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Original Research

Optimization of Rice Hull Bokashi Application Rates for Improving Soil Properties and Performance of Pepper (*Capsicum spp*) under Tropical Conditions in Owerri Nigeria

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Abstract

Food insecurity, waste disposal, soil degradation and low agricultural productivity remain major challenges in Nigeria. This work was carried out to evaluate the characteristics of fermented Rice Hull-Bokashi (RH-B) and its effects on soil and pepper (*Capsicum spp.*) performance. The fermentation process lasted for 12 days, during which, temperature, pH, moisture, and bulk density were monitored. Five pot treatments were tested: control, 16 t/ha bokashi, 19 t/ha bokashi, 22 t/ha and 25 t/ha bokashi. The treatments were arranged in a completely randomized design (CRD), with three replications. Chemical properties of fermented RH-B, as well as pre- and post-planting soil attributes, were analyzed. Vegetative growth and yield parameters of pepper were measured. The data generated from the influence of the various treatments on soil characteristics and plant performance was subjected to Analyses of Variance (ANOVA) using SPSS. Significant means were separated using LSD at 5 % probability. Results of soil analysis after treatment application indicated that the application of bokashi significantly improved soil properties. Bulk density (BD) decreased progressively from 1.65 gcm^{-3} in T1 to 1.38 gcm^{-3} in T5, representing a 16.36 % reduction relative to the control. Moisture content (MC) increased across treatments, with the highest increase recorded in T5 (33.71 %). Soil pH improved towards neutral 5.60 in T1 to 6.17 in T5, representing a 10.18 % improved pH. Organic carbon (OC), Total nitrogen (TN) and available P increased substantially across treatments, with T5 recording 53.85 %, 38.89 % and 78.77 % increase over T1. At 6 and 8 WAP, T2 recorded the highest increase in plant height (33.56 % and 41.39 %) relative to the control (T1) while T3, T4, and T5 showed only slight increases (1.26 – 8.67 %; 13.45 % - 13.82 %,) and were not notably different from the control. At 10 WAP, plant height, leaf area, number of leaves, and branches increased substantially under T2, which recorded 37.51 %, 92.47 %, 65.99 %, and 597.01 % respectively over T1. At twelve (12) weeks after planting, plant height increased under T2 with a 40.94 % increase, number of leaves with a 47.69 % increase, leaf area with a 10.10 % increase, and stem girth with a 3.33% increase over the control (T1).

1. Introduction

Rice hull bokashi is a fermented organic soil amendment produced by subjecting the rice husks to microbial fermentation, at the same time introducing nitrogen-rich material such as manure, bran or other organic residues (Kujala & Kinnunen, 2026). It originated in East Asia where organic wastes from households are fermented and used to improve soil fertility (Park and DuPonte, 2008). During the composting process microorganisms can be introduced and fermented anaerobically or micro aerobically. Fan *et al*., (2008) claimed that fermented bokashi improves microbial diversity, it is odorless, allows humification and climatically smart. It has high carbon content and organic matter, a C/N ratio of around 10 – 20, high silica, 15 – 20 %, organic acids like lactic acid, acetic acid (Hamidu *et al*., 2025; Kujala & Kinnunen, 2026; Fauzan *et al*., 2022).

Concurrently, Nigeria faces significant waste disposal problems, agricultural challenges, including food insecurity challenges associated to declining in soil fertility (Ahukaemere *et al*., 2012; FAO, 2021; and Ahukaemere *et al*., 2023). Rice hull disposal remains a critical challenge in southeastern Nigeria

