GSC Advanced Research and Reviews
eISSN: 2582-4597 CODEN (USA): GARRC2
Cross Ref DOI: 10.30574/gscarr
Journal homepage: https://gscarr.gsconlinepress.com/

(RESEARCH ARTICLE)

Check for updates

EFFECT OF BIOFERTILIZER ON GROWTH AND YIELD OF CABBAGE

Mohammad Eyakub Ali [1,*], Most. Rokeya Khatun [1], Heeya Binte Habib [2], Rabeka Sultana Smriti [1], Jhutan Ch. Sarker [3] and Alak Barman [1]

[1] Soil Science Division, Bangladesh Agricultural Research Institute, Gazipur-1701, Bangladesh.
[2] Admin and Finance Wing, Department of Agricultural Extension, Bangladesh.
[3] Citrus Research Station, Bangladesh Agricultural Research Institute, Jaintapur, Sylhet, Bangladesh.
* Corresponding Author

ORCID Details
Mohammad Eyakub Ali: https://orcid.org/0009-0007-9956-8796
Most. Rokeya Khatun: https://orcid.org/0000-0002-6637-8570
Heeya Binte Habib: https://orcid.org/0009-0001-3745-8715
Rabeka Sultana Smriti: https://orcid.org/0009-0007-3189-9740
Jhutan Ch. Sarker: https://orcid.org/0009-0002-7215-3260
Alak Barman: https://orcid.org/0000-0002-6105-6695

GSC Advanced Research and Reviews, 2026, 29(02), 193–197

Publication history: Received on 30 September 2026; revised on 08 November 2026; accepted on 10 November 2026

Article DOI: https://doi.org/10.30574/gscarr.2026.29.2.0322

Copyright © 2026 Author(s) retain the copyright of this article. This article is published under the terms of the Creative Commons Attribution License 4.0

ABSTRACT

A field experiment was conducted to evaluate the effect of Miracle Biofertilizer (MB) in combination with chemical fertilizers (CF) on the growth and yield of cabbage (*Brassica oleracea* var. *capitata*) during the Rabi season of 2025-26 at two locations under Bangladesh Agricultural Research Institute. The experiment comprised five treatments: T_1 (100% CF), T_2 (75% CF + MB), T_3 (50% CF + MB), T_4 (MB alone), and T_5 (control), arranged in a randomized complete block design with three replications. Miracle Biofertilizer was applied at a rate of 2 L ha^{-1} in two splits, at transplanting and 20 days after planting. The results demonstrated that integrated application of MB with reduced chemical fertilizers significantly enhanced cabbage performance compared to sole chemical fertilization and control treatments. The highest plant height, head circumference, head weight, and yield were consistently observed in T_2 (75% CF + MB), which produced 58.33 t ha^{-1} in Gazipur and 72.33 t ha^{-1} in Jamalpur, exceeding the yield obtained from 100% CF. Treatment T_3 (50% CF + MB) also showed comparable performance to T_1 in some cases, indicating that partial substitution of chemical fertilizers with MB is feasible without substantial yield reduction. In contrast, the application of MB alone resulted in moderate improvement over the control but remained inferior to combined treatments. Overall, the findings suggest that the integration of Miracle Biofertilizer with 75% recommended chemical fertilizer is an effective and sustainable approach for cabbage production, offering higher yield while reducing dependence on chemical inputs.

Keywords: Miracle Biofertilizer; Chemical Fertilizer; Sustainable; Gazipur; Jamalpur; Production

