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Production of eggplant as affected by the application of varying levels of sugarcane filter cake combined with fixed amount of inorganic fertilizer

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Abstract

Food security remains a critical concern in the Philippines, especially amid challenges such as rapid population growth, climate change, and high agricultural input costs. This study evaluated the effects of sugarcane filter cake, an organic by-product of the sugar industry, on the growth and yield of eggplant (*Solanum melongena* L.) under varying application levels combined with recommended rates of inorganic fertilizer. Conducted at the Cagayan State University Integrated Farm from January to April 2025, the field experiment employed a Randomized Complete Block Design (RCBD) with six treatment combinations. Results revealed that the combination of recommended inorganic fertilizer and 2 tons/ha of sugarcane filter cake (Treatment 4) produced the most favorable outcomes across several parameters, including plant height, number of fruits per plant, fruit weight, and overall yield (16.9 tons/ha). Statistical analyses indicated significant differences among treatments, highlighting the synergistic effect of combining organic and inorganic fertilizers. These findings support the potential of sugarcane filter cake as a sustainable soil amendment that enhances eggplant productivity while addressing environmental and economic challenges in agriculture. The study aligns with Sustainable Development Goals (SDGs) on zero hunger, responsible production, and land biodiversity.

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Introduction

Food security remains the pressing issue in developing countries like the Philippines due to the rapid population growth, climate change, and natural disasters which have strained agricultural productivity. According to the Food and Agriculture Organization (FAO, 2023), the country ranks 67th in terms of the four pillars of food security such as food affordability, availability, quality and safety, and sustainability and adaptation. This is the reason why sustainable agricultural practices that can enhance crop yield and resilience must be adopted by farmers.

The high cost of inputs in the production sector, particularly due the use of inorganic fertilizers and different agro-chemicals, poses a significant barrier to many farmers because not all of them can finance the high demand of this inputs which are highly available in the local market. The continues use of fertilizer, while initially effective at boosting yields, can lead to long-term soil degradation, reduced microbial diversity, and water quality issues through run-off (Gupta *et al.*, 2019). Additionally, the overuse of chemical fertilizers can result in diminished soil fertility over time, necessitating even higher inputs to maintain yields. This cycle not only increases production costs but also undermines the sustainability of farming practices, exacerbating food insecurity as farmers struggle to keep up with rising expenses (FAO, 2021).

Exploring alternative organic amendments is crucial for promoting sustainable agricultural practices. Sugarcane filter cake, a by-product of the sugar extraction process, presents a promising option for enhancing soil fertility. Rich in organic matter and essential nutrients, sugarcane filter cake can improve soil structure, increase water retention, and promote beneficial microbial activity (Ali *et al.,* 2020). Previous studies have shown that organic amendments like sugarcane filter cake can significantly enhance plant growth and nutrient availability, thereby offering a viable solution to the challenges faced by eggplant (Sahu *et al.,* 2019).

Eggplant (*Solanum melongena* L.) is a tender perennial plant of the Nightshade or Solanaceae family. It is extensively grown in the Philippines making it as one of the most important vegetables in the country. This vegetable is a good source of calcium, phosphorous, potassium, iron, protein, folic acid and vitamins A and B. It is high in fiber and low in fat, calories and sodium. According to Philippine Statistic Authority 2023, the area planted for eggplant from January to June 2023 increased to 13.76 thousand hectares or by 1.0 percent from the 13.62 thousand hectares in the same period of 2022. However, despite the increase in the current area planted by eggplant the production of eggplant from April to June 2023 was registered at 102.98 thousand metric tons, which indicates a decrease of -3.6 percent from the 106.87 thousand metric tons output in the same quarter of 2022 wherein Ilocos Region had the largest eggplant production with 60.46 thousand metric tons or 58.7 percent share to the total production during the quarter and followed by Cagayan Valley with 7.91 thousand metric tons and Central Luzon with 7.06 thousand metric tons. Considering that the said crop is a high value crop and could not tolerate acidic soil, it is necessary therefore to improve the area of cultivation to commend higher yield. By doing so, the application of filter cake as soil ameliorant would possible increase the pH of the soil and also affect the overall yield of crops.

