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EFFECT OF RICE HUSK ASH AND CATTLE MANURE ON SWEET CORN IN PEAT SOIL

Nadhira Ghea Salsabila[1], Dedik Budianta[1*], Naomi Tias Brian[2] dan Warsito[1]

[1)] Department of Soil Science, Faculty of Agriculture, Sriwijaya University, Ogan Ilir, Indonesia, 30662
[2)] Department of Crop Cultivation, Faculty of Agriculture, Sriwijaya University, Ogan Ilir, Indonesia, 30662

*) Corresponding author: dedik.budianta@unsri.ac.id

ABSTRACT

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Sweet corn (*Zea mays* L. *saccharata*) productivity on peat soils is often constrained by high acidity, low fertility, and limited nutrient availability. Organic-based soil amendments such as rice husk ash and cattle manure may improve soil chemical properties and support crop growth on peatlands. This study aimed to evaluate the effects of rice husk ash and cattle manure on the growth and yield of sweet corn cultivated on peat soil. The field experiment was conducted from December 2022 to February 2023 at Bandar Agung Village, Lalan District, Musi Banyuasin Regency, while laboratory analyses and data processing were completed from June 2022 to May 2023. The study used a factorial randomized block design with two factors and three replications. Rice husk ash was applied at rates of 0, 30, and 60 t ha^{-1}, while cattle manure was applied at 0, 42, and 84 t ha^{-1}. The results showed that treatment A2S1 (60 t ha^{-1} rice husk ash and 42 t ha^{-1} cattle manure) tended to produce higher values for several yield parameters, particularly cob length, cob weight, and cob diameter. The treatments significantly affected cob diameter, number of leaves, cob length, and cob weight with husk and without husk, whereas plant height, plant wet weight, and plant dry weight were not significantly affected. The application of rice husk ash, cattle manure, and dolomite also increased soil pH under acidic peat soil conditions. These findings indicate that appropriate combinations of organic amendments may improve sweet corn productivity and support sustainable peatland agriculture.

Keywords: crop productivity, organic amendment, peatland agriculture, soil fertility, soil chemistry

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INTRODUCTION

Corn (*Zea mays* L.) is one of the most important food crops in Indonesia, ranking second after rice, while globally it ranks third after wheat and rice (Erenstein et al., 2022). Corn plays a strategic role in national and global food security due to its high carbohydrate and protein content, making it suitable for food, feed, and industrial purposes (Padhan et al., 2024). In Indonesia, the increasing demand for corn-based products has encouraged the expansion of corn cultivation into marginal lands to meet production needs.

Sweet corn (*Zea mays* L. *saccharata*) is a special type of corn that is increasingly preferred by consumers due to its sweeter taste, tender texture, and shorter harvesting period compared to ordinary corn (Sidahmed et al., 2025). Sweet corn also has relatively high economic value and wide utilization, including fresh consumption and processed food products. Agronomically, sweet corn is sensitive to soil nutrient availability and is often used as an indicator plant for evaluating the uptake of nitrogen, phosphorus, and potassium (Canatoy & Daquiado, 2021). Therefore, optimal soil fertility management is essential to support its growth and yield, especially when cultivated on suboptimal lands.

Peat soils, as one of the marginal land types, represent both opportunities and challenges for agricultural development in Indonesia (Barchia et al., 2021). Peatlands are formed from the accumulation of partially decomposed organic matter originating from surrounding vegetation over a long period under anaerobic conditions (Leifeld et al., 2019). These soils are generally characterized by low pH, high acidity, low base saturation, and limited availability of essential nutrients such as phosphorus and potassium (Fatimah et al., 2024). Consequently, plant growth on peat soils is often constrained without appropriate soil management interventions.

Peatland utilization has increased significantly in several Indonesian provinces, including Riau, West Kalimantan, Central Kalimantan, and South Sumatra. Indonesia possesses extensive tropical peatlands distributed across Sumatra, Kalimantan, and Papua, which play important roles in agriculture and ecosystem sustainability (Anda et al., 2021). Despite their large extent, peat soils pose serious limitations for crop production due to the presence of organic acids that inhibit nutrient availability and root development (Asie et al., 2025). Therefore, effective soil amelioration strategies are required to improve peat soil fertility and support sustainable agricultural practices (Maswar et al., 2021).