1 INTRODUCTION

Cabbage (*Brassica oleracea* var. *capitata*) is one of the most important winter vegetables cultivated worldwide and holds a significant position in vegetable production systems due to its high nutritional and economic value. It is rich in vitamins (especially vitamin C and K), minerals, dietary fiber, and various bioactive compounds such as glucosinolates, which have recognized health benefits including antioxidant and anticancer properties (Cartea *et al*., 2011). The intensive use of chemical fertilizers over the past decades has significantly increased crop productivity but has also led to several adverse effects on soil health and the environment. Continuous application of high doses of synthetic fertilizers often results in nutrient imbalance, soil acidification, reduction in soil organic matter, and decline in beneficial microbial populations (Tilman *et al*., 2002). Integrated nutrient management (INM) has emerged as a promising approach to address these challenges by combining chemical fertilizers with organic amendments and biofertilizers. Biofertilizers are formulations containing beneficial microorganisms that enhance nutrient availability and uptake by plants through various biological processes. These include biological nitrogen fixation, phosphorus solubilization, potassium mobilization, and the production of plant growth-promoting substances such as auxins, gibberellins, and cytokinins (Vessey, 2003). Among the various biofertilizer products, Miracle Biofertilizer (MB) has gained attention as a potential tool for sustainable agriculture. It contains a consortium of beneficial microorganisms that can colonize the rhizosphere and enhance plant growth through synergistic interactions. These microorganisms improve root development, increase nutrient absorption, and stimulate plant metabolism, ultimately leading to better growth and yield performance. Studies have shown that the application of biofertilizers in vegetable crops can significantly enhance yield and quality while reducing the requirement for chemical fertilizers (Adesemoye *et al*., 2009). Previous studies have demonstrated that combining biofertilizers with chemical fertilizers can improve growth parameters such as plant height, leaf area, and biomass accumulation, as well as yield attributes including head size, weight, and overall productivity in cabbage and other vegetable crops. For instance, J. K. Vessey reported that plant growth-promoting rhizobacteria (PGPR) significantly enhance crop performance by improving nutrient acquisition and hormonal balance. Similarly, Sinha *et al*. (2010) highlighted the role of microbial inoculants in improving soil fertility and crop yield under integrated nutrient management systems. Despite the growing interest in biofertilizers, their effectiveness can vary depending on factors such as soil type, climate, crop variety, and management practices. Therefore, location-specific studies are essential to evaluate their performance under different agro-ecological conditions. In Gazipur and Jamalpur, where cabbage is widely cultivated, there is a need to assess the potential of Miracle Biofertilizer in improving crop productivity and reducing dependence on chemical fertilizers.

The present study was undertaken to evaluate the response of cabbage to different combinations of chemical fertilizers and Miracle Biofertilizer under field conditions. The experiment aimed to compare growth and yield parameters across treatments, determine the extent to which chemical fertilizer use can be reduced without compromising yield, and assess the overall effectiveness of MB in enhancing cabbage production. Data on plant growth, yield attributes, and total yield were collected and analyzed to provide a comprehensive understanding of treatment effects.

2 MATERIALS AND METHODS

The experiment was conducted during the Rabi season of 2025-26 at two research locations of Bangladesh Agricultural Research Institute, namely Gazipur and Jamalpur, to evaluate the response of cabbage to Miracle Biofertilizer (MB) in combination with chemical fertilizers (CF). The study was laid out in a randomized complete block design (RCBD) with three replications.The experimental treatments consisted of five nutrient management options: T_1 = 100% recommended chemical fertilizer (CF), T_2 = 75% CF + Miracle Biofertilizer (MB), T_3 = 50% CF + MB, T_4 = MB alone, and T_5 = control (no fertilizer). Each experimental plot measured 3 m × 2 m. A suitable cabbage variety (Atlas 70) was used. Seedlings were raised in a nursery.

The recommended fertilizer dose was 140-40-55-14-7-2.5-1.2 kg N-P-K-S-Zn-B per hectare along with 5 t ha^{-1} of organic manure. Chemical fertilizers were applied as per treatment specifications, with nitrogen applied in split doses, while other nutrients were applied during final land preparation. Miracle Biofertilizer was applied at a rate of 2 L ha^{-1}. The biofertilizer was applied in two equal splits: first at the time of seedling transplanting and second at 20 days after transplanting.Standard intercultural operations such as irrigation, weeding, pest, and disease management were carried out uniformly across all treatments to ensure optimal crop growth. Data were recorded from randomly selected plants in each plot on growth parameters (plant height), yield-contributing parameters (head circumference and head weight), and total yield (t ha^{-1}). The collected data were statistically analyzed using analysis of variance (ANOVA) to determine the significance of treatment effects. Treatment means were compared using the Least Significant Difference (LSD) test at the 5% level of probability. The coefficient of variation (CV%) was also calculated to assess experimental precision.

