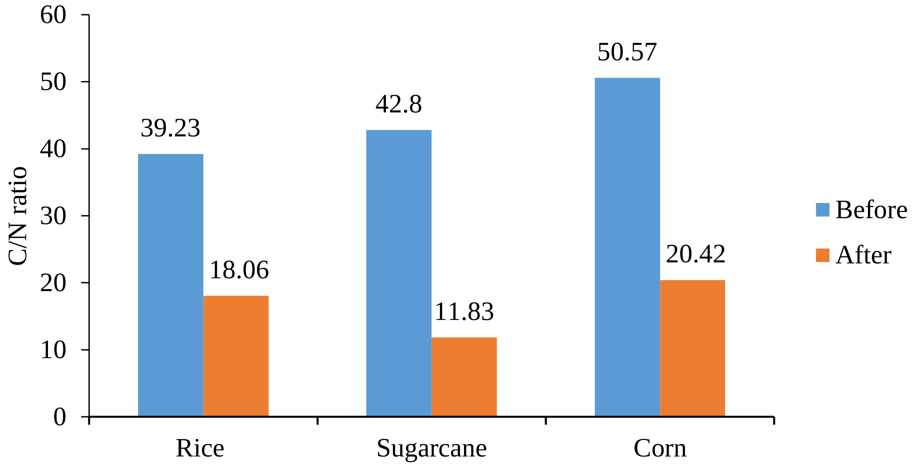

Figure 3. C/N ratio changes in composting

a finer texture by day 40. Plant organic matter is inherently rigid, often dense, due to its lignocellulosic composition, with lignin being a major constituent. The higher the percentage of lignin within organic matter, the more intricate its texture. The shift from a hard to crumb-like texture typically signifies microbial-driven lignin degradation activity [18].

C/N ratio

The C/N ratio serves as an indicator of compost maturity, reflecting alterations during the composting process due to the utilization of carbon as an energy source. This carbon is converted into CO_2, leading to a reduction in carbon content over time [23]. Comparing the C/N ratios before and after composting yielded the following results: rice compost decreased by 21%, sugarcane by 30%, and corn by 32% from their initial values. The final C/N ratios after composting were as follows: rice (18.05), sugarcane (20.42), and corn (11.82). An optimal C/N ratio is crucial for successful composting. Composts with high C/N ratios pose challenges for nutrient absorption by plants. In accordance with compost standards, the C/N ratio should typically fall within the 10 to 20 range [24]. The reduction in C/N ratios during composting is attributed to decreased carbon content and elevated nitrogen (N) levels in the compost. Microorganisms play their role by utilizing carbon as an energy source during decomposition, leading to reduced carbon content, while nitrogen levels increase due to microbial production of ammonia or atmospheric nitrogen [25].

NPK contents (%)

The quality of compost is closely associated with its nutrient content, and Table 3 illustrates the varying levels of increase in elements such as N, P, and K. A well-executed composting process typically enhances nutrient value [26].

The quantity of NPK nutrient content in the compost is determined by the specific organic materials used in composting, each of which possesses distinct characteristics. In this instance, the order of NPK content, from highest to lowest, was organic matter, corn, sugarcane, and rice. However, post-composting, N, P, and K content exhibited an increase. The increment in N content can be attributed to microorganisms converting organic N into mineral N [27].

In contrast, the heightened P content in all compositions resulted from the involvement of phosphate-solubilizing microorganisms (PSM). Numerous studies suggest that the utilization of multiple microbial strains is more effective in enhancing P content availability in compost compared to the use of a single strain. Additionally, the increased potassium (K_2O) content resulted from microorganisms utilizing it as a catalyst in the decomposition process [28], and the application of diverse microbial strains is believed to have a more substantial impact on plant growth than using a single strain [29].