Soil ameliorants play a crucial role in improving the chemical and physical properties of peat soils (Septiyana et al., 2017). The application of ameliorants can enhance peat maturity by stabilizing organic acids through interactions with polyvalent cations, resulting in longer carbon chains with higher molecular weight and improved soil structure (Maftuah et al., 2019). Traditionally, liming materials such as dolomite have been used to increase soil pH. However, the use of organic-based ameliorants has gained attention due to their multifunctional benefits, including nutrient supply and soil conditioning (Shaaban et al., 2017).

Rice husk ash is a potential organic-based ameliorant derived from the combustion of rice husks, which are abundant agricultural by-products in rice-producing regions. South Sumatra is one of Indonesia's major rice production centers and generates substantial quantities of rice husk waste annually. In 2024, the harvested rice area in South Sumatra reached approximately 521.09 thousand hectares, with rice production of about 2.91 million tons of milled dry grain (GKG), indicating the high potential availability of rice husk biomass in the region (Central Bureau of Statistics, 2025). Rice husk ash contains high silica content and exhibits pozzolanic properties, making it suitable for improving soil structure and chemical characteristics (Riono & Apriyanto, 2020).

The application of rice husk ash has been reported to increase soil pH, enhance porosity, and improve the availability of nutrients such as phosphorus, potassium, silicon, and carbon (Mosharrof et al., 2021). Additionally, rice husk ash can facilitate root penetration by loosening soil structure, which is particularly beneficial for crops grown on peat soils (Yin et al., 2022). However, excessive application may disrupt soil chemical balance, indicating the need for appropriate dosage evaluation (Qu et al., 2014).

Cattle manure is another organic input widely used to improve soil fertility and structure (Ayamba et al., 2021). Manure has natural properties that do not degrade soil quality and can supply both macro and micronutrients (Dhaliwal et al., 2019). Moreover, cattle manure enhances soil water-holding capacity, stimulates soil microbial activity, increases cation exchange capacity, and improves soil aggregation (Rayne & Aula, 2020). These characteristics make cattle manure a suitable amendment for improving peat soil productivity.

The use of cattle manure also supports sustainable agriculture by recycling livestock waste and reducing dependency on inorganic fertilizers (Wang et al., 2021). Compared to other livestock manures, cattle manure contains relatively higher levels of nitrogen, phosphorus, and potassium, which can improve soil physical properties such as aggregate stability, pore space, bulk density, and plasticity, while enhancing soil water retention (Adekiya et al., 2020). Nevertheless, inappropriate application rates may lead to nutrient imbalance and suboptimal crop performance.

Previous studies have primarily examined the individual effects of rice husk ash or cattle manure on soil fertility and crop growth. However, limited information is available regarding the combined effects of these organic amendments on sweet corn growth and production under peat soil conditions. This gap in knowledge is particularly important given the increasing need for sustainable peatland management that balances crop productivity with soil health preservation.

Therefore, this study was conducted to evaluate the effects of rice husk ash and cattle manure on the growth and production of sweet corn cultivated on peat soil. The study specifically aimed to determine the most appropriate combination and application rates of these organic amendments to support sweet corn productivity. The findings are expected to contribute valuable information for sustainable soil management practices and the development of environmentally friendly sweet corn cultivation strategies on peatlands.

MATERIALS AND METHODS

Locations and research period

This research was conducted from June 2022 to May 2023 on peat agricultural land located in Bandar Agung Village, Lalan District, Musi Banyuasin Regency, South Sumatra, Indonesia. Laboratory analyses of soil and plant samples were carried out at the Laboratory of Soil Chemistry, Biology, and Fertility, Faculty of Agriculture, Sriwijaya University, Indralaya. The study was experimental research designed to evaluate the effects of organic amendments on sweet corn growth and yield under peat soil conditions.

Materials and equipment

The materials used in this study consisted of peat soil as the planting medium, rice husk ash, cattle manure, sweet corn seeds (*Zea mays* L. *saccharata*), agricultural lime, water, and inorganic fertilizers (urea, SP-36, and KCl) applied as basal fertilizer according to recommended rates. The tools and equipment included hoes, buckets, watering cans, scissors, calipers, measuring tape, rulers, permanent markers, plot labels, pH meter, analytical balance, and oven for dry weight determination.

