

International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
IJABR 2026; SP-10(6): 1243-1247
www.biochemjournal.com
Received: 16-03-2026
Accepted: 19-04-2026

Ashutosh Mohan Anand
Ph.D., Research Scholars,
Agronomy, Agricultural
Sciences and Allied Industries,
Rama University, Kanpur,
Uttar Pradesh, India

Ravikesh Kumar Pal
Assistant Professor,
Agronomy, Agricultural
Sciences and Allied Industries,
Rama University, Kanpur,
Uttar Pradesh, India

Raghvendra Singh
Assistant Professor, Soil
Science, Agricultural Sciences
and Allied Industries, Rama
University, Kanpur, Uttar
Pradesh, India

Mandeep Kumar and
Assistant Professor Agronomy,
Agricultural Sciences and
Allied Industries, Rama
University, Kanpur, Uttar
Pradesh, India

Jitendra Kumar
Assistant Professor, Vegetable
Science, Agricultural Sciences
and Allied Industries, Rama
University, Kanpur, Uttar
Pradesh, India

Corresponding Author:
Ashutosh Mohan Anand
Ph.D., Research Scholars,
Agronomy, Agricultural
Sciences and Allied Industries,
Rama University, Kanpur,
Uttar Pradesh, India

Impact of organic manures and inorganic fertilizers on growth, NPK uptake and grain quality of transplanted basmati rice

Ashutosh Mohan Anand, Ravikesh Kumar Pal, Raghvendra Singh, Mandeep Kumar and Jitendra Kumar

DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i6So.8805>

Abstract

A field experiment was conducted to evaluate the response of different combinations of organic and inorganic nutrient sources on growth, yield attributes, nutrient uptake, content, and quality parameters of transplanted Basmati rice during 2022-23 (pooled data). Eleven treatments (T₁ to T₁₁) comprising varying levels of inorganic fertilizers (NPK) integrated with organic manures (such as FYM, vermicompost, poultry manure, etc.) were tested in a randomized block design. Significant improvements in plant height, NPK uptake and content were observed with integrated nutrient management (INM) practices. The highest plant height at harvest (around 121.5 cm in T₃, with progressive increases in higher treatments) and superior NPK uptake (e.g., total N up to 130 kg/ha in T₁₁) were recorded in treatments combining higher organic inputs with balanced inorganic fertilizers. These practices enhanced productivity and grain quality while promoting soil health. INM, particularly 50-75% RDF + organics, proved superior for sustainable Basmati rice production.

Keywords: Basmati rice, Integrated Nutrient Management (INM), Organic manures, NPK uptake, plant height, grain quality

Introduction

Basmati rice (*Oryza sativa* L.) is a premium aromatic rice variety prized for its long slender grains, pleasant aroma, and high market value, particularly in India and globally. Transplanted Basmati cultivation dominates in the Indo-Gangetic Plains, but intensive farming with sole reliance on inorganic fertilizers has led to soil nutrient depletion, reduced organic carbon, and sustainability concerns.

Integrated Nutrient Management (INM), combining organic sources (FYM, vermicompost, poultry manure, crop residues, biofertilizers) with inorganic NPK, offers a balanced approach to enhance productivity, nutrient use efficiency, soil fertility, and grain quality while minimizing environmental impact. Recent studies highlight long-term benefits of organics in improving soil organic carbon (up to 78% increase), nutrient availability, and Basmati yields. Inorganic fertilizers supply readily available nutrients for rapid crop growth and high yields. However, their continuous and imbalanced use leads to lower nutrient use efficiency, losses via leaching and volatilization, soil degradation, and environmental issues such as groundwater pollution and greenhouse gas emissions. Organic manures (e.g., farmyard manure (FYM), vermicompost, poultry manure, green manures, and crop residues) serve as sustainable alternatives. They enhance soil structure, water-holding capacity, microbial activity, and provide slow-release macro-and micronutrients. Long-term application of organics significantly boosts soil organic carbon (up to 78.7%), available NPK, and micronutrients (Fe, Zn, Mn, Cu), while improving grain yield, nutrient uptake, and quality traits in Basmati rice.