As interest in organic farming and sustainable agricultural practices increases, there is a pressing need to explore innovative soil management strategies that can enhance crop yield and quality while preserving biodiversity (Gomez *et al.,* 2020). Additionally, this research aligns with several Sustainable Development Goals (SDGs). It contributes to SDG 2 (Zero Hunger) by enhancing agricultural productivity and food security, supports SDG 12 (Responsible Consumption and Production) through sustainable farming practices, and aligns with SDG 15 (Life on Land) by promoting biodiversity and soil health. This study aimed to determine the response of eggplant as affected by the application of

different levels of sugarcane filter cake combined with fixed amount of inorganic fertilizer. Specifically, it aimed to evaluate the effect of varying levels of sugarcane filter cake on the growth, yield, and economics of return of eggplant cultivation.

Materials and methods

Collection of filter cake

A fully decomposed filter cake was collected at the dumping site of Universal Robina Corporation (URC) at Sto. Domingo, Piat, Cagayan. This is determined by its brown color and must not produce a foul odor. The material must not also produce high temperature to be considered as fully decomposed material. A one (1) kilogram of the filter cake were brought to the Regional Soil Analytical Laboratory, Tuguegarao City for analysis of pH, organic content, total nitrogen, available phosphorous, exchangeable potassium, and micronutrients.

Securing of planting materials

Planting materials were secured from the Department of Agriculture Regional Office 02 under the High-Value Crops Program (HVCP). A request letter was sent to their office one (1) month prior in the conduct of the study.

Soil sampling

Soil sampling was done by randomly collecting samples in ten (10) different locations from the experimental field. Collected samples was mixed and air-dried prior to submission to Cagayan Valley Agricultural Integrated Laboratory (CVIAL) for nutrient analysis. The report of the analysis is used as the basis in drawing the different fertilizer dressings.

Land preparation

The experimental area consisting of 720 m^2 were thoroughly prepared using the conventional system of dry land preparation. The field was plowed and harrowed twice at one week interval in between each activity to make the soil friable. These were done to attain good soil tilth and aeration to facilitate planting and to ensure better crop growth and development and ultimately higher yield. An elevated experimental plot measuring 4m×5m were constructed to accommodate the different treatment combinations. Drainage was also made to avoid rotting of plants, especially during heavy downpour of rain.

Experimental design and treatments

The Randomized Complete Block (RCB) was used in the experiment. The following treatment combinations are as follows:

Treatment 1- Control (No application)

Treatment 2- Recommendation Rate of Inorganic fertilizer

Treatment 3- Recommendation Rate (Inorganic) + 1 ton of Sugarcane Filter Cake

Treatment 4- Recommendation Rate (Inorganic) + 2 tons of Sugarcane Filter Cake

Treatment 5-Recommendation Rate (Inorganic) + 3 tons Sugarcane Filter Cake

Treatment 6- 2 tons of Sugarcane Filter Cake

An alleyway of one (1) meter in between replications and treatments were provided to facilitate the performance of different cultural management activities.

Seed sowing

Seeds were sown in seedling trays to minimize transplanting shock and to avoid overcrowding of seedlings. The growing media composed of carbonized rice hull, garden soil and compost in equal proportion are mixed properly and sterilized to avoid the occurrence of a soil-borne pathogen. Seeds were sown in germinating trays. One seed was planted per seed hole of the seedling tray to avoid competition. Trays was also labelled accordingly.

Application of sugarcane filter cake

The fully decomposed sugarcane filter cake is applied 2 weeks before planting to allow nutrients to become available to plants before their growth cycle starts. The recommended rate for the sugarcane filter cake is based on the analysis from the Cagayan Valley Integrated Agricultural Laboratory (CVIAL).

Transplanting

Seedlings were transplanted three weeks after seed sowing at a distance of 75cm between furrows and 50cm in between hills at one seedling per hill. Transplanting was observed late in the afternoon to minimize stress to the newly transplanted crop.

Mulching

Rice straw was used as mulching materials. These were done by evenly spreading dried rice straws over the experimental plots with a thickness of 3-5 cm to minimize soil moisture losses and growth of weeds.

Fertilizer application

The kind and number of fertilizers applied in each of the specified treatments was based from the result of soil analysis. All organic fertilizer materials were applied basally while the total amount of inorganic fertilizer was applied on a staggard basis, i.e., 10, 30 and 50 days after transplanting but still following the soil recommendation.