Soil and amendment analysis

Initial peat soil and rice husk ash samples were analyzed prior to the experiment to determine their chemical characteristics. The analyses included soil pH, total nitrogen (N-total), available phosphorus (P_2O_5 Bray I), and exchangeable potassium (K). Soil pH was measured using a pH meter in H_2O suspension. Total nitrogen was determined using the Kjeldahl method, available phosphorus was analyzed using the Bray I extraction method, and exchangeable potassium was determined using the ammonium acetate extraction method at pH 7. All laboratory analyses were conducted at the Laboratory of Soil Chemistry, Biology, and Fertility, Faculty of Agriculture, Sriwijaya University.

Experimental design and treatments

The experiment was arranged in a factorial randomized block design with two factors. The first factor was the dose of rice husk ash (A), consisting of three levels: A0 = control (without rice husk ash), A1 = 30 tons ha^{-1} (150 g polybag^{-1}), and A2 = 60 tons ha^{-1} (300 g polybag^{-1}). The second factor was the dose of cattle manure (S), consisting of S0 = control (without manure), S1 = 42 tons ha^{-1} (210 g polybag^{-1}), and S2 = 84 tons ha^{-1} (420 g polybag^{-1}). The combination of the two factors resulted in nine treatment combinations, which were replicated three times in each treatment. Each experimental unit consisted of two plant samples, resulting in a total of 54 plants. The experiment was conducted using polybags filled with peat soil collected from peat agricultural land in Bandar Agung Village. The polybags were arranged under field conditions at the experimental site.

Planting and treatment application

Rice husk ash was mixed thoroughly with the peat soil planting medium according to treatment levels and incubated for three days prior to planting. Dolomite was uniformly applied to all treatments during land preparation to reduce soil acidity and provide similar initial soil conditions. After incubation, cattle manure was added to the planting medium and incubated for an additional seven days. Basal inorganic fertilizers were applied uniformly to all treatments to ensure minimum nutrient requirements for sweet corn growth under peat soil conditions. The organic amendments were evaluated as supplementary soil ameliorants rather than sole nutrient sources. For the control treatment, only basal inorganic fertilizers were applied. Sweet corn seeds were planted after the incubation period, and routine maintenance, including watering and weed control, was carried out throughout the growing period.

Data collection and observation

Growth observations included plant height and number of leaves, which were measured periodically during the vegetative phase. Harvesting was conducted at 73 days after planting. Yield-related parameters observed at harvest included cob length with husk, cob weight with husk, cob length without husk, cob weight without husk, cob diameter, plant fresh weight, plant dry weight, and soil pH after harvest. Plant dry weight was determined by oven-drying samples until constant weight was achieved.

Statistical Analysis

The data obtained were subjected to analysis of variance (ANOVA) based on the factorial randomized block design. If the calculated F value was higher than the F table value at the 5% significance level, the treatments were considered to have a significant effect on the observed parameters. Mean comparisons were then performed using the Least Significant Difference (LSD) test at the 5% level to determine differences among treatment means.

RESULTS AND DISCUSSION

The application of rice husk ash and cow manure on peat soil significantly influenced the growth and yield components of sweet corn. Overall, treatment A2S1 tended to produce higher values for several growth and yield parameters of sweet corn grown on peat soil, although some vegetative variables were not significantly affected by the treatments.

Vegetative growth and biomass accumulation

Peat soil characteristics

Initial chemical evaluations of the peat soil planting medium and rice husk ash were conducted at the Chemistry and Soil Fertility Laboratory, Faculty of Agriculture, Sriwijaya University prior to the rice husk and cow manure treatments. The chemical characteristics of the peat soil are presented in Table 1. Based on Table 1, the peat soil had a pH of 3.86 (very acidic), total nitrogen content of 1.23% (very high), available phosphorus of 24.02 mg kg^{-1} (Bray I; very high), and exchangeable potassium of 50.25 me 100 g^{-1} (very high). Highly acidic peat soils naturally constrain crop production due to the abundance of organic acids that inhibit root development and nutrient availability despite high baseline nutrient concentrations.