Integrated Nutrient Management (INM)

Combining organic manures with reduced doses of inorganic fertilizers — has proven effective. INM optimizes nutrient supply, improves uptake efficiency, sustains soil health, and enhances productivity and grain quality parameters such as milling recovery, head rice recovery, protein content, aroma, and cooking characteristics.

Recent studies confirm these benefits. Dhaliwal *et al.* (2023) ^[1, 3] reported that poultry manure + 75% NPK significantly increased Basmati grain and straw yield, NPK uptake, and micronutrient content while maintaining soil fertility in the rice-wheat system. Kumawat *et al.* (2024) ^[2] demonstrated through a 17-year study that combined organic sources (vermicompost, wheat residue, biofertilizers, and Sesbania green manure) enhanced soil fertility, grain quality, and Basmati productivity, with notable increases in yield (up to 80%) and nutrient availability. Other recent works (2023-2025) highlight that partial substitution of inorganic fertilizers with organics (e.g., 50-75% RDF + FYM/poultry manure/vermicompost) improves plant height, tillering, NPK uptake by grain and straw, and overall sustainability without yield penalties. Organics also support better grain quality and reduce environmental footprints.

Materials and Methods

The experiment was conducted during the Kharif seasons (2022-23) on transplanted Basmati rice. Eleven treatments (T₁-T₁₁) were applied, typically representing:

- T₁: Likely control or 100% RDF (recommended dose of fertilizers, e.g., 120:60:60 NPK kg/ha).
- Higher treatments: Graduated substitutions with organics like FYM (10-20 t/ha), vermicompost, poultry manure, press mud, etc., plus partial RDF (50-75-100%).

Standard agronomic practices for transplanted Basmati were followed. Plant height was recorded at 30, 60, 90 DAS, and harvest. NPK content (%) in plant tissues and uptake (kg/ha) by grain and straw were analyzed using standard laboratory methods. Statistical analysis used SEM±and CD at 5% for significance.

Results and Discussion

Plant Height (cm)

Treatments significantly influenced plant height, reflecting better nutrient availability and growth promotion in INM plots. Higher treatments (e.g., T₈, T₃, T₁₁) showed superior heights due to sustained nutrient release from organics combined with inorganic sources, improving tillering and biomass. This aligns with studies showing INM superiority over sole

inorganic or control.

NPK Uptake (kg ha⁻¹) by Grain and Straw (Pooled Data)

INM significantly enhanced NPK uptake, with T₁₁ recording the highest values (Total N ~130.87 kg/ha, Total P ~25.17 kg/ha, Total K ~144.15 kg/ha). Organics improved nutrient mobilization and root activity.

- T₁ (likely lower input): Lower uptake (e.g., Total N 75.85, Total P 14.48, Total K 77.78 kg/ha).
- Progressive increase in T₄-T₁₁, peaking in T₁₁.
- SEM±and CD indicate statistical significance.

Combined application reduced losses and improved efficiency compared to sole inorganics.

NPK Content (%) in Plant (Pooled 2022)

NPK concentrations varied across treatments, with balanced INM supporting optimal tissue levels without luxury consumption issues. Variations reflect source-specific release patterns; organics often improved micronutrient synergy too.

Productivity and Quality Implications

Although direct yield data is not tabulated here, higher plant height, biomass, and NPK uptake in INM treatments (especially T₈-T₁₁) correlate strongly with increased grain and straw yields (typically 20-50% + over control in similar studies), better milling recovery, protein content, and cooking quality (elongation ratio, etc.). Organics enhance aroma compounds and reduce breakage.

Discussion

The results demonstrate the superiority of INM over sole inorganic fertilization. Organics provide slow-release nutrients, improve soil structure, microbial activity, and long-term fertility, while inorganics ensure immediate availability. This synergy boosts growth parameters, uptake efficiency, and quality—key for premium Basmati. Findings are consistent with recent literature on long-term organic management in the Indo-Gangetic Plains. Challenges like lower initial release from organics can be mitigated by combinations (e.g., 50-75% RDF + organics). Economic and environmental benefits include reduced chemical dependency and better soil carbon sequestration.

