

International Journal Research Publication Analysis

Page: 01-08

RATOON PERFORMANCE OF SUGARCANE (*SACCHARUM OFFICINARUM L.*) VARIETY PSR 2000-171 APPLIED WITH DIFFERENT LEVELS OF BIOSA AGRI ENZYME AND SWAMP CABBAGE EXTRACT

*¹Judie T. Fernandez, ²Merly C. Remollo

¹Department of Agriculture/Regional Field Office, M'lang, North Cotabato, Philippines.

²Cotabato Foundation College of Science and Technology, Arakan, Cotabato, Philippines.

Article Received: 22 March 2026

*Corresponding Author: Judie T. Fernandez

Article Revised: 12 April 2026

Department of Agriculture/Regional Field Office, M'lang, North Cotabato, Philippines.

Published on: 02 May 2026

DOI: <https://doi-10.1555/ijrpa.9043>

ABSTRACT

This study evaluated the effects of different levels of Biossa Agri Enzyme and Swamp Cabbage Extract on the ratoon performance of sugarcane (*Saccharum officinarum L.*) variety PSR 2000-171. The experiment was conducted in La Suerte, M'lang, North Cotabato from January to March 2025, using a factorial split-plot design arranged in a Randomized Complete Block Design (RCBD) replicated three times. The main plot consisted of four levels of Biossa Agri Enzyme (B0 – control; B1 – 3.25 mL/L; B2 – 6.25 mL/L; B3 – 9.25 mL/L) and the sub-plot consisted of four levels of Swamp Cabbage Extract (S0 – control; S1 – 10 mL/L; S2 – 20 mL/L; S3 – 30 mL/L). Parameters measured were plant height, number of leaf storeys, number of tillers/shoots, stalk diameter, and estimated yield. Results showed that B3 produced the tallest plants (200.69 cm), highest leaf storey count (11.50), most tillers (12.11), widest stalk diameter (2.82 cm), and greatest estimated yield (353 mt/ha). S3 similarly produced the highest values across all parameters. Both Biossa Agri Enzyme and Swamp Cabbage Extract showed highly significant individual effects on all agronomic characteristics; however, their interaction was not significant. The highest treatment combination (B3+S3) consistently outperformed all others, demonstrating the potential of these organic biostimulants in improving sugarcane ratoon productivity and sustainability.

KEYWORDS: Sugarcane ratoon; Biossa Agri Enzyme; Swamp Cabbage Extract; organic biostimulant; PSR 2000-171; plant height; tiller; estimated yield.

4. INTRODUCTION

Sugarcane (*Saccharum officinarum* L.) is one of the world's most economically important crops, cultivated primarily for sugar and increasingly for biofuel production. In the Philippines, Republic Act 10659 promotes farmer income through improved productivity, product diversification, and mill modernization. The ratoon crop — new shoots arising from the root system after main crop harvest — contributes substantially to overall production, as it reduces the cost and labor associated with replanting. However, ratoon crops are heavy feeders requiring timely nutrient management to sustain yields across successive cropping cycles (Singh et al., 2015).

Conventional synthetic fertilizers, while effective, impose significant production costs and environmental burdens. Organic and biofertilizer alternatives have therefore attracted increasing attention as cost-effective and ecologically sound supplements or substitutes. Biossa Agri Enzyme, an enzyme-based biofertilizer, has demonstrated capacity to improve soil nutrient availability, enhance microbial activity, and support plant growth (Maambong, 2023; Nosheen et al., 2021). Swamp Cabbage Extract (SCE), derived from *Ipomoea aquatica*, is a fermented plant juice rich in nitrogen, phosphorus, potassium, calcium, and protein, which promotes plant growth, improves leaf greenness, and enhances tiller production when applied as an organic foliar fertilizer (Gebana, 2023; Tacdrup, 2002 as cited in Gebana, 2023).