Table 1. Peat soil characteristics

Variable	Results*	Criteria**
pH	3.86	Very Acidic
N-Total	1.23 %	Very High
P_2O_5 Bray	24.02ppm	Very High
Potassium	50.25 me/100 g	Very High

Notes:
*) Based on laboratory analysis conducted at the Chemistry and Soil Fertility Laboratory, Faculty of Agriculture, Sriwijaya University (2022)
**) Criteria based on Soil Research Institute (2009)

Rice husk ash characteristics

The chemical characteristics of rice husk ash are presented in Table 2. Based on Table 2, rice husk ash had an alkaline pH of 8.80. The ash contained high levels of potassium (K) and phosphorus (P), while the nitrogen (N) content was relatively low. In addition, rice husk ash also contained calcium (Ca), magnesium (Mg), and silica (Si) in varying proportions, as determined from laboratory analysis.

Table 2. Rice husk ash characteristics

Variable	Results*	Criteria**
pH	8.80	Very Alkaline
N-Total	0.028 %	Very Low
P_2O_5 Bray	70.99 ppm	Very High
Potassium	87.99 me/100 g	Very High

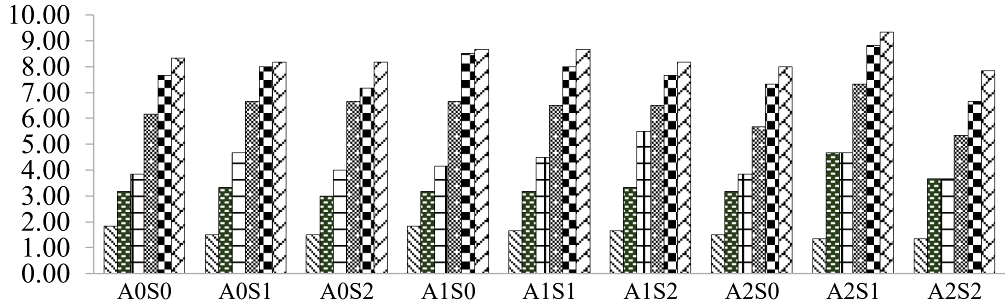
Notes:
*) Based on laboratory analysis conducted at the Chemistry and Soil Fertility Laboratory, Faculty of Agriculture, Sriwijaya University (2022)
**) Criteria based on Soil Research Institute (2009)

Plant height

The application of rice husk ash and cow manure did not significantly affect sweet corn plant height at any observation time from 1 to 6 weeks after planting (WAP) ($p > 0.05$). However, plant height generally increased over time across all treatments. At 6 WAP, treatment A2S1, consisting of rice husk ash at 60 t ha^{-1} and cow manure at 42 t ha^{-1}, tended to produce the highest mean plant height (121.00 cm), while the lowest mean plant height (85.33 cm) was observed in treatment A2S0. The application of rice husk ash and cow manure had no significant effect on plant height from 1 to 6 weeks after planting (WAP) ($p > 0.05$). Since the treatment effects were not statistically significant, no further mean comparison test was conducted for this variable.

Number of leaves

The number of leaves of sweet corn observed from 1 to 6 weeks after planting (WAP) is presented in Figure 1. At 6 WAP, the highest average number of leaves was recorded in the A2S1 treatment (rice husk ash 60 tons ha^{-1} and cow manure 42 tons ha^{-1}) with an average of 9.33 leaves, while the lowest average was observed in the A2S2 treatment at 7.83 leaves. The number of leaves was not significantly affected at 1, 3, 4, 5, and 6 WAP ($p > 0.05$), but showed a significant effect at 2 WAP ($p < 0.05$).



	A0S0	A0S1	A0S2	A1S0	A1S1	A1S2	A2S0	A2S1	A2S2
1 MST	1.83	1.50	1.50	1.83	1.67	1.67	1.50	1.33	1.33
2 MST	3.17	3.33	3.00	3.17	3.17	3.33	3.17	4.67	3.67
3 MST	3.83	4.67	4.00	4.17	4.50	5.50	3.83	4.67	3.67
4 MST	6.17	6.67	6.67	6.67	6.50	6.50	5.67	7.33	5.33
5 MST	7.67	8.00	7.17	8.50	8.00	7.67	7.33	8.83	6.67
6 MST	8.33	8.17	8.17	8.67	8.67	8.17	8.00	9.33	7.83

Figure 1. Average number of leaves of sweet corn plants

Further analysis showed that the application of rice husk ash and cow manure had a significant effect on the number of leaves at 2 WAP. The results of the Least Significant Difference (LSD) test at the 5% significance level are presented in Table 3. The highest mean number of leaves at 2 WAP was observed in the A2S1 treatment (4.67 leaves), whereas the lowest value occurred in the A0S2 treatment (3.00 leaves). Significant differences were observed among treatments, indicating variation in leaf number response to the applied amendments.