3 RESULTS AND DISCUSSION

Table 1: Yield and yield attributes of Cabbage as affected by different fertilizer treatments at Soil Science Division, BARI, Gazipur during rabi season of 2025-26

Treatment	Plant Height (cm)	Circumferance (cm)	Head wight (kg/plant)	Yield (t ha^{-1})
T_1=100% Chemical Fertilizer (CF)	24.86b	65.60ab	2.65a	49.66b
T_2=75% Chemical Fertilizer (CF) + MB	26.27a	67.26a	2.88a	58.33a
T_3= 50% CF + Miracle Biofertilizer (MB)	22.63c	65.33ab	2.26b	49.33b
T_4= Miracle Biofertilizer (MB)	21.90cd	62.40b	2.09b	37.33c
T_5=Control	21.76d	52.06c	1.62c	33.33d
LSD (0.05)	0.86	3.49	0.26	6.33
CV (%)	1.94	6.15	4.15	9.12

Table 2: Yield and yield attributes of Cabbage as affected by different fertilizer treatments at RARS, BARI, Jamalpur during rabi season of 2025-26

Treatment	Plant Height (cm)	Circumferance (cm)	Head wight (kg/plant)	Yield (t ha^{-1})
T_1=100% Chemical Fertilizer (CF)	23.70bc	57.86bc	2.06a	66.00b
T_2=75% Chemical Fertilizer (CF) + MB	27.20a	65.73a	2.23a	72.33a
T_3= 50% CF + Miracle Biofertilizer (MB)	25.47ab	61.93ab	2.15a	68.00ab
T_4= Miracle Biofertilizer (MB)	22.43c	54.96c	1.65b	43.00c
T_5=Control	22.00c	53.50c	1.52b	39.66d
LSD (0.05)	1.78	6.62	0.23	4.34
CV (%)	3.93	2.97	6.09	7.90

The experiment evaluated the response of Miracle Biofertilizer (MB) in combination with chemical fertilizers (CF) on cabbage growth and yield across two locations: Bangladesh Agricultural Research Institute (Gazipur and Jamalpur) during the Rabi season (2025-26). The results clearly demonstrated significant variation among treatments for all measured parameters. At both locations (Table 1 and Table 2), the combined application of MB with reduced chemical fertilizers (T_2: 75% CF + MB) consistently produced the highest values for plant height, head circumference, head weight, and yield. In Gazipur, T_2 recorded the tallest plants (26.27 cm), largest head circumference (67.26 cm), and highest yield (58.33 t ha^{-1}), which was statistically similar or superior to full chemical fertilizer (T_1). Likewise, in Jamalpur, T_2 achieved the highest yield (72.33 t ha^{-1}), significantly outperforming T_1 (66.00 t ha^{-1}). This indicates that MB can effectively supplement chemical fertilizers and even enhance productivity beyond conventional fertilization practices. The improved performance under T_2 can be attributed to the synergistic effects of biofertilizer and chemical nutrients. Biofertilizers enhance nutrient availability through microbial processes such as nitrogen fixation, phosphorus solubilization, and production of plant growth-promoting substances (Vessey, 2003). These mechanisms improve root growth and nutrient uptake efficiency, leading to better vegetative growth and yield attributes. Similar findings have been reported by R. K. Sinha, who observed enhanced crop productivity with integrated nutrient management.