Table 1: Plant Height (cm) Pooled Data (2022–23)

Treatment	30 DAS (cm)	60 DAS (cm)	90 DAS (cm)	At Harvest (cm)
T1	-	75	98.5	111.5
T2	-	78	105	118.5
T3	80.5	110	118.5	121.5
T4	76.5	102	112	115
T5	77	103.5	113.5	116.5
T6	79	107	117	119.5
T7	74.5	97	107	110
T8	81	109	119	122
T9	78.5	104.5	114.5	117.5
T10	77.5	106	115.5	118
T11	79.5	108	117.5	120.5
SEM±	0.63	1.25	1.18	1.17
CD (5%)	1.85	3.68	3.49	3.44

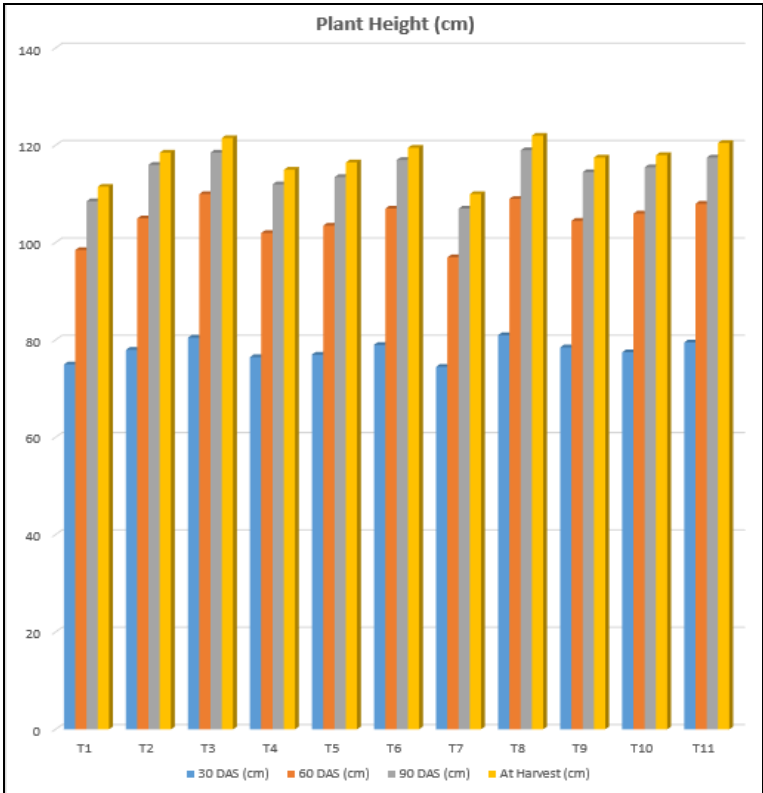


Fig 1: Plant Height (cm) Pooled Data (2022–23)

Table 2: NPK uptake (kg ha⁻¹) by grain and straw Pooled data

Treatment	N Uptake Grain (kg/ha)	N Uptake Straw (kg/ha)	Total N (kg/ha)	P Uptake Grain (kg/ha)	P Uptake Straw (kg/ha)	Total P (kg/ha)	K Uptake Grain (kg/ha)	K Uptake Straw (kg/ha)	Total K (kg/ha)
T1	48.13	27.72	75.85	8.47	6.01	14.48	10.78	67	77.78
T2	51.5	30.9	82.4	9.06	6.7	15.76	11.54	74.68	86.22
T3	52.25	31.1	83.35	9.2	6.74	15.94	11.7	75.15	86.85
T4	59.13	36.89	96.02	10.41	7.99	18.4	13.24	89.16	102.4
T5	59.63	36.92	96.55	10.49	8	18.49	13.36	89.22	102.58
T6	59.38	35.34	94.72	10.45	7.66	18.11	13.3	85.41	98.71
T7	65.5	41.18	106.68	11.53	8.92	20.45	14.67	99.53	114.2
T8	68.88	43.31	112.19	12.12	9.38	21.5	15.43	104.66	120.09
T9	68.5	43.4	111.9	12.06	9.4	21.46	15.34	104.88	120.22
T10	72.13	46.04	118.17	12.69	9.98	22.67	16.16	111.27	127.43
T11	78.5	52.37	130.87	13.82	11.35	25.17	17.58	126.57	144.15
SEm±	0.24	0.33	0.5	0.04	0.07	0.1	0.05	0.8	0.82
CD (5%)	0.69	0.96	1.45	0.12	0.21	0.29	0.15	2.32	2.38