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where large quantity of rice is grown yearly to meet rising demand, yet the bi-product is not appropriately put to use and replenish the soil nutrient. Nigeria generates more than 80 million tons of crop residues annually, with rice hull (RH) posing significant environmental challenges (FMARD, 2020). The implementation of the National Rice Development Strategy (NARDS) has increased rice production, with output rising from 6 million tons in 2008 to 12.85 million tons in 2018, resulting in over 2 million tons of RH as waste (FMARD, 2020). Rice hull is often dumped indiscriminately, forming waste hills that pose public health and environmental risks. The burning of rice hull is a major contributor to high levels of greenhouse gases in Southeast Nigeria associated with health problems. Innovative solutions are needed to transform RH into value-added products. Several researchers are developing different alternative uses that convert rice hull into a product around which sustainable value chains can be built to benefit local farmers. Asadi *et al*., (2021) reported that incorporating rice hull biochar into the soil increased soil organic carbon, cation exchange capacity, microbial activity, and crop growth. Haefele *et al*., (2011), in a field study showed that rice husks increased rice yield by 16 – 35 % in a poor soil affected by water stress. Again, rice husk biochar can improve nutrient-use efficiency and reduce nutrient losses. When rice husk biochar was integrated with inorganic fertilizer, it improved nutrient availability and rice productivity and at the same time reduced nitrate leaching (Oladele, *et al*., 2019). Olanrewaju *et al*., (2024) reported that rice husk biochar can provide a local available source of silicon and improved rice yield. The increased available silicon helped to increase grain yield. Rice husk biochar or ash is disposable and reduces the problems associated with dumping rice husks which constitute an environmental hazard associated with refuse disposal. The ash provides a way of recycling the residue into agricultural use that improves soil properties

One of the best alternatives to burning rice hull is its conversion to valuable products such as bokashi. By transforming RH into bokashi, this project promotes waste-to-wealth conversion, enhances soil fertility, promotes crop performance and improves food security. Therefore, the objectives of this study were to (i) produce cheap biofertilizer (bokashi) from rice hull, (ii) characterize soil amended with fermented RH bokashi, and (iii) determine its effect on pepper production.

2. Materials and Methods

2.1 Study Site

The study was conducted at the demonstration farm of the Federal University of Technology, Owerri (FUTO), Owerri West Imo State. FUTO lies between latitude 5°17¹N and 5°38¹N, and longitude 7°11¹E and 7°45¹E, covering an area of about 5,100 km² (Fig. 1). The mean minimum and maximum temperature are 23.5°C and 32.1°C, with relative humidity ranging from 70% to 80% [NIMET, 2024], with annual rainfall of about 1,500 mm to 2,200 mm. Agro-wastes commonly generated in the area include sawdust, cassava peel, rice hull, maize straw, maize bran, empty palm bunch, oil palm press fiber, food wastes, etc. The geology of the study site is Benin formation. The study area is dominated by subsistence farmers who primarily produce maize, cassava, yam, plantation crops, and vegetables. Soil fertility is enhanced by the application of both synthetic and natural fertilizers.