Plant heights

The results of the Analysis of Variance (ANOVA) indicated that the types of compost did not significantly influence on the height of corn plants at 15 and 30 days after planting (DAP) (Table 4). Nevertheless, it was observed that the types of compost did affect plant height at 45 and 60 DAP. Specifically, sugarcane and corn composts exhibited no significant difference at 45 DAP but were significantly different from rice compost. At 60 DAP, rice and sugarcane composts did not significantly differ, but both significantly varied from corn compost. Notably, the compost dose had an impact on plant height, with D22.5 and D15 doses showing significant differences at 15 DAP, while dose treatment exhibited significant differences at 45 and 60 DAP. In short, both the types and doses of compost exhibited effects on plant height at specific doses and ages. The average height of sweet corn is presented in Table 3. The utilization of organic matter as compost can enhance nutrient levels and promote the growth of corn plants [30]. Additionally, the application of corn husk compost can increase the presence of essential nutrients such as N, P, and K in the soil, which are beneficial for plant growth [31]. The presence of *Trichoderma* sp. in the compost was also believed to contribute to the increased height of sweet corn [32].

Table 3. The content of N, P, K, pH, and C-Organic in various types of compost

Nutrient Content	Materials			Compost		
	Rice Straws	Sugarcane leaves	Corn husks	Rice Compost	Sugarcane Compost	Corn Compost
N (%)	0.88	0.81	0.91	1.23	1.51	2.49
P (ppm)	19.8	10.1	40.2	51	86.1	2002
K (ppm)	1941	2628	2324	3349	3857	5562
pH	7.91	7.36	8.51	7.26	9.14	7.74
C-org	34.52	40.96	38.95	22.21	30.84	29.45

Table 4. Sweet-corn plant heights as a result of compost types and dose at various ages on observations

Treatment	Plant height (cm) at Age (DAP)			
	15	30	45	60
RSC	14.82	38.27 a	92.49 a	135.66 a
SLC	15.15	36.02 a	101.77 b	136.11 a
CHC	15.68	35.42 a	105.76 b	144.29 b
LSD 5%	ns	ns	9.19	6.83
D7.5	13.81 a	37.70 a	86.48 a	126.31 a
D15	15.78 b	36.08 a	101.17 b	139.82 b
D22.5	16.06 b	35.93 a	112.36 c	149.93 c
LSD 5%	1.52	3.73	9.19	6.83
CV (%)	9.96	10.21	9.19	5.01

Note: Values followed by the same letter in the same column are not significantly different based on the 5% of LSD test; ns = not significant; DAP = day after planting.

Leaf area

The Analysis of Variance (ANOVA) demonstrated that the corn leaf area was not significantly affected by the types of compost at the ages of 15 to 30 days after planting (DAP) (Table 5). However, significant differences were observed at 45 and 60 DAP. Specifically, due to the application of corn compost (CHC), the leaf area was 5% greater than that of SLC and RSC treatments at 45 DAP, with an average value of 468 cm^2, and 12% higher at 60 DAP compared to SLC and RSC, with an average value of 404 cm^2. Regarding treatment doses, D7.5 and D15 doses were not significantly different at 15 DAP, with an average value of 14.24, which was 21% lower than the D22.5 treatment. However, at 30, 45, and 60 DAP, the treatment dose significantly influenced the corn leaf area. It was found that the D22.5 treatment resulted in a 6% larger leaf area than D15, while D15 exhibited a 13% greater leaf area than D7.5. In summary, the types of compost treatments only significantly affected the leaf area at 45 and 60 DAP. Conversely, the treatment dose significantly impacted all ages during the observation. The highest leaf area value among compost types was observed in corn compost, while the optimal compost dose was found to be 22 t ha^{-1}. The potassium (K) content in rice, corn, and sugarcane composts was determined as follows: 3349, 5562, and 3857 ppm. This outcome suggests that the K element may have contributed to the expansion of the leaf area, as it plays a role in enhancing the photosynthesis process in plants by increasing the leaf area index. Consequently, this process augments CO_2 assimilation and the translocation of photosynthetic products [33].