Table 3. Effect of rice husk ash and cow manure on the number of sweet corn leaves at 2 weeks after planting.

Treatment			Number of leaves at 2 WAP
Code	Rice husk ash (A) (ton ha^{-1})	Cow manure (S) (ton ha^{-1})	
A0S0	0	0	3.17$_{ab}$
A0S1	0	42	3.33$_{c}$
A0S2	0	84	3.00$_{a}$
A1S0	30	0	3.17$_{ab}$
A1S1	30	42	3.17$_{ab}$
A1S2	30	84	3.33$_{c}$
A2S0	60	0	3.17$_{ab}$
A2S1	60	42	4.67$_{e}$
A2S2	60	84	3.67$_{cd}$
	LSD 5%		0.54

Note: Numbers followed by the same letter are not significantly different at the 5% LSD test.

Plant fresh weight

The highest average wet weight was observed in treatment A2S1, consisting of rice husk ash at 60 t ha^{-1} (300 g polybag^{-1}) combined with cow manure at 42 t ha^{-1} (210 g polybag^{-1}), with a mean value of 347.75 g. Meanwhile, the lowest average wet weight was recorded in treatment A2S2, consisting of rice husk ash at 60 t ha^{-1} (300 g polybag^{-1}) and cow manure at 84 t ha^{-1} (420 g polybag^{-1}), with a mean value of 253.08 g. The application of rice husk ash and cow manure showed no significant effect on plant wet weight at the 5% LSD level. However, treatment A2S1 tended to produce a higher average wet weight compared with the other treatments.

Plant dry weight

The highest average dry weight was obtained in treatment A2S1, consisting of rice husk ash at 60 t ha^{-1} (300 g polybag^{-1}) combined with cow manure at 42 t ha^{-1} (210 g polybag^{-1}), with an average value of 160.70 g. In contrast, the lowest average dry weight was observed in treatment A0S2, which received no rice husk ash and cow manure at 84 t ha^{-1} (420 g polybag^{-1}), with a mean value of 103.75 g. The application of rice husk ash and cow manure did not significantly affect plant dry weight at the 5% LSD level. Nevertheless, treatment A2S1 tended to show a higher average dry weight compared with the other treatments.

Over all the applied treatments, treatment A2S1 tended to show higher mean values of plant fresh weight and dry weight compared with other treatments, although the differences were not statistically significant. This trend suggests that the combination of rice husk ash and cow manure may have contributed to better nutrient availability and soil physical conditions in peat soil. According to Liu et al., (2024), organic fertilizer application significantly increases fresh biomass due to improved availability of nitrogen, phosphorus, and potassium, which are essential for vegetative growth. Cow manure contributes organic matter that enhances soil structure, water retention, and microbial activity, while rice husk ash supplies potassium and alkaline elements that improve nutrient uptake efficiency (Pratiwi et al., 2023). Although statistically the treatments were not significantly different, the trend showed that balanced organic amendment application resulted in higher biomass accumulation.

Plant dry weight is a reliable indicator of plant growth success as it reflects the actual biomass after water removal. Huang et al. (2019) stated that plant dry weight represents the accumulation of photosynthates during the growth period, indicating optimal physiological processes. Variation in biomass measurements may have been influenced by peat soil particles adhering to plant roots during sampling and weighing.

Yield components of sweet corn

Cob length with husk

The highest average cob with husk length was observed in the A2S1 treatment (rice husk ash 60 tons ha^{-1} and cow manure 42 tons ha^{-1}), with a mean value of 31.50 cm, whereas the lowest average was recorded in the A2S0 treatment at 25.50 cm (Table 4). The effect of rice husk ash and cow manure on cob with husk length was evaluated using the Least Significant Difference (LSD) test at the 5% significance level. The results showed a significant effect of treatment on cob without husk length at 6 weeks after planting (WAP). The LSD test results presented in Table 4 indicated that the A2S1 treatment was significantly different from A2S0, A1S0, A0S0, A0S2, A1S2, A1S1, A0S1, and A2S2.