Water management

An equal amount of water was applied to plants early in the morning or late in the afternoon. Water was made available when needed.

Controlling of pest and diseases

The occurrence of pests and diseases was strictly monitored and recorded. This was done to serve as a bases for applying appropriate control methods. Hand-picking and spraying of double-action insecticides are done to control the occurrence of insect pests during the conduct of the study.

Priming

Harvesting was undertaken as fruits get longer and firm. This was done by cutting the fruit peduncle from the plant's lateral branches. A total of five (5) priming's was done in the experiment. Plants in the harvest area of each plot were used to determine the agronomic characteristics and yield and yield parameters. Plants in the edge of the rows and those planted in the outer rows were excluded to minimize biased results.

Statistical tool

All data were analyzed using the Microsoft excel. The Analysis of Variance (ANOVA) using the Tukey's Honest Significance Difference (HSD) test at 5% and 1% was used to determine the significance of the different treatments tested.

Results and discussion

Average plant height

Fig. 1 shows the average plant height of eggplant as affected by the application of inorganic fertilizer supplemented with varying levels of sugarcane filter cake. It was found out that Treatment 4 (RR Inorganic fertilizer + 2 tons of sugarcane filter cake) produced the tallest plant height with a mean of 93.33 cm. This was closely followed by Treatment 5 (RR inorganic fertilizer + 3 tons filter cake) and Treatment 3 (RR inorganic fertilizer + 1 ton filter cake), which recorded mean heights of 90.33 cm and 88.33 cm, respectively.

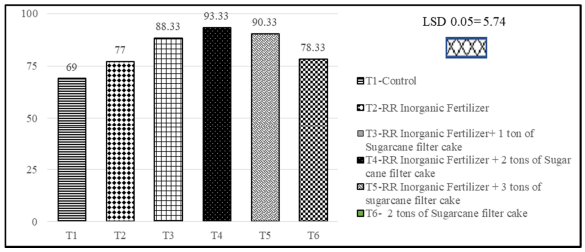

Fig. 1. Average plant height of eggplant supplemented with the application of sugarcane filter cake

On the other hand, treatments involving either filter cake alone (Treatment 6, 2 tons filter cake) or inorganic fertilizer alone (Treatment 2 yielded comparatively shorter plants, with average heights of 78.33 cm and 77 cm, respectively. The control treatment (Treatment 1), which received no fertilization, recorded the shortest plants, averaging 69 cm.

Analysis of variance revealed a significant difference among the treatments, indicating that the type and combination of amendments had a statistically measurable impact on plant height. Further mean comparisons showed that although

Treatment 5 yielded the tallest plants numerically, it was not statistically different from Treatments 4 and 3. Similarly, there was no significant difference among Treatments 6, 2, and 1. However, significant differences were observed when Treatments 5, 4, and 3 were compared to Treatments 6, 2, and 1. The result of the study could be explained that additional application of filter cake enhances the growth of eggplant due to high amount of nutrient such as nitrogen which helps in the vegetative phase of the crop.

These results indicate that while both organic and inorganic fertilizers individually contribute to plant growth, their combined application results in a synergistic effect that significantly improves vegetative development, as measured by plant height. This improvement is likely due to the nutrient-rich nature of sugarcane filter cake, which contains essential macro and micronutrients such as nitrogen, phosphorus, potassium, and calcium, along with a high organic matter content that supports microbial activity and improves soil structure. Wongkoon *et al.* (2017) reported that compost derived from filter cake significantly improved nutrient availability and plant growth, supporting the findings of the current study. Furthermore, Borges *et al.* (2019) found that the application of sugarcane filter cake improved phosphorus availability in the soil, which is critical for root development and vegetative growth in crops such as eggplant.

Average number of days to bear flower

The average number of days for eggplant to bear flower supplemented with the application of sugarcane filter cake is shown in Fig. 2. Analysis of variance revealed a highly significant difference ($p < 0.01$) among the treatments, indicating that the type and combination of fertilizers had a substantial effect on the flowering time of eggplants. Interestingly, the earliest flowering was recorded in the control treatment (Treatment 1), with a mean of 51 days after transplanting. This was closely followed by Treatment 6 (recommended rate of organic fertilizer), Treatment 2 (100% recommended rate of inorganic fertilizer), Treatment 5 (RR inorganic fertilizer + 3 tons sugarcane filter cake), and Treatment 3 (RR inorganic fertilizer + 1 ton filter cake), which recorded flowering times of 52.00, 52.33, 53.00, and 54.00 days, respectively. On the other hand, the most delayed flowering was observed in Treatment 4 (RR inorganic fertilizer + 2 tons sugarcane filter cake), which flowered at an average of 55.33 days after transplanting.