Despite the documented potential of both inputs on various crops, empirical evidence on their combined effects on sugarcane ratoon performance — particularly for the locally important PSR 2000-171 variety — remains limited. This study therefore aimed to determine the individual and interactive effects of varying levels of Biossa Agri Enzyme and Swamp Cabbage Extract on the ratoon growth and estimated yield of sugarcane variety PSR 2000-171, and to identify the optimal treatment combination for maximizing agronomic performance under organic input management.

5. MATERIALS AND METHODS

Study Location and Period

The experiment was conducted from January to March 2025 at La Suerte, M'lang, North Cotabato (approximately 6.8910°N, 124.9657°E; elevation ~58 m above sea level). The soil at the experimental site was clay loam.

Experimental Design and Treatments

The study was laid out in a factorial split-plot design arranged in a Randomized Complete Block Design (RCBD) with three replications. The total experimental area was 63.08 m², subdivided into three blocks, each containing 16 subplots (1 m × 1 m each, separated by 0.2-m alleys). The main plot treatment was Bioassa Agri Enzyme at four levels: B0 (control, 0 mL/L), B1 (3.25 mL/L), B2 (6.25 mL/L), and B3 (9.25 mL/L of water). The sub-plot treatment was Swamp Cabbage Extract at four levels: S0 (control, 0 mL/L), S1 (10 mL/L), S2 (20 mL/L), and S3 (30 mL/L of water).

Preparation of Swamp Cabbage Extract

Swamp cabbage (*Ipomoea aquatica*) was harvested at the early vegetative stage (8–10 inches height) and chopped into 2–3 cm pieces. The chopped material was mixed with brown sugar in a 2:1 ratio (8 kg cabbage: 4 kg sugar), placed in an airtight container, covered with bond paper, and stored in a cool, dark location. After 21 days of fermentation, the liquid was extracted through squeezing and straining, then stored in a clean, sealed bottle.

Application of Treatments

Bioassa Agri Enzyme was obtained from Matalam, Cotabato. Both treatments were dissolved in water at designated concentrations and applied as foliar sprays using a hand sprayer. The first application was made 60 days after stubble shaving, between 5:00–6:00 AM. Subsequent applications followed at 15-day intervals (second and third applications).

Cultural Management

After harvest, stubble shaving was performed followed by off-barring to stimulate secondary root development. Manual weeding was conducted after off-barring and weekly thereafter. Insect pest and disease monitoring was performed regularly throughout the study period. No synthetic pesticides were applied.

Data Collected

Five agronomic parameters were measured: (1) Plant height (cm) — measured from the base to the tip of the tallest leaf using a steel tape; (2) Number of leaf storeys — counted manually at study termination; (3) Number of tillers/shoots — counted from sample plants at study termination; (4) Stalk diameter (cm) — measured using a caliper; and (5) Estimated yield (mt/ha) — calculated using the formula $ASW = 0.13698 \times (D \times H)^{1.2965}$, where H = average stalk height and D = average stalk diameter.

Statistical Analysis

Data were analyzed using the Statistical Tool for Agricultural Research (STAR). Analysis of Variance (ANOVA) was computed at 5% and 1% significance levels. Differences among treatment means were compared using the Least Significant Difference (LSD) test.

RESULTS AND DISCUSSION

Plant Height (cm)

The highest plant height was recorded in B3 (200.69 cm), followed by B2 (189.00 cm) and B1 (186.35 cm), while B0 (control) produced the shortest plants (164.06 cm). Among Swamp Cabbage Extract treatments, S3 produced the tallest plants (198.11 cm), followed by S1 (190.56 cm) and S2 (183.92 cm), with S0 recording the lowest (167.50 cm). Both Bioassa Agri Enzyme ($p = 0.0000$) and Swamp Cabbage Extract ($p = 0.0000$) showed highly significant individual effects on plant height. The interaction between the two treatments, however, was not significant ($p = 0.9739$), indicating that the two factors independently drive plant height improvement. These findings align with Sime (2015), who reported that higher organic foliar fertilizer rates result in increased plant height, and with Sugiono et al. (2020), who confirmed that organic fertilizers significantly affect plant height under biofertilizer treatments.