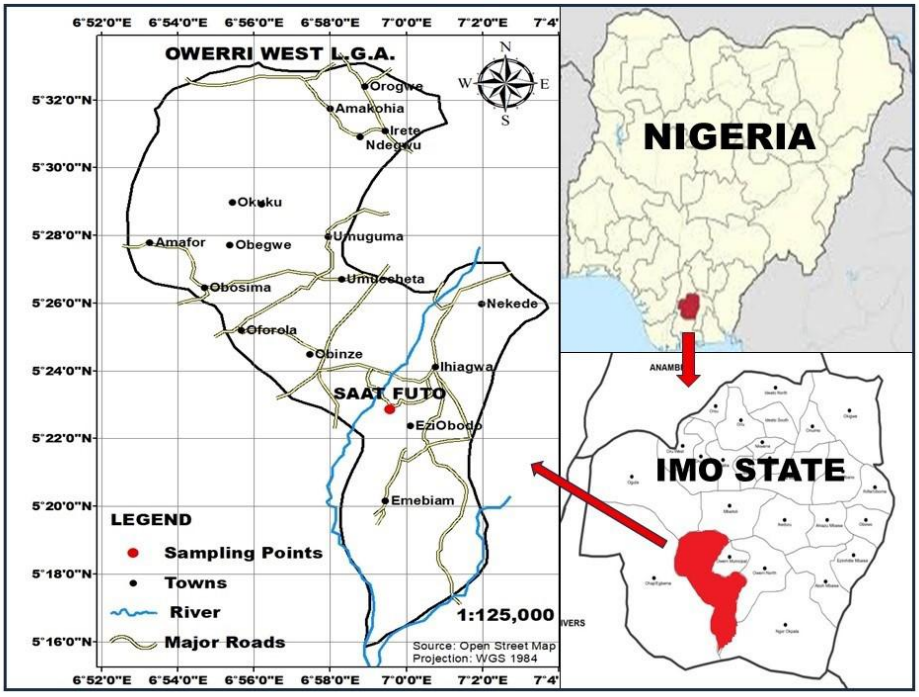


Figure 1. Map of the study location

2.2 Experimental Design and Treatment Application

The treatments were arranged in a CRD, consisting of six different treatments, each replicated 3 times. The treatments include T1 = Control, T2 = 16 t/ha, T3 = 19 t/ha, T4 = 22 t/ha, T5 = 25 t/ha. Appropriate quantity of bokashi was weighed and applied to each pot two weeks before planting of the test crop. The test crop was raised in a nursery box for 3 weeks before transplanting to the experimental pot. The treatment effect on soil physicochemical properties was determined at 16 weeks after treatment application.

2.3 Measurement of plant Parameters

Pepper growth parameters were obtained at 2-week interval after transplanting. Plant height was obtained by measurement using a measuring tape. Number of branches and leaves was counted manually. Stem girth was measured with a Veneer caliper while leave area was obtained with a leaf area meter. Fruit number were counted manually while the fruit weight was measured using a weighing balance.

2.4 Characterization of Soil and Bokashi

The physicochemical properties of soils before and after treatment application, and the chemical properties of fermented and unfermented bokashi were analyzed at the Department of Soil Science, Federal University of Technology, Owerri laboratory using standard laboratory procedures

Particle size distribution was determined by hydrometer method (Gee and Or, 2002). Bulk density (gcm^{-3}) was determined using core method (Grossman and Reinsch, 2002). This was calculated using:

$$\text{BD } (gcm^3) = \frac{\text{Mass of oven dried soil}}{\text{Total soil volume}} \quad (1)$$

Moisture content was calculated using:

$$MC\ (\%) = \frac{\text{Wt.of moist soil} - \text{Wt.of dry soil}}{\text{wt.of dry soil}} \text{ x } 100 \quad (2)$$

Organic carbon was measured by wet digestion method (Nelson and Sommers, 1996). Available Phosphorus was extracted with Bray II solution (Olsen and Sommers 1982). Total Nitrogen was determined using modified kjeldhal method according to the procedures of (Bremmer and Mulvaney 1982). Soil pH was determined by a 1:2.5 soil-water ratio as described by Thomas, (1982). Exchangeable bases were determined by the ammonium acetate at neutral pH (NH_4OAc of pH 7) as proposed by Thomas, (1982).

2.5 Data Analysis

The data generated from the effects of the various treatment on soil properties and pepper performance were subjected to Analyses of Variance (ANOVA) using SPSS while those from fermented and unfermented bokashi were subjected to using T-test using SPSS. LSD (5% probability) was adopted for mean separation.

3. Results and Discussion

3.1 Properties of the fermented RH-Bokashi and soil before treatment application

The attributes of the soil before amendment are presented in Table 1 while those of bokashi after fermentation are presented in Table 2. **T**he soil properties prior to the application of fermented RH-B as presented in Table 1 showed that soils of study site have high sand (**958.4 g kg^{-1}**), low clay (**32.8 g kg^{-1}**), and silt content (**8.8 g kg^{-1}**). The basic cations (Ca, Mg, and K), OC and TN values were low according to the ratings of Landon (1991), and FAO (2006) for tropical soils. This suggests a need for the application of rice hull bokashi RH-B as organic amendment for optimum soil and crop productivity.

The pH of RH -B was 9.8 (Table 2), revealing a strongly alkaline status of RH-B. This high pH suggests that the direct application of RH-B to soils of the study area could help ameliorate soil acidity - a major constraint limiting soil and crop productivity in Southeastern Nigeria. The high available phosphorus, Ca, Mg, K and Na levels suggests that fermented RH-B could serve as a nutrient rich source. Total N, Organic and total carbon are high. The high TN content in RH-B reflects effective N enrichment during fermentation and indicates strong potential as an organic N source. High OC enhances soil aggregation, moisture retention, and microbial activity, confirming the potential of RH -B as a soil conditioner.