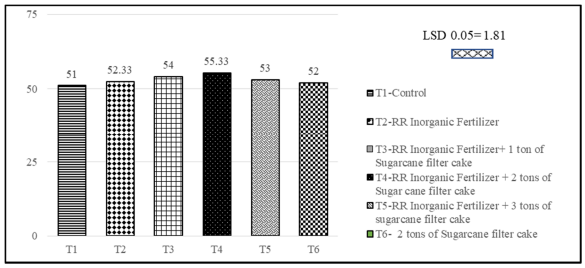

Fig. 2. Average number of days for eggplant to bear flower as affected by the supplementation of sugarcane filter cake

Mean comparisons further showed that although the control plants flowered the earliest, their flowering time was not significantly different from those in Treatments 6 and Treatment 2. Similarly, Treatment 5 did not differ significantly from Treatment 3, and Treatment 3 was not significantly different from Treatment 4. Significant differences were observed only when the control treatment (T1) was compared with Treatments 5, Treatment 3, and Treatment 4, indicating that these treatments delayed flowering. A significant delay was also evident when comparing Treatment 5 with Treatment 4.

The observed delay in flowering in treatments involving the combination of inorganic fertilizer and sugarcane filter cake, especially at higher rates, may be attributed to the enhanced nitrogen availability. High nitrogen levels are known to promote vegetative growth and can delay the transition to the reproductive phase, including flowering. This aligns with findings by Nawaz *et al.* (2015), who reported that excessive nitrogen availability can delay flowering in many vegetable crops due to prolonged vegetative development. Similarly, Kumar *et al.* (2018) highlighted that while organic amendments

such as sugarcane filter cake improve soil fertility, their effect on flowering time may depend on the nutrient composition and release rate, with high nitrogen levels tending to extend the vegetative phase.

Average number of lateral branches per plant

Fig. 3 presents the average number of lateral branches produced by eggplant in response to various fertilizer treatments, including the supplementation of sugarcane filter cake. Statistical analysis revealed that there were no significant differences among the treatments, indicating that the different combinations of inorganic fertilizer and sugarcane filter cake had no measurable effect on the formation of lateral branches. Across all treatments, the average number of lateral branches per plant ranged from 2.33 to 3.00, suggesting a uniform branching pattern regardless of nutrient input. This outcome may be attributed to the genetic characteristics of the eggplant variety used, which appears to have a relatively fixed pattern of branching that is less influenced by external nutrient management practices.

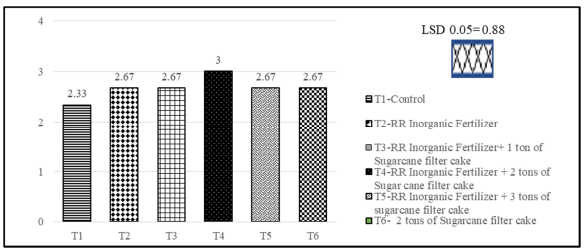

Fig. 3. Average number of lateral branches produced per plant by eggplant supplemented with the application of sugarcane filter cake

Average number of fruits per plant

The effect of sugarcane filter cake supplementation on the number of fruits of eggplant is presented in Fig. 4. Among the treatments evaluated, Treatment 4 (recommended rate of inorganic fertilizer + 2 tons of sugarcane filter cake per hectare) produced the highest number of fruits per plant, with a mean of 17. This was followed by Treatment 5, Treatment 3, Treatment 6, and Treatment 2 with 15, 14, 13 and 12 number of fruits per plant. In contrast, the control group (Treatment 1), which did not receive any fertilizer input, recorded the lowest yield, with an average of 8.00 fruits per plant.

