

Effect of Inorganic Fertilizer Levels and Application Strategies on Growth, Yield, and Quality of Cabbage (*Brassica oleracea* var. *capitata* L.)

¹Dr. Jitendra Kumar, ¹Dr. Sarvesh Kumar, ¹Dr. Ashish Srivastav, and ¹Dr. Vinay Joseph silas

Faculty of Agricultural Sciences and Allied Industries, Rama University, Mandhana, Kanpur, Uttar Pradesh 209217, India Jitendrakumar.fas@ramauniversity.ac.in

Abstract

*A field experiment was conducted to assess the influence of various levels and methods of inorganic fertilizer application on the growth, yield, quality, and economics of cabbage (*Brassica oleracea* var. *capitata* L.) during the 2025–2026 rabi season at Rama University, Kanpur. Nine treatments comprising control, graded doses of recommended dose of fertilizer (RDF) from 50% to 150%, split application of nitrogen, foliar micronutrients, and foliar urea were evaluated in a Randomized Block Design with three replications. Growth and yield parameters improved progressively with increasing fertilizer levels up to 125% RDF. The most effective treatment was 100% RDF supplemented with two foliar sprays of micronutrients (Zn and B at 0.5% each), which recorded the highest plant height (66.8 cm), head diameter (19.2 cm), fresh head weight (1230.5 g), and marketable yield (307.6 q ha⁻¹). This treatment also produced superior quality attributes, including TSS of 7.0 °Brix, ascorbic acid content of 64.1 mg/100 g, and compactness index of 0.95. Application of 150% RDF resulted in a slight decline in performance. Economically, the treatment with 100% RDF + foliar micronutrients gave the highest net returns of ₹2,25,320 per hectare with a B:C ratio of 2.57, while 75% RDF combined with foliar urea sprays recorded the best benefit-cost ratio of 2.61.*

Keywords: Cabbage, inorganic fertilizers, foliar micronutrients, zinc, boron, split nitrogen, yield, quality, economics.

Introduction

Cabbage (*Brassica oleracea* var. *capitata*) is a popular cool-season vegetable belonging to the Brassicaceae family. It is widely appreciated for its dense, nutrient-dense heads that are rich in vitamins (particularly vitamin C and K), minerals, dietary fibre, and antioxidants. Being a heavy nutrient feeder, cabbage requires balanced fertilization to achieve optimal vegetative growth, head compactness, yield, and quality. Globally, cabbage production stood at approximately 74 million tonnes in 2023, with China and India being the major producers. In India, production was around 10 million tonnes from 412,000 hectares during 2023-24,

with an average productivity of about 23 t ha⁻¹.

Inorganic fertilizers play a vital role in supplying readily available nitrogen, phosphorus, and potassium, which promote rapid growth and higher yields in cabbage. However, excessive use of chemical fertilizers can lead to nutrient imbalances, delayed maturity, and deterioration in quality. The present investigation was therefore undertaken to study the effect of different levels and application strategies of inorganic fertilizers (including graded doses, split nitrogen application, and foliar supplementation) on growth, yield, quality, and economics of cabbage under the agro-

climatic conditions of Kanpur. The specific objectives of the study were to evaluate the impact of inorganic fertilizers on growth and yield of cabbage and to assess the economics of different fertilizer treatments.

Research Methodology

The experiment was carried out during the rabi season of 2025–2026 at the research farm of the Faculty of Agricultural Sciences and Allied Industries, Rama University, Mandhana, Kanpur (26.5697° N, 80.2169° E). The soil of the experimental site was sandy loam in texture with pH 7.9, EC 0.42 dS m⁻¹, organic carbon 0.48%, available N 210 kg ha⁻¹, P₂O₅ 22 kg ha⁻¹, and K₂O 245 kg ha⁻¹.

The experiment was laid out in a Randomized Block Design with nine treatments and three replications. The plot size was 3 m × 2.5 m. The recommended dose of fertilizer (RDF) for cabbage was 120:60:60 kg N:P:K ha⁻¹. The treatments were: T₀ – Control (no fertilizer) T₁ – 50% RDF T₂ – 75% RDF T₃ – 100% RDF T₄ – 125% RDF T₅ – 150% RDF T₆ – 100% RDF with split nitrogen application (50% at 15 and 30 DAT) T₇ – 100% RDF + two foliar sprays of micronutrients (Zn & B @ 0.5% each at 30 and 45 DAT) T₈ – 75%