Table 1. Mean Plant Height (cm) of Sugarcane PSR 2000-171 by Treatment.

Treatment (Bioassa)	S0 (Control)	S1 (10 mL/L)	S2 (20 mL/L)	S3 (30 mL/L)	Mean
B0 (Control)	146.11	164.56	166.22	179.33	164.06 c
B1 (3.25 mL/L)	166.67	195.00	184.56	199.22	186.36 b
B2 (6.25 mL/L)	174.78	198.11	185.78	197.33	189.00 b
B3 (9.25 mL/L)	182.44	204.67	199.11	216.56	200.69 a
Mean	167.50 c	190.58 ab	183.92 b	198.11 a	185.03

Means with the same letter superscripts are not significantly different (LSD test, $p < 0.05$).
CV(a)%=5.43; CV(b)%=10.72

Number of Leaf Storeys

B3 produced the highest mean leaf storey count (11.50), followed by B2 (10.58) and B1 (10.53), with B0 recording the lowest (8.47). For Swamp Cabbage Extract, S3 had the highest mean (11.36), followed by S1 (10.67) and S2 (10.42), with S0 having the lowest (8.64). Both Bioassa Agri Enzyme ($p = 0.0004$) and Swamp Cabbage Extract ($p = 0.0000$) showed highly significant effects on leaf storey count. The interaction between the two treatments was not statistically significant ($p = 0.1215$). These results support the findings of Tacdrup (2002) as

cited by Gebana (2023), who reported that fermented plant juice from swamp cabbage promotes healthier and faster plant growth, producing more robust and greener leaves. Martin et al. (2022) similarly affirmed that biofertilizers influence plant performance by regulating intraspecific leaf characteristics.

Table 2. Mean Number of Leaf Storeys of Sugarcane PSR 2000-171 by Treatment

Treatment (Biossa)	S0 (Control)	S1 (10 mL/L)	S2 (20 mL/L)	S3 (30 mL/L)	Mean
B0 (Control)	7.22	8.11	8.89	9.67	8.47 c
B1 (3.25 mL/L)	8.78	11.11	10.11	12.11	10.53 b
B2 (6.25 mL/L)	8.33	12.00	10.56	11.44	10.58 b
B3 (9.25 mL/L)	10.22	11.44	12.11	12.22	11.50 a
Mean	8.64 c	10.67 ab	10.42 b	11.36 a	10.27

Means with the same letter superscripts are not significantly different (LSD test, $p < 0.05$).
CV(a)%=13.12; CV(b)%=14.58

Number of Tillers/Shoots

B3 produced the most tillers (12.11), followed by B1 (10.58) and B2 (10.53), with B0 recording the fewest (7.06). Among Swamp Cabbage Extract treatments, S3 produced the highest mean tiller count (12.42), followed by S2 (10.58) and S1 (9.50), with S0 the lowest (7.78). Both Biossa Agri Enzyme ($p = 0.0035$) and Swamp Cabbage Extract ($p = 0.0000$) showed highly significant effects on tiller production; however, the interaction was not significant ($p = 0.6384$). These findings are consistent with Al-Zubaidi et al. (2020), who reported that biofertilizer application benefits tiller production in sugarcane, and with Silva et al. (2022), who confirmed that number of tillers is a key yield component in sugarcane and that foliar nutrient application enhances metabolic processes contributing to tiller development.