Table 1. Soil properties before rh-B application

Parameter	Unit	Content
Sand	g kg^{-1}	958.4
Clay	g kg^{-1}	32.8
Silt	g kg^{-1}	8.8
BD	g cm^{-3}	1.69
pH		5.46
OC	g kg^{-1}	10.02
TN	g kg^{-1}	1.9
AvP	mg kg^{-1}	20.22
Ca	cmol kg^{-1}	2.62
Mg	cmol kg^{-1}	1.1
Na	cmol kg^{-1}	0.496
K	cmol kg^{-1}	0.289
TEB	cmol kg^{-1}	4.505
TEA	cmol kg^{-1}	0.58
ECEC	cmol kg^{-1}	5.085
BS	%	88.59

Note: OC = Organic carbon AvP = Available P, Ca = Calcium, Mg = Magnesium, K = potassium, Na = sodium, TEB = Total Exchangeable bases, BS= Base Saturation.

3.2 Effect of Treatment on Soil Physical Properties

Bulk density (BD) decreased progressively from 1.65 g cm^{-3} in T1 to 1.38 g cm^{-3} in T5, representing a 16.36% reduction relative to the control. Significant variation was recorded among

Table 2. Fermented RH-B properties

Parameter	Unit	Content
pH		9.8
TN	g kg^{-1}	6.8
AV.P	mg kg^{-1}	7163.45
TC	g kg^{-1}	473
OC	g kg^{-1}	282.66
InC	g kg^{-1}	190.33
Ca	cmol kg^{-1}	72.19
Mg	cmol kg^{-1}	15.82
K	cmol kg^{-1}	22.23
Na	cmol kg^{-1}	18.58

Note: OC = Organic carbon AvP = Available P, tc = Total carbon, INC = inorganic carbon, Ca = Calcium, Mg = Magnesium, K = potassium, Na = sodium, TEB = Total Exchangeable bases, BS= Base Saturation.

Table 3. Effects of RH-Bokashi amendment on soil physico-chemical properties

Parameter	T1	T2	T3	T4	T5	LSD (0.05)
Sand	946.9	940.3	943.6	940.3	953.6	4.14
Clay	13.2	13.2	13.2	13.2	13.2	NS
Silt	26.5	46.5	43.2	46.5	33.2	4.33
BD	1.65	1.54	1.52	1.52	1.38	0.02
MC	14.21	16.11	15.9	16.21	19	0.99
pH	5.6	5.74	5.82	5.92	6.17	0.05
OC	10.01	13.8	14.2	14.9	15.4	0.46
TN	1.8	2.1	2.3	2.4	2.5	0.01
AvP	19.72	28.11	30.39	33.16	35.25	0.89
EsA	0.61	0.67	0.7	0.71	0.69	0.03
Ca	2.4	2.65	3.02	3.48	3.67	0.27
Mg	0.95	1	1.32	1.47	1.88	0.37
Na	0.42	0.57	0.61	0.64	0.66	0.01
K	0.26	0.38	0.4	0.41	0.42	0.01
TEB	4.03	4.6	5.35	5.99	6.63	0.48
TEA	0.61	0.67	0.7	0.71	0.69	0.03
ECEC	4.64	5.27	6.05	6.7	7.32	0.49
BS	86.76	87.25	88.42	89.4	90.57	1.22

Note: T1=Control, T2=16t/ha, T3=19t/ha, T4=22t/ha, T5=25t/ha, OC = Organic carbon AvP = Available P, Ca = Calcium, Mg = Magnesium, K = potassium, Na = sodium, TEB = Total Exchangeable bases, BS= Base Saturation.

the bokashi rates with T2 having the least BD value. The reductions observed in T2 (−6.67%), T3 (−7.88%), and T4 (−7.88%) were also notable, indicating statistical significance. The decline in bulk density suggests improved soil structure, likely due to enhanced aggregation and increased organic matter content (Kabi, 2025). It was also proven that low bulk density improves root penetration, aeration, and water infiltration, which are essential for optimal crop growth (Ahukaemere *et al*., 2023; Hartati *et al*., 2025). Moisture content (MC) in all the treatments were higher than the control, with the highest increase recorded in T5 (33.71%). Treatments T2–T4 showed increase ranging from 11.89 % to 14.07% compared with T1. These increases were statistically significant ($P = .05$). The improved moisture retention recorded in this work may be attributed to increased organic carbon, which enhances the soil's water-holding capacity. Sanepara *et al* (2015) reported improved moisture content in soils amended with organic manure.