Chlorophyll index

The results of the Analysis of Variance (ANOVA) demonstrated a significant response in the chlorophyll index concerning the types of compost (Table 6). Composts SLC and CHC exhibited a similar response, being 10% higher than rice straw compost (RSC). Additionally, the D22.5 treatment displayed an 8% increase compared to D7.5 and D15, with an average value of 41. Overall, both the types and doses of compost significantly influenced the chlorophyll value. Although the sugarcane and corn compost types were not significantly different from each other, both outperformed the rice compost. Furthermore, a significant response in the chlorophyll index was observed based on the dose, with D22.5 treatment yielding better results than D7.5 and D15. Chlorophyll content is also influenced by environmental factors, such as sunlight, carbohydrates, oxygen, nitrogen, magnesium, iron, water, and temperature

Table 6. Leaf chlorophyll index as a result of compost of types and dose

Treatments	Leaf Chlorophyll Index (CCI)
RSC	39.83 a
SLC	43.11 b
CHC	44.15 b
LSD 5%	2,98
D7.5	40.10 a
D15	42.66 ab
D22.5	44.33 b
LSD 5%	2.98
CV %	7.03

Note: Values followed by the same letter in the same column are not significantly different based on the 5% of LSD test; DAP = day after planting.

Table 5. Sweet-corn leaf area as a result of compost types and dose on observations

Treatment	Leaf area (cm^2 $plant^{-1}$) at Agr (DAP)			
	15	30	45	60
RSC	15.07	182	362.77 a	388.03 a
SLC	15.34	192.29	375.40 ab	420.25 b
CHC	15.40	209.49	388.92 b	456.44 c
LSD 5%	ns	ns	18.04	27.97
D7.5	14.28 a	176.29 a	346 a	381.70 a
D15	14.21 a	188.59 ab	374.88 b	417.96 b
D22.5	17.28 b	218.9 b	406.22 c	465.07 c
LSD 5%	2.58	28.11	18.04	27.97
CV %	16.89	15.99	4.80	6.63

Note: Values followed by the same letter in the same column are not significantly different based on the 5% of LSD test; ns = not significant; DAP = day after planting.

[34]. Chlorophyll content below 50 CCI is categorized as low [35]. One explanation for this could be insufficient nitrogen (N) uptake in the leaves. Inorganic fertilizers contain more N than organic composts. In this study, the 200 kg/ha fertilizer dose appeared inadequate to meet the N requirements of the corn plants, as indicated by the chlorophyll content results.

The dry weight of plants

The Analysis of Variance (ANOVA) indicated that the types of compost did not have a significant impact on the dry weight of the plants at 15 DAP (Table 7). However, the CHC compost type showed a significant difference, being 25% higher than RSC compost at 30-60 DAP, with an average dry weight of 59 g compared to 47 g, and 16% higher compared to D15, with an average of 59 g compared to 51 g. The dry weight of corn plants significantly responded to the compost dose treatment at all ages during the observation. D15 treatment was not significantly different from D22.5 at 15 and 60 DAP but significantly different from D7.5, with a 19% difference at 15 DAP and a 12% difference at 60 DAP, resulting in an average value of 93.66 g. At 30 and 45 DAP, the D22.5 treatment was 3% higher than D15 and D7.5 treatments, with an average dry weight of 40.6 g. In summary, both the types and doses of compost treatments significantly influenced the dry weight of the plants. CHC compost was not significantly different from SLC compost but significantly different from RSC compost. The treatment dose had a significant effect on the corn's dry weight, with the highest values observed in the D22.5 and D15 treatments at 15 and 60 DAP. Specifically, D15 treatment was significantly different from D7.5 at all ages observed, except at 45 DAP. Plant dry weight serves as a measure of plant growth and development, reflecting the accumulation of organic compounds synthesized by plants. Plant dry weight is indicative of the plants' nutritional status and is closely related to nutrient availability. Previous studies have shown that *Trichoderma* spp. can enhance soil nutrients and plant growth [36].