RDF + two foliar sprays of 2% urea (at 30 and 45 DAT)

Urea, single superphosphate, and muriate of potash were used as sources of N, P, and K respectively. Full doses of P and K were applied as basal, while nitrogen was applied according to the treatment schedule. A high-yielding cabbage variety was raised in nursery beds in October 2025 and transplanted at the 4–5 true leaf stage using 60 cm × 45 cm spacing. Standard agronomic practices including irrigation, weed management, and integrated pest management were followed throughout the crop period. Observations were recorded on five randomly selected plants per plot for various growth, yield, quality, and economic parameters. The data were statistically analyzed using ANOVA in RBD, and the critical difference (CD) was worked out at 5% level of significance.

Results and Discussion

Growth Parameters

Table 1: Effect of Inorganic Fertilizer Levels on Growth Parameters of Cabbage

Treat ment	Pla nt He igh			Pla nt Sp rea	Stal k Len gth	Hea d Dia met

	t (cm)			d at 60 DA T (cm ²)	at Ha rve st (cm)	er at Har vest (cm)
	30 DA T	60 D A T	90 D A T			
T ₀ (Control)	12. 8	25 .4	39 .2	292 .7	14. 2	10.8
T ₁ (50% RDF)	15. 6	33 .1	47 .5	418 .4	16. 8	13.4
T ₂ (75% RDF)	18. 2	39 .6	55 .8	505 .9	18. 5	15.2
T ₃ (100% RDF)	20. 1	45 .8	62 .9	589 .6	20. 1	17.6
T ₄ (125% RDF)	20. 8	47 .9	65 .7	622 .8	21. 4	18.9
T ₅ (150% RDF)	19. 5	46 .2	63 .4	605 .1	20. 9	18.3
T ₆ (100% RDF – Split	20. 6	46 .7	65 .1	597 .3	19. 7	18.1

N)						
T ₇ (100% RDF + Micron utrients)	21. 3	48 .4	66 .8	635 .2	19. 3	19.2
T ₈ (75% RDF + 2% Urea foliar)	20. 4	46 .3	64 .5	592 .8	19. 9	17.8
SEM	0.4	0. 8	1. 1	9.2	0.6	0.4
CD (5%)	1.3	2. 6	3. 4	29. 4	1.8	1.1
CV (%)	6.2	7. 1	6. 8	8.7	7.9	6.5

Plant height, plant spread, stalk length, and head diameter increased significantly with increasing fertilizer levels up to 125% RDF. The tallest plants at harvest (66.8 cm) were recorded in T₇ (100% RDF + foliar Zn & B), followed by T₄ (125% RDF). The control produced the shortest plants. The progressive improvement in growth was mainly due to the role of nitrogen in cell division and elongation. Foliar application of zinc and boron in T₇ further boosted these parameters by enhancing chlorophyll synthesis, enzyme activity, and translocation of

photosynthates. A slight reduction at 150% RDF indicated nutrient imbalance.

Yield and Yield Attributes

Table 2: Effect of Inorganic Fertilizer Levels on Yield and Yield Attributes of Cabbage

Treatment	Fresh Head Weight (g)	Dry Head Weight (g)	Yield per Plot (kg)	Marketable Yield (q ha ⁻¹)
T ₀ (Control)	435.8	38.6	2.18	102.6
T ₁ (50% RDF)	698.4	62.4	3.52	166.2
T ₂ (75% RDF)	905.7	81.2	4.68	222.4
T ₃ (100% RDF)	1138.2	102.5	5.96	282.5
T ₄ (125% RDF)	1202.6	108.7	6.38	300.8
T ₅ (150% RDF)	1167.9	105.3	6.14	291.4
T ₆ (100% RDF – Split N)	1164.3	104.9	6.09	289.7
T ₇ (100% RDF + Micronutri)	1230.5	111.4	6.52	307.6

ents)				
T ₈ (75% RDF + 2% Urea foliar)	1153.8	103.8	6.02	286.2
SEM	15.8	1.5	0.09	—
CD (5%)	49.7	4.8	0.28	13.2
CV (%)	9.1	8.3	7.4	7.4

Fresh head weight, dry head weight, yield per plot, and marketable yield per hectare followed the same trend. The highest fresh head weight (1230.5 g), dry head weight (111.4 g), and marketable yield (307.6 q ha⁻¹) were obtained in T₇. The superior performance of T₇ was attributed to the synergistic effect of adequate macronutrients and micronutrients, which improved assimilate partitioning and head filling.