3.3 Treatment effect on Soil Chemical Properties

Soil pH increased steadily from 5.60 in T1 to 6.17 in T5, representing a 10.18 % increase. Considerable variation ($P = .05$) was recorded in the pH values of the treatments. The shift toward near-neutral pH suggests reduced soil acidity, which enhances nutrient availability and microbial activity. This also reveals the capacity of bokashi in ameliorating the acidic nature of soils of the study area if used as a liming material. Organic carbon (OC) increased markedly across treatments, with T5 recording a 53.85% increase over T1. Statistically significant difference was recorded in the organic carbon content across the treatment rates. The increase in OC reflects improved organic matter status, which is one of the key factors of soil quality. Total nitrogen (TN) also increased progressively, with T5 producing the highest (38.89 %). The consistent rise in TN corresponds with increased organic carbon, indicating enhanced nutrient cycling and mineralization. Ahukemere *et al*., (2015) reported a similar result showing significant positive relationship between organic carbon and nitrogen availability. Available phosphorus (AvP) showed substantial improvement (78.77 %) in T5, revealing significant increase in phosphorus availability. This agrees with the finding of Devnita *et al*., (2020) who reported that rice hull bokashi reduced P retention and increased available P in an Andisol. Fermentation in the bokashi produces organic acids and soluble organic compounds that can compete with phosphates for adsorption sites, especially in highly weathered soil. Exchangeable bases (Ca, Mg, Na, and K) increased considerably across treatments. Calcium increased by 52.92 %, magnesium by 97.89 %, and potassium by 61.54 % relative to the control. Consequently, the TEB and ECEC also increased significantly, with T5 showing increases of 64.52 % and 57.76 %, respectively. These improvements reflect enhanced nutrient retention capacity and soil quality. Devnita *et al*., (2020) reported a relatively high CEC indicating that the bokashi, with high carboxyl and phenolic groups, contributes to high exchange sites when added to the soil. Consequently, the total exchangeable bases are also increased (Lima *et al*., 2015). Base saturation (BS) increased slightly from 86.76 % in T1 to 90.57 % in T5, indicating statistical significance and improved soil fertility status. The consistent improvement in organic carbon, nutrient availability, exchangeable bases, and cation exchange capacity, coupled with reduced bulk density and increased moisture retention, demonstrates enhanced soil quality and fertility. The use of rice hull bokashi helps to improve nutrient availability, soil structure, water-holding capacity and microbial activity

which promote better plant growth, nutrient-use efficiency and increased crop yield. The use of bokashi also helps to recycle organic wastes into useful soil amendments, and reduces organic waste disposal and environmental pollution, at the same time decreases use and dependence on inorganic fertilizers. This contributes to sustainable soil management and nutrient cycling.

3.4 Effect of RH-B on Pepper vegetative growth at 2-4 WAP

Effects of RH-B amendments on pepper growth parameters are shown in Tables 4-9. At 2 to 4 WAP, none of the treatments had a statistically significant influence on height and number of leaves (Tables 4-5) of plant. Also, at 2 WAP, no significant variation was recorded in number of branches (Table 4). At this early stage, low mineralization rate, microbial activity and immobilization of nutrients by micro-organisms could temporarily limit nutrient availability, resulting in slow early growth response. The amendments notably increased the vegetative growth of pepper from 6-12 weeks after planting.

3.5 Effect of RH-B on Pepper vegetative growth at 6 WAP

The amendments impacted varying influences on pepper growth parameters six weeks after planting (6 WAP) (Table 6). T2 recorded the highest increase (33.56 %) relative to the control (T1). Treatments T3, T4, and T5 showed only slight increases (1.26–8.67 %) and were not considerably different ($P = .05$) from the control. A similar result was observed for number of leaves. T2 significantly increased leaf production by 35.20 % compared to T1. In contrast, T3, T4, and T5 reduced leaf number by 8.11 %, 10.79 %, and 21.57 %, respectively. The reduction in leaf number suggests that increasing bokashi amendment rate higher than 16 t/ha may not enhance pepper vegetative growth and development. Leaf area showed pronounced response to treatment application. T2 increased leaf area by 179.65 %, revealing enhanced photosynthetic processes. T4 also improved leaf area by 39.68 %, though to a lesser extent. Conversely, T3 and T5 reduced leaf area by 22.03 % and 31.36 %, respectively.