Table 4. Effect of rice husk ash and cow manure on cob with husk length of sweet corn

Treatment			Cob length with husk (cm)
Code	Rice husk ash (A) (ton ha^{-1})	Cow manure (S) (ton ha^{-1})	
A0S0	0	0	26.00$_{ab}$
A0S1	0	42	28.50$_{c}$
A0S2	0	84	26.17$_{b}$
A1S0	30	0	25.67$_{ab}$
A1S1	30	42	28.08$_{c}$
A1S2	30	84	26.25$_{b}$
A2S0	60	0	25.50$_{a}$
A2S1	60	42	31.50$_{e}$
A2S2	60	84	29.50$_{d}$
LSD 5%			0.64

Note: Numbers followed by the same letter are not significantly different at the 5% LSD test.

Cob weight with husk

The highest average cob weight with husk was obtained in the A2S1 treatment (rice husk ash 60 tons ha^{-1} and cow manure 42 tons ha^{-1}) with a mean value of 413.60 g, while the lowest weight was recorded in the A2S0 treatment at 260.90 g (Table 5). The effect of rice husk ash and cow manure on cob weight with husk was analyzed using the Least Significant Difference (LSD) test at the 5% significance level. The results showed that the treatments had a significant effect on husked cob weight at 6 weeks after planting (WAP). The LSD test results presented in Table 5 indicated that the A2S1 treatment was significantly different from A2S0, A2S2, A0S0, A0S1, A1S0, A1S1, and A1S2.

Table 5. Effect of rice husk ash and cow manure on husked cob weight of sweet corn

Treatment			Cob weight with husk (g)
Symbol	Rice husk ash (A) (ton ha^{-1})	Cow Manure (S) (ton ha^{-1})	
A0S0	0	0	278.02_{ab}
A0S1	0	42	294.12_{abc}
A0S2	0	84	260.90_{a}
A1S0	30	0	318.05_{cd}
A1S1	30	42	345.02_{d}
A1S2	30	84	297.43_{abc}
A2S0	60	0	309.87_{bcd}
A2S1	60	42	413.60_{e}
A2S2	60	84	272.92_{ab}
LSD 5%			37.96

Note: Numbers followed by the same letter are not significantly different at the 5% LSD test.

Cob length without husk

The highest average cob without husk length was recorded in the A2S1 treatment (rice husk ash 60 tons ha^{-1} and cow manure 42 tons ha^{-1}) with a mean value of 24.50 cm, whereas the lowest value was observed in the A1S2 treatment at 18.83 cm. The effect of rice husk ash and cow manure on cob without husk length was analyzed using the Least Significant Difference (LSD) test at the 5% significance level. The results showed that the treatments had a significant effect on cob without husk length at 6 weeks after planting (WAP). Based on the LSD test results presented in Table 6**,** the A2S1 treatment was not significantly different from A0S1 but was significantly different from A1S2, A2S0, A1S1, A0S2, A0S0, A1S0, and A2S2.

Table 6. Effect of rice husk ash and cow manure on cob length without husk

Treatment			Cob length without husk (cm)
Code	Rice husk ash (A) (ton ha^{-1})	Cow manure (S) (ton ha^{-1})	
A0S0	0	0	21.42_{cde}
A0S1	0	42	24.33_{f}
A0S2	0	84	20.75_{bcd}
A1S0	30	0	22.25_{de}
A1S1	30	42	20.58_{bc}
A1S2	30	84	18.83_{a}
A2S0	60	0	19.58_{ab}
A2S1	60	42	24.50_{f}
A2S2	60	84	22.33_{e}
LSD 5%			1.51

Note: Numbers followed by the same letter are not significantly different at the 5% LSD test.

Cob weight without husk

The highest average cob without husk weight was obtained in the A2S1 treatment (rice husk ash 60 tons ha^{-1} and cow manure 42 tons ha^{-1}), with a mean value of 262.15 g, whereas the lowest value was recorded in the A0S0 treatment at 177.67 g (Table 7). The effect of rice husk ash and cow manure on cob without husk weight was analyzed using the Least Significant Difference (LSD) test at the 5% significance level. The results showed that the treatments had a significant effect on cob without husk weight at 6 weeks after planting (WAP). The A2S1 treatment was not significantly different from A1S0, A2S0, and A1S1, but was significantly different from A0S0, A2S2, A0S2, A0S1, and A1S2.