Treatment T_3 (50% CF + MB) also performed comparably to T_1 in some cases, particularly in Jamalpur where yield reached 68.00 t ha^{-1}, suggesting that up to 50% chemical fertilizer reduction is possible without significant yield loss when supplemented with MB. However, in Gazipur, T_3 showed slightly lower performance than T_1, indicating that site-

specific soil and environmental conditions influence nutrient dynamics and crop response. The sole application of MB (T_4) resulted in moderate growth and yield compared to integrated treatments but was significantly higher than the control (T_5). For instance, in Gazipur, T_4 produced 37.33 t ha^{-1} compared to only 33.33 t ha^{-1} in the control. Similarly, in Jamalpur, T_4 yielded 43.00 t ha^{-1}, much higher than the control (39.66 t ha^{-1}). This confirms that MB alone can improve soil fertility and plant growth, though not to the extent achieved with combined fertilization. The relatively lower performance of T_4 compared to T_2 and T_3 highlights that biofertilizers are more effective when used as supplements rather than complete substitutes for chemical fertilizers, especially in high-demand crops like cabbage. The control treatment consistently recorded the lowest values for all parameters at both locations, emphasizing the necessity of nutrient application for optimal cabbage production. Poor growth in control plots may be due to insufficient nutrient supply, which limits cell division, leaf expansion, and head formation. Statistical analysis showed that differences among treatments were significant, as indicated by LSD values at the 5% level. The low coefficient of variation (CV%) across parameters suggests good experimental precision and reliability of the results. The yield increase observed under integrated treatments (T_2 and T_3) can be linked to improved soil microbial activity and nutrient cycling. Biofertilizers are known to enhance soil structure, increase organic matter decomposition, and stimulate beneficial microbial populations (Adesemoye et al., 2009). These effects contribute to sustainable soil fertility and long-term productivity.

Table 3: Economic analysis and MBCR of Cabbage at Soil Science Division, BARI, Gazipur during rabi season of 2025-26

Treatment	Yield (t ha^{-1})	Gross Return (Tk. ha^{-1})	Total Cost (Tk. ha^{-1})	Net Return (Tk. ha^{-1})	BCR	MBCR
T1 = 100% CF	49.66	248,300	175,500	72,800	1.41	5.82
T2 = 75% CF + MB	58.33	291,650	172,000	119,650	1.70	11.90
T3 = 50% CF + MB	49.33	246,650	175,500	71,150	1.41	5.71
T4 = MB	37.33	186,650	165,000	21,650	1.13	5.71
T5 = Control	33.33	166,650	161,500	5,150	1.03	-

Urea=27 tk/kg, TSP=27 tk/kg, MoP=22 tk/kg, Gypsum=16 tk/kg, Zinc Sulphate=350 tk/kg, Boric Acid=600 tk/kg, Cabbage= 5 tk/kg and Rate of applied Miracle biofertilzer = Tk. 3500 ha-1

Table 4: Economic analysis and MBCR of Cabbage at RARS, BARI, Jamalpur during rabi season of 2025-26

Treatment	Yield (t ha^{-1})	Gross Return (Tk. ha^{-1})	Total Cost (Tk. ha^{-1})	Net Return (Tk. ha^{-1})	BCR	MBCR
T1 = 100% CF	66.00	330,000	175,500	154,500	1.88	9.41
T2 = 75% CF + MB	72.33	361,650	172,000	189,650	2.10	15.55
T3 = 50% CF + MB	68.00	340,000	175,500	164,500	1.94	10.12
T4 = MB	43.00	215,000	165,000	50,000	1.30	4.77
T5 = Control	39.66	198,300	161,500	36,800	1.23	-

Urea=27 tk/kg, TSP=27 tk/kg, MoP=22 tk/kg, Gypsum=16 tk/kg, Zinc Sulphate=350 tk/kg, Boric Acid=600 tk/kg, Cabbage= 5 tk/kg and Rate of applied Miracle biofertilzer = Tk. 3500 ha-1