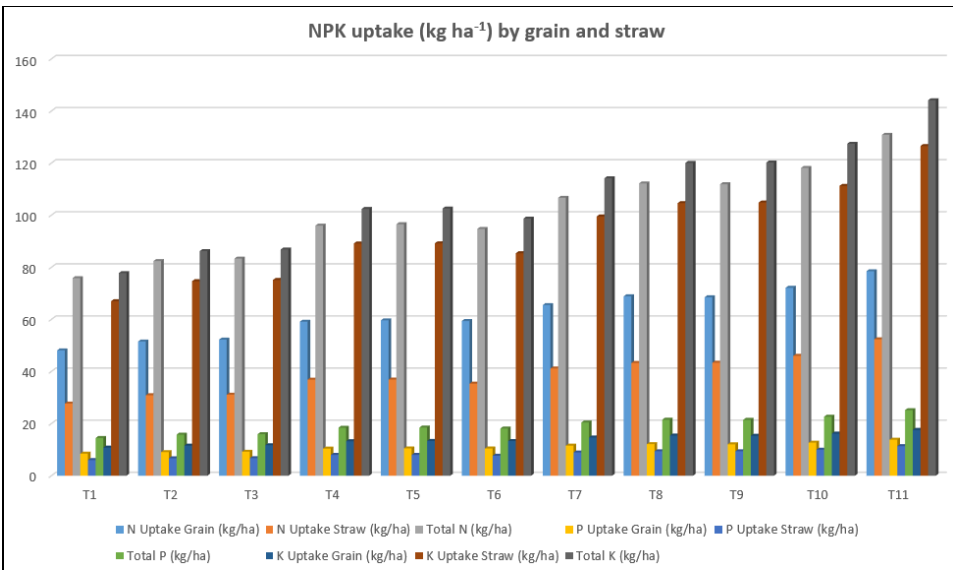
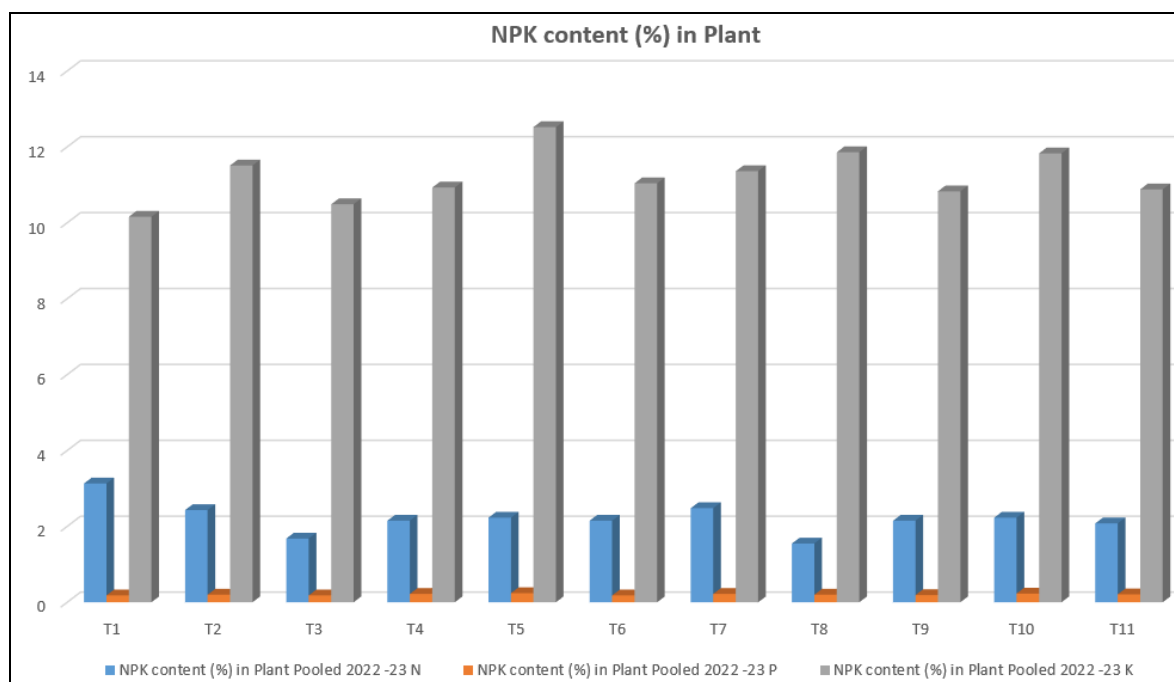