Table 7. Effect of rice husk ash and cow manure on cob weight without husk

Treatment			Cob Weight Without Skin (g)
Code	Rice husk ash (A) (ton ha^{-1})	Cow manure (S) (ton ha^{-1})	
A0S0	0	0	177.67a
A0S1	0	42	191.13a
A0S2	0	84	188.10a
A1S0	30	0	241.32bc
A1S1	30	42	230.62b
A1S2	30	84	195.08a
A2S0	60	0	228.60b
A2S1	60	42	262.15bc
A2S2	60	84	187.08a
	LSD 5%		26.01

Note: Numbers followed by the same letter are not significantly different at the 5% LSD test.

Cob diameter

The highest average cob diameter was observed in the A2S1 treatment (rice husk ash 60 tons ha^{-1} and cow manure 42 tons ha^{-1}), reaching 50.15 mm, while the lowest cob diameter was recorded in the A1S2 treatment at 42.62 mm (Table 8). The effect of rice husk ash and cow manure on cob diameter was analyzed using the Least Significant Difference (LSD) test at the 5% significance level. The results indicated that the treatments significantly affected cob diameter at 6 weeks after planting (WAP). Based on the LSD test results presented in Table 8, the A2S1 treatment was not significantly different from A1S0, A0S2, and A0S1, but showed significant differences compared to A1S2, A0S0, A2S2, A2S0, and A1S1.

Cob weight with husk, cob weight without husk, cob length, and cob diameter are critical indicators of sweet corn productivity. The highest cob weight and size were consistently observed in the A2S1 treatment, indicating that nutrient availability during the generative phase was adequate. This supports the findings of Salsabila & Bernas (2023), who reported that organic fertilization increases microbial activity, accelerating decomposition and nutrient mineralization, which ultimately supports cob development (Liu et al., 2025).

Potassium supplied by rice husk ash plays an essential role in carbohydrate translocation and enzyme activation, which enhances cob weight and diameter.

Meanwhile, phosphorus from cow manure supports energy transfer and seed development, and nitrogen sustains photosynthesis during cob filling. According to Liu et al. (2018), phosphorus and potassium significantly influence cob size and kernel development due to their roles in assimilate translocation.

The increase in cob diameter is also associated with cell division and enlargement processes regulated by plant hormones such as auxin. Afrida et al. (2024) explained that improved nutrient availability enhances hormonal activity, resulting in larger cob diameter and a greater number of kernel rows. Furthermore, Paul et al. (2023) stated that sufficient availability of P and K elements is crucial for optimal cob and seed formation, while nutrient deficiencies lead to smaller and imperfect cobs.

Table 8. Effect of rice husk ash and cow manure on cob diameter of sweet corn

Treatment			Cob diameter (mm)
Code	Rice husk ash (A) (ton ha^{-1}	Cow manure (S) (ton ha^{-1})	
A0S0	0	0	43.00$_{a}$
A0S1	0	42	46.27$_{cd}$
A0S2	0	84	49.45$_{d}$
A1S0	30	0	47.32$_{cd}$
A1S1	30	42	45.55$_{abc}$
A1S2	30	84	42.62$_{a}$
A2S0	60	0	43.43$_{ab}$
A2S1	60	42	50.15$_{d}$
A2S2	60	84	43.13$_{a}$
LSD 5%			3.07

Note: Values followed by the same letter are not significantly different at the 5% LSD test.

Effect of organic amendments on soil pH

The initial soil pH prior to land management and treatment application was categorized as very acidic (pH 3.86). After the application of rice husk ash, cow manure, and dolomite, the final soil pH values showed an overall increase across all treatments. The highest soil pH value (7.17) was observed in treatment A1S2, which consisted of rice husk ash at 150 g polybag^{-1} combined with cow manure at 84 t ha^{-1} (420 g polybag^{-1}). An increase in soil pH was also observed in the control treatment, indicating an improvement compared to the initial soil condition. Statistical observations showed that the application of the ameliorants led to higher soil pH values compared to the initial condition. The results of peat soil pH analysis are presented in Table 9.