Table 4. Effects of the amendments on pepper growth parameters at 2 WAP

Trt.	Plant height (cm)	No. of leaves	Leaf area (cm²)	No. of branches	Stem girth (cm)
T1	4.83a	3.67a	3.91a	0.00a	0.00a
T2	7.73a	5.33a	8.01a	0.00a	0.00a
T3	7.27a	2.67a	5.46a	0.00a	0.00a
T4	6.17a	5.00a	4.44a	0.00a	0.00a
T5	7.60a	2.00a	3.89a	0.00a	0.00a

Note: T1=Control, T2=16t/ha, T3=19t/ha, T4=22t/ha, T5=25t/ha

The substantial improvement observed in T2 may be attributed to enhanced nutrient availability and improved soil physical conditions, particularly increased organic carbon and exchangeable nutrients observed earlier. With exception of T2, no treatment rate stimulated branching at 6 WAP. Stem girth was not significantly affected by treatments, as indicated in Table 6. Nevertheless, T2 and T3 recorded increases of 33.76 % and 19.11 %, respectively, indicating moderate structural improvement in plant vigor. T5 reduced stem girth by 4.46 %. In general, among all treatments, T2 (16 t/ha) consistently produced superior growth performance at 6 WAP. The increases in the growth parameters indicate that bokashi treatment created more conducive soil conditions for early pepper growth.

3.6 Effects of the Amendments on Pepper Growth Parameters at 8 WAP

At eight weeks after planting (8 WAP), the amendments significantly influenced pepper growth parameters. Plant height increased across all treatments relative to the control (T1), with T2 showing statistically significant increase (41.39%). Treatments T3 and T4 recorded moderate increases (13.82% and 13.45%, respectively), while T5 showed a slight improvement (3.47%).

Table 5. Effects of the amendments on pepper growth parameters at 4 WAT

Trt.	Plant height (cm)	No. of leaves	Leaf area (cm²)	No. of branches	Stem girth (cm)
T1	6.67a	5.00a	3.57b	0.00a	0.00a
T2	9.93a	9.33a	24.01a	0.00a	0.00a
T3	13.50a	6.67a	14.31a	0.00a	0.00a
T4	11.10a	7.67a	12.99a	0.00a	0.00a
T5	11.30a	6.33a	10.57a	0.00a	0.00a

Note: T1=Control, T2=16t/ha, T3=19t/ha, T4=22t/ha, T5=25t/ha.

Number of leaves showed varied significant responses with T3 having the highest increase (22.52%), followed by T2 (11.24%), while T4 did not differ from T1 statistically. In contrast, T5 caused a substantial decrease (52.13%), revealing possible nutrient imbalance or slow mineralization and release of nutrient elements. The decrease in number of plant leaves under T5 corresponded with its lower leaf area values. Leaf area followed a similar pattern with plant height. Also, T2 increased branching by 247.76% compared with T1, while T4 and T5 completely reduced branching (100% reduction relative to T1). This suggests that only the optimal amendment level promoted vegetative differentiation and canopy development. Generally, Stem girth was not statistically different among treatments.

3.7 Effects of the Amendments on Pepper Growth Parameters at 10 WAP

At ten weeks after planting (10 WAP) (Table 8), the amendments significantly influenced pepper vegetative performance, with pronounced treatment effects observed across most growth parameters. Plant height, leaf area, number of leaves, and branches increased substantially under T2, which recorded a 37.51 %, (92.47 %), (65.99 %), and 597.01 % respectively over the control (T1). Stem girth showed minor

increases under T2 (5.67 %), T3 (7.67 %), and T4 (3.33 %), while T5 reduced stem girth by 29.00 %. The numerical increases under moderate amendment levels suggest improved plant development and strength.