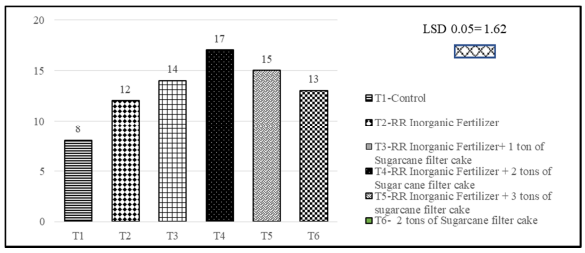

Fig. 4. Average number of fruits produced per plant by eggplant supplemented with the application of sugarcane filter cake

Analysis of variance revealed highly significant differences among treatments, indicating that the incorporation of sugarcane filter cake, either alone or in combination with inorganic fertilizer, positively influenced fruit production. Post-hoc comparisons using Tukey's HSD test showed that Treatment 5 differed significantly from Treatments 6, 4, 3, 2, and 1. Similarly, Treatment 3 was significantly different from Treatments 6, 2, and 1. Notably, Treatments 6 and 2 also differed significantly from the control, while no statistically significant difference was observed between Treatments 2 and 6, or between Treatments 3 and 5.

The observed increases in fruit number suggest that sugarcane filter cake plays a critical role in enhancing eggplant productivity. The organic matter in the filter cake improves soil structure and moisture retention, while its nutrient content contributes to sustained fruit development. According to Singh *et al.* (2017), the addition of sugarcane filter cake enhances the availability of essential nutrients and stimulates microbial activity, both of which are vital for fruit set and development in solanaceous crops like eggplant. Moreover, Pires and Martinho (2019) found that combining organic amendments with chemical fertilizers significantly improves reproductive growth parameters, including fruit number.

Average weight of harvested fruit per plant

The influence of sugarcane filter cake application on the average fruit weight per eggplant plant is

presented in Fig. 5. Analysis of variance indicated a highly significant difference among treatments tested, confirming that nutrient management strategies had a substantial effect on fruit weight. Among the six treatments, Treatment 4 (recommended rate of inorganic fertilizer + 2 tons of sugarcane filter cake per hectare) produced the heaviest average fruit weight, with a mean of 1305.82 grams per plant. This was followed by Treatment 5 (1031.77 g), Treatment 3 (1015.79 g), Treatment 6 (956.27 g), and Treatment 2 (881.87 g). The control group (Treatment 1) recorded the lowest fruit weight with a mean of 751.83 grams per plant.

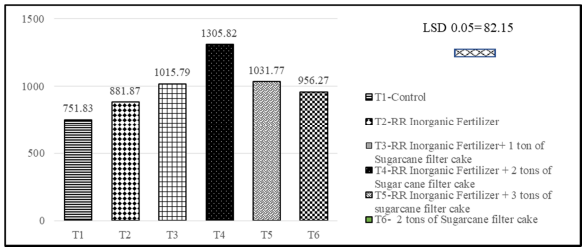

Fig. 5. Average fruit weight of eggplant per plant as affected by the supplementation of sugarcane filter cake

Pairwise comparisons among treatment means revealed several notable differences. Treatment 4 had a significantly higher fruit weight compared to all other treatments, including T6, T5, T3, T2, and T1. Additionally, Treatment 5 was significantly different from both T2 and T1, while Treatment 2 also showed a significant difference from the control (T1). However, no significant differences were found between Treatments 2 and 6, or between T2 and T3. Similarly, the differences between Treatments 6 and 3, 6 and 5, and 3 and 5 were not statistically significant.

The enhanced fruit weight in Treatment 4 highlights the positive effect of combining organic and inorganic nutrient sources. The sugarcane filter cake not only adds organic matter to the soil, improving its physical structure and water-holding capacity, but also contributes nutrients such as phosphorus, calcium, and micronutrients essential for fruit development. These findings are supported by Pires and Martinho (2019), who observed improved fruit weight in crops treated with filter cake in combination with mineral fertilizers.

The increase in fruit weight aligns with the earlier results on fruit number, reinforcing the conclusion that sugarcane filter cake enhances both fruit quantity and quality. As demonstrated in similar studies of Singh *et al.*, 2017; Mahmoud and Ibrahim, 2012, organic amendments play a vital role in stimulating root growth, nutrient uptake, and reproductive output which are key factors directly linked to heavier fruit production.