Crop growth rates

The Analysis of Variance results revealed that the growth rate from 15 to 30 days after planting (DAP) did not significantly respond to the types or doses of compost treatment (Table 8). However, the growth rate showed a significant response from 30 to 45 and 45 to 60 DAP, where CHC significantly differed from SLC and RSC. Regarding the compost dose treatment, there was no significant difference between the D7.5 and D15 doses. However, a significant response was observed in the D22.5 treatment, which was 21% higher than D15 and D7.5.

Crop yields

The analysis of variance revealed a significant interaction between the types and doses of compost. The CHCD22.5 treatment had the most substantial and significant impact on crop yields compared to all other treatments (Table 9). The CHCD15 and SLCD22.5 treatments exhibited no significant difference, followed by the RSCD15 and SLCD15 treatments, which also showed similar results. In contrast, the treatment with the lowest yield was the RSCD7.5 treatment. The variations in crop yields were closely related to the nutrient content of each compost type and the dosage applied. It was observed that corn husk compost contained higher levels of NPK nutrients compared to other compost types, leading to

Table 7. Plant dry weight as a result of compost types and dose

Treatments	Dry weight (g plant^{-1}) at Age (DAP)			
	15	30	45	60
RSC	3.03	19.51 a	37.61 a	85.80 a
SLC	3.09	21.07 ab	45.45 b	91.74 ab
CHC	3.17	23.77 b	51.91 b	93.01 b
LSD 5%	ns	3.36	7.48	7.08
D7.5	2.73 a	18.53 a	34.90 a	83.22 a
D15	3.18 b	21.3 a	43.40 b	89.53 b
D22.5	3.37 b	24.53 b	56.67 c	97.8 b
LSD 5%	0.37	3.36	7.48	7.08
CV %	11.87	15.64	16.62	6.25

Note: Values followed by the same letter in the same column are not significantly different based on the 5% of LSD test; ns = not significant; DAP = day after planting.

Table 8. The growth rate of sweet corn plants as a result of compost type and dose at various ages on certain observations

Treatments	Crop Growth Rate (g cm^{-2} $days^{-1}$) at Age (DAP)		
	15-30	30-45	45-60
RSC	18.26	15.44 a	37.82 a
SLC	19.23	17.79 ab	38.15 a
CHC	22.49	19.77 b	48.51 b
LSD 5%	ns	3.15	5.09
D7.5	19.29	16.96 a	36.29 a
D15	18.57	15.84 a	38.36 a
D22.5	22.11	20.20 b	49.83 b
LSD 5%	ns	3.14	5.09
CV (%)	18.80	17.81	12.26

Note: Values followed by the same letter in the same column are not significantly different based on the 5% of LSD test.

Table 9. Interaction between compost types and dose on sweet-corn plants' yield

Treatments	Yield (t ha^{-1})		
	D7.5	D15	D22.5
RSC	4.80 a	6.74 b	8.72 de
SLC	6.06 b	6.76 b	8.00 cd
CHC	6.13 b	7.60 c	9.29 e
LSD 5%	0.44		
CV %	8.49		

Note: Values followed by the same letter in the same row and column are not significantly different based on the 5% of LSD test; ns = not significant; DAP = day after planting.

differences in production. The nitrogen (N) element played a crucial role in corn yield [37]. Dose differences also had a notable impact on sweet-corn productivity. Specifically, compost with higher doses was considered more optimal, especially regarding nutrient uptake compared to chemical fertilizers [38]**.** One of compost's functions was to enhance nutrient absorption by stimulating root growth through the production of the hormone IAA (indole acetic acid), thus optimizing nutrient uptake from the soil [39]**.** Combining organic compost and inorganic fertilizer significantly increased corn production compared to using either alone [40]. Multiple studies have reported that the application of organic compost, along with chemical fertilizer, can boost sweet corn production [41]**.** Applying organic composts improves the soil's physical and biological characteristics, enhancing nutrient absorption from the soil to the plants [42]**.** Numerous studies focusing on rice straw, sugarcane, and corn husk compost for sweet corn have consistently demonstrated increased yields [43,44,45]**.**

Corn cob length

The analysis of variance revealed a significant interaction between the type and dose of compost for corn cob length (Table 10). The CHCD22.5 treatment resulted in the longest corn cobs, outperforming all other treatments. Following this, the SLCD22.5 and RSCD22.5 treatments at the same dose exhibited similar outcomes. When considering the 15 t ha^{-1} compost dose, the CHC (corn) compost treatment proved superior to both SLC and RSC composts. Specifically, rice straw compost had the shortest length at the lowest dose (D7.5) compared to the other composts, while corn compost had the longest length at this dose.