Economic Analysis

Table 3: Effect of Inorganic Fertilizer Levels on Economics

Treatment	Cost of Cultivation (Rs. ha ⁻¹)	Gross Returns (Rs. ha ⁻¹)	Net Returns (Rs. ha ⁻¹)	B:C Ratio
T ₀ (Control)				
T ₁ (50% RDF)				
T ₂ (75% RDF)				
T ₃ (100% RDF)				
T ₄ (125% RDF)				
T ₅ (150% RDF)				
T ₆ (100% RDF – Split N)				
T ₇ (100% RDF + Micronutri)				

T ₀ (Control)	86,500	1,23, 120	36,62 0	1.4 2
T ₁ (50% RDF)	1,06,80 0	1,99, 440	92,64 0	1.8 7
T ₂ (75% RDF)	1,19,20 0	2,66, 880	1,47, 680	2.2 4
T ₃ (100% RDF)	1,33,50 0	3,39, 000	2,05, 500	2.5 4
T ₄ (125% RDF)	1,46,80 0	3,60, 960	2,14, 160	2.4 6
T ₅ (150% RDF)	1,60,20 0	3,49, 680	1,89, 480	2.1 8
T ₆ (100% RDF – Split N)	1,36,80 0	3,46, 800	2,10, 000	2.5 4
T ₇ (100% RDF + Micronutr rients)	1,43,80 0	3,69, 120	2,25, 320	2.5 7
T ₈ (75% RDF + 2% Urea foliar)	1,31,50 0	3,43, 680	2,12, 180	2.6 1

Treatment T₇ recorded the highest net returns (₹2,25,320 ha⁻¹) with a B:C ratio of 2.57. However, T₈ (75% RDF + foliar urea) gave the highest benefit-cost ratio of 2.61, indicating better input-use efficiency at lower fertilizer doses.

Conclusion

The present study revealed that application of 100% RDF supplemented with foliar

sprays of micronutrients (Zn and B) was the most effective treatment for maximizing growth, yield, quality, and economic returns in cabbage under Kanpur conditions. Application of 125% RDF also performed well, whereas 75% RDF combined with foliar urea offered a cost-effective option with the highest B:C ratio. Excessive use of fertilizers (150% RDF) is not advisable due to slight decline in performance. These findings provide practical recommendations for achieving sustainable and profitable cabbage production through balanced inorganic nutrition and targeted foliar supplementation.

References

- Anushruti, Singh, D., & Kumar, A. (2022). Effect of integrated nutrient management on growth and yield of cabbage (*Brassica oleracea* var. *capitata* L.). *Journal of Pharmacognosy and Phytochemistry*, 11(1), 234–238.
- Chandel, R., Singh, A., & Kumar, V. (2021). Integrated nutrient management in cabbage under subtropical conditions. *Indian Journal of Horticulture*, 78(3), 456–461.
- Devi, S., Kumar, A., & Singh, R. (2017). Effect of vermicompost and biofertilizers on cabbage. *International Journal of Current Microbiology and Applied Sciences*, 6(12), 2345–2351.

- Kumar, R., Singh, S., & Yadav, P. (2021). Influence of organic and inorganic sources on curd yield of cauliflower. *Journal of Krishi Vigyan*, 9(2), 112–118.
- Rabindra, K., Singh, M., & Kumar, S. (2021). Effect of integrated nutrient management on growth and yield of cauliflower. *Annals of Plant and Soil Research*, 23(4), 567–572.
- Sharma, R., & Suryavanshi, P. (2020). Biofertilizer combinations for enhanced growth and yield of cauliflower. *International Journal of Current Microbiology and Applied Sciences*, 9(8), 1456–1464.
- Singh, A., Kumar, P., & Yadav, R. (2020a). Integrated nutrient management in cabbage under Gangetic plains. *Vegetable Science*, 47(2), 189–195.
- Singh, R., Yadav, S., & Kumar, V. (2020b). Effect of high fertilizer doses on growth and quality of broccoli. *Indian Journal of Agricultural Sciences*, 90(5), 789–794.
- Sreekanth, M., Reddy, K., & Rao, P. (2022). Influence of biofertilizers on cabbage yield. *Journal of Research ANGRAU*, 50(1), 34–40.
- Zargar, G. H., Singh, S., & Kumar, A. (2021). Economic evaluation of integrated nutrient management in cabbage. *Journal of Soil Science and Plant Nutrition*, 21(3), 1456–1463