Yield in tons/ha

Fig. 6 shows the average yield of eggplant per hectare as affected by the supplementation of sugarcane filter cake. Analysis of variance revealed a highly significant difference among the treatments tested, indicating that fertilization strategies significantly influenced yield. Among the treatments, Treatment 4 (recommended rate of inorganic fertilizer + 2 tons of sugarcane filter cake per hectare) produced the highest adjusted yield, with a mean of 16.9 tons per hectare. This was followed closely by Treatment 5 (13.28 tons/ha), Treatment 3 (13.06 tons/ha), Treatment 6 (12.3 tons/ha), and Treatment 2 (11.34 tons/ha). The control group (Treatment 1) recorded the lowest yield, with a mean of 9.67 tons per hectare.

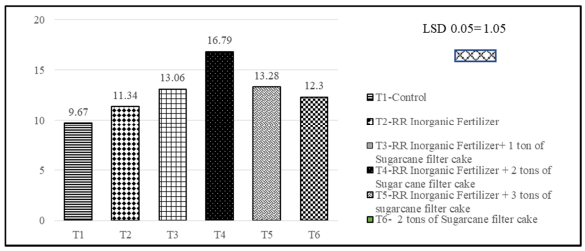

Fig. 6. Yield of eggplant in tons per hectare as affected by the supplementation of sugarcane filter cake

Pairwise comparisons of means revealed that Treatment 4 significantly outperformed all other treatments in terms of adjusted yield, showing a substantial increase in productivity. Treatment 5 also differed significantly from Treatments 6, 2, and 1. Additionally, Treatment 3 had a significantly higher

yield compared to Treatments 2 and 1, and Treatment 2 was significantly different from the control. However, no significant difference was found between Treatment 5 and Treatment 3, nor between Treatment 3 and Treatment 6, and Treatment 6 and Treatment 2.

The results of this study are consistent with the findings of Santos *et al.* (2017), which examined the effects of sugarcane filter cake as an organic fertilizer for agricultural crops. In their study, sugarcane filter cake was found to significantly improve soil fertility due to its rich nutrient composition, including potassium, calcium, magnesium, and phosphorus. This organic matter enhances soil structure, improves nutrient availability, and increases microbial activity, all of which are crucial for optimal plant growth. These findings align with the results of Treatment 4 (RR Inorganic Fertilizer + 2 tons of sugarcane filter cake) in this study, which recorded the highest adjusted yield of 17.5 tons/ha. The combination of sugarcane filter cake and inorganic fertilizers created a synergistic effect that provided a balanced and continuous supply of nutrients, boosting plant health and fruit production. The organic matter from the filter cake likely facilitated better microbial activity in the soil, further enhancing nutrient cycling and availability, which contributed to the higher yield in Treatment 4.

Cost and return analysis

Table 1 presents the partial budget analysis for eggplant production supplemented with sugarcane filter cake. The highest production cost, amounting to ₱148,820.00, was recorded in Treatment 5 (Recommended Rate of Inorganic Fertilizer + 3 tons of Sugarcane Filter Cake). This increase was attributed to the greater quantity of organic fertilizer used and the additional labor required for its application. In contrast, the lowest production cost (₱122,000.00) was observed in the control treatment (Treatment 1), where no fertilizer was applied.

Table 1. Partial budget analysis of eggplant supplemented with the application of sugarcane filter cake

Particulars	T1	T2	T3	T4	T5	T6
A. Materials						
Seeds	5400	5400	5400	5400	5400	5400
Fertilizer						
46-0-0		3200	3200	3200	3200	
16-20-0		2400	2400	2400	2400	
14-14-14		1820	1820	1820	1820	
Sugarcane Filter Cake			5600	11200	16800	11200
Pre-mixed media	8000	8000	8000	8000	8000	8000
Seed Tray	6200	6200	6200	6200	6200	6200
Irrigation	10000	10000	10000	10000	10000	10000
Sub Total	29600	37020	42620	48220	54820	40800
B. Labor						
Plowing	7000	7000	7000	7000	7000	7000
Harrowing	7000	7000	7000	7000	7000	7000
Planting	6400	6400	6400	6400	6400	6400
Fertilizer Application	2000	2000	2000	2000	2000	2000
Organic Fert. Application			800	1200	1600	1200
Weeding	4000	4000	4000	4000	4000	4000
Harvesting	16000	16000	16000	16000	16000	16000
Sub Total	42400	42400	43200	43600	44000	43600
C. Miscellaneous	50000	50000	50000	50000	50000	50000
D. Total Production Cost	122000	129420	135820	141820	148820	134400
E. Weight of harvested fruits	9670	11340	13060	16900	13280	12300
F. Gross Income	193400	226800	261200	338000	265600	246000
G. Net Income	71400	97380	125380	196180	116780	111600
ROI	58.53	75.24	92.31	138.33	78.41	83.04