Soil pH improvement was one of the most significant findings in this study. The initial pH of 3.86 indicated highly acidic peat soil conditions, which limit nutrient availability and plant growth. The application of rice husk ash, cow manure, and dolomite significantly increased soil pH across treatments. Rice husk ash contains alkaline elements such as calcium and magnesium that neutralize soil acidity, while cow manure enhances buffering capacity and stimulates microbial activity.

Table 9. Soil pH before and after rice husk ash and cow manure treatments

Treatment			pH (H20)	Ctiteria*
Code	Rice husk ash (A) (ton ha^{-1})	Cow manure (S) ton ha^{-1})		
A0S0	0	0	6.82±0.12	Neutral
A0S1	0	42	6.86±0.12	Neutral
A0S2	0	84	6.09±0.09	Acidic
A1S0	30	0	6.28±0.10	Acidic
A1S1	30	42	6.83±0.13	Neutral
A1S2	30	84	7.17±0.10	Neutral
A2S0	60	0	6.70±0.10	Neutral
A2S1	60	42	5.95±0.04	Acidic
A2S2	60	84	5.93±0.05	Acidic

Source: *) Soil pH criteria based on the Soil Research Institute (2002).

The relatively high exchangeable potassium values observed in the peat soil and rice husk ash were likely related to the high organic matter content of peat and the mineral ash composition of rice husk ash. Rice husk ash is known to contain considerable amounts of soluble potassium and alkaline minerals released during combustion, which may contribute to elevated exchangeable K levels in the soil. Potassium plays an important role in carbohydrate translocation and cob development; however, high exchangeable K values alone did not always correspond to the highest sweet corn productivity, indicating that balanced nutrient availability and appropriate amendment combinations were also important.

The highest soil pH value was observed in treatment A1S2; however, optimal plant growth and yield were not always achieved at the highest pH level. This indicates that excessive amendment application may not directly correspond to maximum plant performance. According to Teutscherova et al. (2023), the combination of rice husk ash and organic fertilizer can effectively neutralize acidic peat soils and increase nutrient availability, especially phosphorus, which is often fixed under acidic conditions.

Additionally, the increase in soil pH in control treatments was influenced by dolomite application during land preparation, indicating that dolomite alone can raise soil pH. However, the combination with organic amendments provides additional benefits by improving soil structure and nutrient supply. Therefore, the increase in soil pH observed in this study cannot be attributed solely to rice husk ash and cattle manure, since dolomite application also contributed to reducing soil acidity across all treatments. This condition may have reduced the contrast among treatments in terms of soil pH response.

Integrated effect of rice husk ash and cow manure

The combined application of rice husk ash and cow manure positively affected sweet corn growth, yield components, and peat soil chemical properties. Treatment A2S1 provided a balanced amendment dose that likely contributed to better nutrient availability without causing nutrient imbalance. Muharram et al. (2025) reported that moderate organic amendment doses are more effective than excessive application, especially in peat soils with high sensitivity to chemical changes.

The reduced response observed under the highest manure dose may have been associated with nutrient imbalance, excessive accumulation of certain ions, or temporary nutrient immobilization under peat soil conditions. Excessive organic amendment application may alter nutrient equilibrium and reduce nutrient uptake efficiency, thereby limiting optimal plant growth and yield. Furthermore, this study was conducted under polybag conditions, which may not fully represent field-scale peatland conditions. The application of basal inorganic fertilizers and dolomite may also have influenced treatment responses and reduced differences among treatments.

Integrated organic soil management using rice husk ash and cow manure is a promising approach for improving sweet corn productivity on peatland while maintaining soil health and sustainability. Further studies under field-scale peatland conditions are required to evaluate the long-term effects of rice husk ash and cow manure application and to determine the optimal amendment combinations for sustainable sweet corn production.

CONCLUSION

The combined application of rice husk ash and cattle manure influenced several growth, yield, and soil chemical properties of sweet corn grown on peat soil. Treatment A2S1, consisting of 60 t ha^{-1} rice husk ash and 42 t ha^{-1} cattle manure, tended to produce better responses for several yield components, particularly cob length, cob weight, and cob diameter. In contrast, vegetative growth parameters such as plant height, wet weight, and dry weight were not significantly affected by the treatments. The application of rice husk ash, cattle manure, and dolomite also increased soil pH under acidic peat soil conditions. Overall, the combined use of rice husk ash and cattle manure shows potential as an organic soil amelioration strategy for improving sweet corn productivity on peat soil.

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