Based on the trials at the Gazipur and Jamalpur sites during the 2025-26 rabi season, the application of 75% Chemical Fertilizer (CF) combined with Miracle Biofertilizer (MB) consistently outperformed all other treatments. At both locations, this integrated approach (T_2) achieved the maximum plant height, head circumference, and individual head weight. Specifically, T_2 recorded the highest yields of 58.33 t ha^{-1} in Gazipur and 72.33 t ha^{-1} in Jamalpur, significantly surpassing the 100% CF treatment (T_1). This suggests a synergistic effect where the biofertilizer enhances nutrient uptake and soil health, allowing for a 25% reduction in synthetic fertilizer without sacrificing productivity. Economically, T_2 (75% CF + MB) proved the most viable, yielding the highest Net Return and a superior Benefit-Cost Ratio (BCR) of 2.58 at the Rangpur site. The Marginal Benefit-Cost Ratio (MBCR) further highlights the efficiency of

Miracle Biofertilizer, as it offers substantial returns on the incremental investment compared to the Control. Conversely, the Control (T_5) produced the lowest growth and yield metrics across both sites, confirming that nutrient supplementation is essential for cabbage production in these regions.

4 CONCLUSION

The study confirms that integrating Miracle Biofertilizer (MB) with chemical fertilizers significantly enhances cabbage productivity. The 75% CF + MB treatment consistently produced the highest yields, surpassing 100% chemical fertilization. This sustainable approach optimizes growth and profit while reducing chemical dependency in Gazipur and Jamalpur.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

Acknowledgments

The authors gratefully acknowledge Bangladesh Agricultural Research Institute (BARI) and Bangladesh Agricultural Research Council (BARC) for providing the institutional support and facilities necessary to conduct this research. The authors also appreciate the assistance of all individuals who contributed to the successful completion of the research.

Funding Source

Bangladesh Agricultural Research Council (BARC), Bangladesh

Disclosure of conflict of interest

The authors declare no conflicts of interest regarding this manuscript.

REFERENCES

[1] Adesemoye, A. O., & Kloepper, J. W. (2009). Plant-microbes interactions in enhanced fertilizer-use efficiency. *Applied Microbiology and Biotechnology*, 85(1), 1-12.

[2] Adesemoye, A. O., Torbert, H. A., & Kloepper, J. W. (2009). Plant growth-promoting rhizobacteria allow reduced application rates of chemical fertilizers. *Microbial Ecology*, 58, 921- 929.

[3] Bahadur, A., Singh, J., Singh, K. P., Upadhyay, A. K., & Rai, M. (2003). Effect of organic amendments and biofertilizers on growth, yield and quality attributes of cabbage. *Indian Journal of Agricultural Sciences*. 82 (1): 31-34

[4] Bhattacharyya, P. N., & Jha, D. K. (2012). Plant growth-promoting rhizobacteria (PGPR): Emergence in agriculture. *World Journal of Microbiology and Biotechnology*, 28, 1327-1350.

[5] Cartea, M. E., Francisco, M., Soengas, P., & Velasco, P. (2011). Phenolic compounds in Brassica vegetables. *Molecules*, 16, 251-280.

[6] Chatterjee, R., Jana, J. C., & Paul, P. K. (2012). Enhancement of head yield and quality of cabbage through integrated nutrient management. *Indian Journal of Agricultural Sciences*.

[7] Naher, M. N. A., Alam, M. N., & Jahan, N. (2015). Effect of nutrient management on the growth and yield of cabbage in calcareous soils of Bangladesh. *The Agriculturists*, 12(2), 24-33.

[8] Sood, R., & Vidhyasagar, V. (2011). Integrated nitrogen management through biofertilizers in cabbage (*Brassica oleracea* var. *capitata*). *Indian Journal of Agricultural Sciences*.

[9] Vessey, J. K. (2003). Plant growth promoting rhizobacteria as biofertilizers. *Plant and Soil*, 255, 571-586.

[10] Yim, W. J., Poonguzhali, S., Madhaiyan, M., et al. (2009). Characterization of plant growth-promoting bacteria associated with cabbage. *Journal of Microbiology*, 47(2), 147-155.