3.8 Effects of the Amendments on Pepper Growth Parameters at 12 WAP

At twelve weeks after planting (12 WAP) (Table 9), plant height significantly increased under T2, which recorded a 40.94 % increase over the control (T1). Treatment T3 increased plant height by 6.66 %, while T4 and T5 reduced plant height by 16.20 % and 11.43 %, respectively. Number of leaves followed a similar pattern. T2 produced a 47.69 % increase relative to T1, T3 recorded a moderate increase of 13.34 %. T4 showed a slight reduction (1.54 %), while T5 resulted in a significant decrease (25.12 %). This suggests that optimal bokashi level (16 t/ha) enhance canopy development, whereas excessive or suboptimal levels may suppress leaf production at later growth stages. For leaf area, T2 produced an increase of 10.10 %, all other treatments reduced leaf area considerably, particularly T4 (40.47%) and T5 (42.07 %). The reduction in leaf area at higher treatment levels may indicate nutrient imbalance as the crop matured. Number of branches increased by 27.09 % under T2 and declined sharply under T4 (45.91 %) and T5 (37.79 %) respectively. However, branching influences fruit-bearing ability of crops including pepper; therefore, the superior performance of T2 suggests improved reproductive architecture development. Du *et al.,* (2026) investigated rice hull fermented with urea and EM microorganisms and discovered that plant height increased by 28.85 % relative to the control. Sajio (2013) studied bokashi at four rates combined with rice husk at four rates significantly affected plant height, flowering time, number of productive branches number of fruits and fresh fruit weight of chilli peper. He discovered 61.77 cm plant height at 40 days after planting.

3.9 Effects of the Amendments on Pepper yield

The result presented in figures 2 and 3 shows that the amendments significantly influenced both the number of fruits and fruit weight of pepper. The number of fruits ranged from 1.67 in T1 to 19.00 in T2. T2 produced the highest number of fruits (19.00), which was significantly different from all other treatments. Although T3 (2.67), T4 (4.33), and T5 (3.33) produced more fruits than the control (1.67), no significant difference was recorded among them. The control (T1) had the lowest fruit number (1.67), indicating poor reproductive performance in the absence of RH-B application. Du et al., (2026) reported fruit weight of 21.62 % relative to the control. The substantial increase observed in T2 suggests that this treatment level greatly enhanced flowering, fruit set, and fruit retention. Fruit weight followed a similar pattern. The control (T1) recorded the lowest fruit weight (0.47 g/kg), while T2 produced the highest fruit weight (105.18 g kg^{-1}). This difference was highly pronounced and statistically significant. T4 recorded 15.77 g kg^{-1}, which was considerably higher than T3 (1.59 g kg^{-1}) and T5 (4.11 g kg^{-1}), but still much lower than

Table 6. Effects of the amendments on pepper growth parameters at 6WAP

Trt.	Plant height (cm)	No. of leaves	Leaf area (cm^2)	No. of branches	Stem girth (cm)
T1	13.50b	12.33b	13.71b	0.00b	1.57a
T2	18.03a	16.67a	38.34a	1.33a	2.10a
T3	14.67b	11.33b	10.69c	0.00b	1.87a
T4	13.67b	11.00b	19.15b	0.00b	1.57a
T5	14.33b	9.67b	9.41c	0.00b	1.50a

Note: T1=Control, T2=16t/ha, T3=19t/ha, T4=22t/ha, T5=25t/ha.

Table 7. Effects of the amendments on pepper growth parameters at 8WAP

Trt.	Plant height (cm)	No. of leaves	Leaf area (cm^2)	No. of branches	Stem girth (cm)
T1	19.33b	23.67a	32.43b	0.67b	1.63a
T2	27.33a	26.33a	46.37a	2.33a	2.17a
T3	22.0b	29.00a	32.60b	0.67b	2.00a
T4	21.93b	23.67a	29.38b	0.00c	1.70a
T5	20.00b	11.33b	18.71c	0.00c	1.50a

Note: T1=Control, T2=16t/ha, T3=19t/ha, T4=22t/ha, T5=25t/ha.

Table 8. Effects of the amendments on pepper growth parameters at 10WAP

Trt.	Plant height (cm)	No. of leaves	Leaf area (cm^2)	No. of branches	Stem girth (cm)
T1	29.33b	26.67b	44.46a	0.67c	3.00a
T2	40.33a	51.33a	73.79a	4.67a	3.17a
T3	31.67b	50.00a	57.85a	2.00a	3.23a
T4	28.33b	42.33a	43.36a	0.67c	3.10a
T5	27.33b	31.67a	36.87b	1.33b	2.13a

Note: T1=Control, T2=16t/ha, T3=19t/ha, T4=22t/ha, T5=25t/ha.