In terms of return on investment (ROI), the highest ROI was achieved in Treatment 4 (Recommended Rate of Inorganic Fertilizer + 2 tons of Sugarcane Filter Cake), with a return of 138.33%. This indicates that the optimal combination of inorganic fertilizer and sugarcane filter cake significantly improved the economic yield of eggplant. The application of sugarcane filter cake led to ROI increases ranging from 16.72% to 79.80% compared to the control, with Treatment 4 showing the greatest profitability. Although Treatment 5 had the highest production cost, it did not yield the highest ROI. This suggests that applying sugarcane filter cake beyond the optimal rate may not result in additional economic benefits.

Conclusion

Based on the results of the study, the use of sugarcane filter cake as an organic soil amendment particularly when combined with recommended rates of inorganic fertilizers can be a beneficial practice for farmers. The findings demonstrate that applying 2 tons of sugarcane filter cake per hectare, along with the standard application of inorganic fertilizers, significantly enhances eggplant growth, fruit yield, and overall productivity. This integrated approach not only boosts crop performance but also helps reduce the financial strain associated with the high cost of inorganic fertilizers. Moreover, it contributes to improved soil fertility, supporting more sustainable and environmentally friendly agricultural practices.

References

Ali HA. 2020. Sugarcane filter cake as an organic amendment for sustainable agricultural practices. Journal of Soil Science and Plant Nutrition **20**(3), 1234–1245.

Borges MM, Abdala B, Souza D, Viglio M, Arruda Coelho L, Pavinato M, Franco P, Henrique. 2019. Organomineral phosphate fertilizer from sugarcane byproduct and its effects on soil phosphorus availability and sugarcane yield. Geoderma **339**, 20-30.
DOI: 10.1016/j.geoderma.2018.12.036.

Food and Agriculture Organization. 2021.

Food and Agriculture Organization. 2023.

Gomez RA. 2020. The role of heirloom tomatoes in sustainable agriculture. Journal of Agricultural Studies **8**(2), 1–14.

Gupta A. 2019. Impact of chemical fertilizers on soil health and sustainability. Environmental Science & Policy **101**, 34–45.

Kumar M, Ouattara S. 2018. Microbial Stability of Worm Castings and Sugarcane Filter Mud Compost Blended with Biochar During Storage. Cogent Environmental Science **4**(1), 1423719. https://www.tandfonline.com/doi/full/10.1080/23311932.2018.1423719

Mahmoud SH, Ibrahim HH. 2012. Use of sugarcane industrial by-products for improving sugarcane productivity and soil health. International Journal of Recycling of Organic Waste in Agriculture **1**(2), 85–90. https://doi.org/10.1007/s40093-016-0132-8

Nawaz M, Chattha MU, Hassan MU, Barbanti L. 2015. Composted sugarcane by-product press mud cake supports wheat growth and improves soil properties. Agronomy for Sustainable Development **35**(3), 839–847. https://doi.org/10.1007/s13593-015-0310-3

Philippine Statistics Authority. 2023. Annual production data.

Pires A, Martinho G. 2019. Waste hierarchy index for circular economy in waste management. J. Waste Manag. **95**, 298–305.

Sahu R. 2019. Effects of organic amendments on growth and yield of vegetables: A review. International Journal of Vegetable Science **25**(3), 235–246.

Santos HG, dos Silva MS da, Franco HCJ, Vitti GC. 2014. Sugarcane response to filter cake enriched with soluble phosphate. Acta Scientiarum. Agronomy **36**(3), 293–300.

Singh R. 2017. Comparative analysis of sugarcane filters cake and chemical fertilizers in crop production. Journal of Crop Improvement **31**(5), 575-590.

Wongkoon S, Tongsiri S, Sooksathan I. 2017. Effect of compost made from filter cake and distillery slop on sugarcane growth. Asia-Pacific Journal of Science and Technology **19**(3), 250–255. https://so01.tci-thaijo.org/index.php/APST/article/view/83127