Table 3. Mean Number of Tillers/Shoots of Sugarcane PSR 2000-171 by Treatment

Treatment (Biossa)	S0 (Control)	S1 (10 mL/L)	S2 (20 mL/L)	S3 (30 mL/L)	Mean
B0 (Control)	5.56	6.56	7.56	8.56	7.06 b
B1 (3.25 mL/L)	7.78	9.78	11.33	13.44	10.58 a
B2 (6.25 mL/L)	7.22	11.00	10.89	13.00	10.53 a
B3 (9.25 mL/L)	10.56	10.67	12.56	14.67	12.11 a
Mean	7.78 c	9.50 b	10.58 b	12.42 a	10.07

Means with the same letter superscripts are not significantly different (LSD test, $p < 0.05$).
CV(a)%=33.12; CV(b)%=26.42

Stalk Diameter (cm)

B3 recorded the widest mean stalk diameter (2.82 cm), followed by B2 (2.36 cm) and B1 (2.19 cm), with B0 recording the smallest (1.59 cm). Similarly, S3 produced the widest stalk (2.58 cm), followed by S1 (2.36 cm) and S2 (2.33 cm), while S0 recorded the narrowest (1.69 cm). Individual applications of Bioassa Agri Enzyme ($p = 0.0000$) and Swamp Cabbage Extract ($p = 0.0000$) showed highly significant effects, while their interaction was not significant ($p = 0.5847$). These findings are consistent with Silva et al. (2022) and Castro (2023), who documented that liquid and organic fertilizer application improves stalk girth and cane yield, particularly under low-rainfall conditions. Yara (2021) further affirmed that foliar application enhances stalk diameter by addressing nutrient deficiencies when soil availability is limited.

Table 4. Mean Stalk Diameter (cm) of Sugarcane PSR 2000-171 by Treatment

Treatment (Bioassa)	S0 (Control)	S1 (10 mL/L)	S2 (20 mL/L)	S3 (30 mL/L)	Mean
B0 (Control)	1.08	1.68	1.62	1.99	1.59 c
B1 (3.25 mL/L)	1.50	2.29	2.31	2.64	2.19 b
B2 (6.25 mL/L)	1.66	2.51	2.50	2.76	2.36 b
B3 (9.25 mL/L)	2.52	2.96	2.88	2.91	2.82 a
Mean	1.69 c	2.36 ab	2.33 b	2.58 a	2.24

Means with the same letter superscripts are not significantly different (LSD test, $p < 0.05$).
CV(a)%=15.76; CV(b)%=21.89

Estimated Yield (mt/ha)

B3 produced the highest estimated yield (353.00 mt/ha), followed by B2 (255.65 mt/ha) and B1 (230.38 mt/ha), while B0 recorded the lowest (98.09 mt/ha). Among SCE treatments, S3 yielded the highest (338.13 mt/ha), followed by S2 (245.84 mt/ha) and S1 (228.66 mt/ha), with S0 the lowest (124.50 mt/ha). Both factors showed highly significant effects individually (Bioassa: $p = 0.0002$; SCE: $p = 0.0000$), while the interaction was not significant ($p = 0.5536$). These results are consistent with Al-Zubaidi et al. (2020) and Sinha et al. (2024), who demonstrated that organic and biofertilizer application at optimal levels significantly enhances sugarcane yield. The high estimated yields in B3+S3 indicate that integrated

organic input management at higher concentrations provides the nutritional foundation necessary for superior ratoon crop productivity.

Table 5. Mean Estimated Yield (mt/ha) of Sugarcane PSR 2000-171 by Treatment

Treatment (Biossa)	S0 (Control)	S1 (10 mL/L)	S2 (20 mL/L)	S3 (30 mL/L)	Mean
B0 (Control)	45.80	91.73	103.53	151.31	98.09 c
B1 (3.25 mL/L)	100.01	222.42	239.07	360.01	230.38 b
B2 (6.25 mL/L)	108.89	271.01	268.50	374.21	255.65 b
B3 (9.25 mL/L)	243.32	329.48	372.24	466.98	353.00 a
Mean	124.50 c	228.66 b	245.84 b	338.13 a	234.28

Means with the same letter superscripts are not significantly different (LSD test, $p < 0.05$).
CV(a)%=42.91; CV(b)%=44.63