Table 9. Effects of the amendments on pepper growth parameters at 12WAP

Trt.	Plant height (cm)	No. of leaves	Leaf area (cm^2)	No. of branches	Stem girth (cm)
T1	35.00b	65.00b	65.44a	12.33a	3.00a
T2	49.33a	96.00a	72.05a	15.67a	3.10a
T3	37.33b	73.67a	48.10a	12.33a	3.33a
T4	29.33b	64.00b	38.96b	6.67b	3.27a
T5	31.00b	48.67c	37.91b	7.67b	2.23b

Note: T1=Control, T2=16t/ha, T3=19t/ha, T4=22t/ha, T5=25t/ha.

T2. The marked superiority of T2 in both fruit number and weight indicates that 16 t/ha of RH-B provided optimal conditions for reproductive growth. The improvement in fruit yield under T2 may be due to enhanced nutrient availability and soil conditions, which likely supported better vegetative growth earlier in the season and consequently greater yield formation. Sajio (2013) reported 69.37 g/plant and 38.67 fruits

of fruit weight and fruit number respectively at 10 t/ha bokashi + 11.2 t/ha rice husk According to Kabi (2025), bokashi creates a more favorable environment for crop growth and yield while also reducing the need for chemical fertilizers.

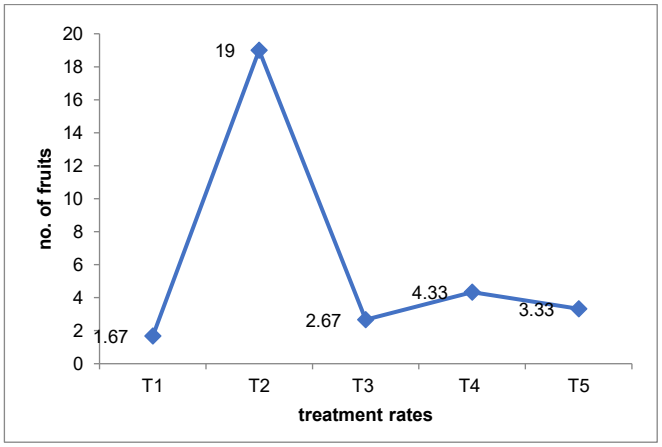


Fig. 2. Effects of amendments on number of fruits

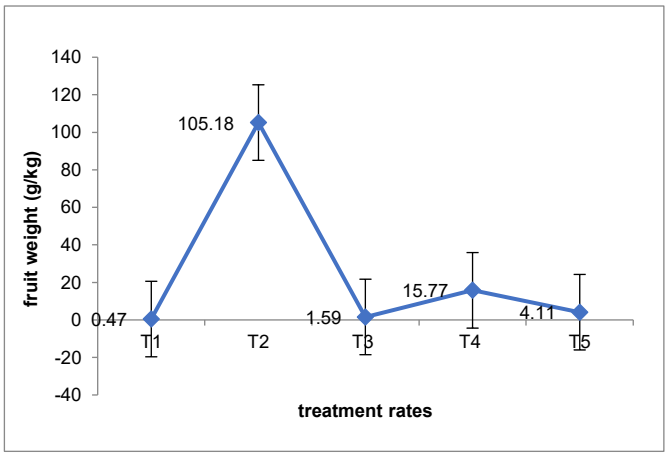


Fig. 3. Effects of amendments on fruit weight.

4. Conclusion

Fermentation of agro-waste is among the fastest and most convenient methods for degrading agricultural wastes. Fermented RH bokashi is an active organic amendment that significantly promotes the productivity and fertility status of degraded soils. The application of RH-B at 16 t/ha notably enhanced soil pH, nutrient availability as well as pepper growth and yield compared with other bokashi application rates and the control. It is recommended that 16 t/ha rice hull bokashi among other rates is the best for soil amendment and increase in pepper production

Although previous studies have demonstrated beneficial effects of rice hull, fermented rice hull and bokashi-based amendments on pepper growth, relatively little published research has specifically evaluated rice hull processed as bokashi and applied at a graded rates to pepper under tropical soil conditions. Therefore, investigating the effect of rice hull bokashi on the growth and yield performance of *Capsicum spp* can provide information on the agronomic value of this locally available agricultural residue. However, further trials are needed to evaluate the effectiveness of fermented bokashi in improving soil fertility status and crop performance under both pot and field conditions across different agro-ecological zones and soil types.

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