In summary, at various doses applied, corn husk compost demonstrated a significantly positive effect compared to other compost types. The analysis of nitrogen (N) content in corn waste indicated a value of 1.23%. Additionally, N fertilization was found to enhance both corn cob length and diameter [46].

Changes in soil content at the beginning and end of the study

The data acquired from soil content analysis before and after treatment revealed an increase in nitrogen (N), phosphorus (P), potassium (K), organic carbon (C-Organic), and soil cation exchange capacity (CEC) (Table 11). The only decrease was observed in the soil carbon-to-nitrogen

Table 10. Interaction between fertilizer types and dose on sweet corn cobs length

Treatments	Corn cob length (cm)		
	D7.5	D15	D22.5
RSC	16.26 a	18.32 cd	17.11 ab
SLC	17.42 bc	17.38 bc	18.61 d
CHC	18.27 cd	19.78 e	20.20 e
LSD 5%	0.63		
CV %	3.46		

Note: Values followed by the same letter in the same row and column are not significantly different based on the 5% of LSD test; ns = not significant; DAP = day after planting.

Table 11. Soil nutrient content before and after treatment results from compost types and doses.

Nutrient content	Before	After compost application		
		Rice compost	Sweet-corn compost	Sugarcane compost
N (%)	0.19	0.27	0.31	0.34
P (ppm)	16.18	19.87	20.81	22.15
K (ppm)	31.90	33.91	36.56	37.12
C-org (%)	2.52	3.36	3.64	4.04
C/N Ratio	13.52	5.79	6.28	6.97
CEC	20.87	27.20	28.52	29.96

(C/N) ratio. These variations in soil content between the study's can be due to the application of organic compost and inorganic fertilizer. Specifically, organic compost had a positive impact on the soil's physical and chemical characteristics by increasing its organic carbon content [47].

Moreover, studies have indicated that compost containing *Trichoderma* spp. can enhance soil nutrition [38]. Combining organic compost with chemical fertilizer on the soil helps prevent the loss of nutrients through denitrification and evaporation, stabilizes nutrient release, and promotes slow and controlled nutrient delivery [50]. Consequently, long-term compost utilization leads to improved soil quality, both in terms of physical and chemical properties, ensuring adequate nutrient supply for plant growth.

Conclusion

The study demonstrated that various types of microbial decomposers effectively degraded organic waste within 50 days while enhancing compost nutrient levels. Compost type and dosage influenced almost all growth parameters, with corn compost proving superior to rice and sugarcane composts at the same dosage. The application of compost at a rate of 22 t ha^{-1} proved highly beneficial, not only increasing crop yield and growth but also enhancing soil fertility and preventing soil degradation. Furthermore, the addition of organic compost led to significant improvements in several soil parameters, including increased nitrogen, phosphorus, potassium, organic carbon, and soil cation exchange capacity. Compost formulations containing *Trichoderma* spp. displayed a positive impact on soil nutrition, emphasizing the role of specific microorganisms in soil enhancement. Combining organic compost with chemical fertilizer effectively prevented nutrient loss through denitrification and evaporation, facilitating nutrient retention and controlled release over time. The long-term use of compost sustained improvements in soil quality, positively affecting both physical and chemical properties, ensuring a consistent nutrient supply for optimal plant growth. These findings describe the significance of organic compost, especially when enriched with beneficial microorganisms like *Trichoderma* spp., in soil management and the sustainable enhancement of soil quality for agricultural purposes.

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