CONCLUSION

The application of Biossa Agri Enzyme at 9.25 mL/L (B3) and Swamp Cabbage Extract at 30 mL/L (S3) consistently produced the highest values across all measured agronomic parameters of sugarcane ratoon variety PSR 2000-171, including plant height (200.69 cm), leaf storeys (11.50), tillers (12.11), stalk diameter (2.82 cm), and estimated yield (353.00 mt/ha). Both treatments showed highly significant individual effects on all parameters, while their interaction was not statistically significant, indicating that each input independently and effectively enhances ratoon performance. The null hypothesis was rejected for all parameters. These findings support the use of B3+S3 as the optimal treatment combination for enhancing sugarcane ratoon productivity and demonstrate the potential of locally available organic inputs as sustainable alternatives to conventional synthetic fertilizers in the North Cotabato sugarcane production context.

ACKNOWLEDGEMENTS

The author expresses sincere gratitude to the sugarcane farmers of La Suerte, M'lang, North Cotabato, and to the [Institution Name] for their support in the conduct of this study. Special appreciation is extended to the Agricultural Technology staff and all individuals who contributed to the completion of the research.

9. REFERENCES

1. Al-Zubaidi, F., & Al Mubarak, H. (2020). Application of biofertilizer on sugarcane tillers and yield at the tillering stage. *Journal of Agricultural Research*, 57(2), 88-97.

2. Canellas, L. P., da Silva, S. F., Olk, D. C., & Olivares, F. L. (2015). Humic and fulvic acids as biostimulants in horticulture. *Scientia Horticulturae*, 196, 15–27.
3. Castro, P. R. (2023). Liquid fertilizer and early application in sugarcane harvest season. *Brazilian Journal of Sugar Research*, 12(1), 45–59.
4. Gebana, M. S. (2023). Effects of swamp cabbage extract on the growth and yield performance of sugarcane [Undergraduate thesis]. Cotabato Foundation College of Science and Technology.
5. Maambong, A. (2023). Effects of Biossa Agri Enzyme on the agronomic characteristics of sugarcane PSR 2002-39 [Undergraduate thesis]. North Cotabato Agri-Industrial College.
6. Martin, C., et al. (2022). Biofertilizer application and intraspecific leaf characteristics in sugarcane. *Plant Biology Journal*, 24(3), 301-310.
7. Mohd Zaini, M., et al. (2022). Biofertilizers: Production, benefits, and limitations. *Applied Microbiology and Biotechnology Reviews*, 10(1), 55-72.
8. Nosheen, A., et al. (2021). Microbes as biofertilizers: A potential approach for sustainable crop production. *Frontiers in Microbiology*, 12, 1–18.
9. PCARRD. (2020). Organic matter and soil biological activity. Philippine Council for Agriculture and Resources Research and Development Technical Bulletin No. 198.
10. Sime, W. (2015). Effect of organic foliar fertilizer application rates on plant height of sugarcane. *East African Journal of Agricultural Sciences*, 8(2), 112-120.
11. Silva, G. M., et al. (2022). Plant height, stalk diameter, and tiller number as sugarcane yield components. *Industrial Crops and Products*, 178, 114–126.
12. Singh, P., et al. (2015). Integrated nutrient management for sustainable sugarcane ratoon production. *Sugar Tech*, 17(4), 340-350.
13. Sinha, S., et al. (2024). Integrated nutrient management with biofertilizers and organic waste for improved sugarcane yield. *Agriculture*, 14(2), 203.
14. Sugiono, D., et al. (2020). Effect of organic fertilizer on plant height, leaf area, and tiller count of sugarcane. *Agronomy Journal*, 112(3), 1895-1905.
15. Tacdrup, R. (2002). Fermented plant juice from swamp cabbage and its effects on plant growth. As cited in Gebana (2023). Cotabato Foundation College of Science and Technology.
16. Yara. (2021). Foliar nutrition in sugarcane ratoon crops: Addressing nutrient deficiencies. *Yara International Technical Bulletin* 15.