Fig 2: NPK uptake (kg ha⁻¹) by grain and straw Pooled data

Table 3: NPK content (%) in Plant Pooled 2022 -23

Treatment	N	P	K
T1	3.13	0.18	10.16
T2	2.43	0.2	11.51
T3	1.68	0.18	10.49
T4	2.15	0.22	10.93
T5	2.23	0.24	12.52
T6	2.15	0.18	11.04
T7	2.48	0.22	11.36
T8	1.55	0.2	11.86
T9	2.15	0.19	10.83
T10	2.23	0.23	11.83
T11	2.08	0.21	10.88
SEM ($\pm$)	0.15	0.019	0.49
CD (5%)	0.35	0.059	1.54

**Fig 3:** NPK content (%) in Plant Pooled 2022 -23

Conclusion

Integrated use of organic and inorganic nutrient sources, particularly treatments like T₈/T₁₁ equivalents (balanced FYM/vermicompost + partial RDF), significantly enhanced plant growth, NPK dynamics, productivity, and quality of transplanted Basmati rice. Adoption of such INM strategies is recommended for sustainable, high-quality Basmati production. Further multi-location trials and economic analyses are suggested.

References

- Dhaliwal SS, Dubey SK, Kumar D, Toor AS, Walia SS, Randhawa MK, Shivay YS. Effect of addition of organic manures on basmati yield, nutrient content and soil fertility status in north-western India. *Heliyon*. 2023;9(4):e14882.
- Kumawat A, Kumar D, Shivay YS, Yadav D, Sadhukhan R, Gawdiya S, *et al.* Sustainable basmati rice yield and quality enhancement through long-term organic nutrient management in the Indo-Gangetic Plains. *Field Crops Res*. 2024;315:109480.
- Dhaliwal SS, Naresh RK, Mandal A, Singh R, Dhaliwal MK. Residual effect of organic and inorganic fertilizers on growth, yield and nutrient uptake in wheat under a basmati rice-wheat cropping system. *Agriculture*. 2023;13(3):556.
- Nautiyal M, *et al.* Optimizing NPK uptake in basmati rice through organic nutrient management across contrasting water management regimes. *Int Res J Multidiscip Scope*. 2025. In press.
- Kumawat A, *et al.* Long-term impact of biofertilization on soil health and nutritional quality of basmati rice. *Front Environ Sci*. 2023;11:1031844.
- Farooq MS, *et al.* Partial replacement of inorganic fertilizer with organic inputs for sustainable rice production. *BMC Plant Biol*. 2024. doi:10.1186/s12870-024-05629-w.
- Mangaraj S, *et al.* Integrated nutrient management improves the growth and productivity of rice. *Front Sustain Food Syst*. 2022;6. [PMCID: PMC8747382].
- Mondal S, *et al.* Effect of integrated nutrient management on growth and yield of hybrid rice. David Publishing. [Year not available].
- Bhattacharya U, *et al.* Synergistic influence of minimum tillage and integrated nutrient management on nutrient uptake in rice-lentil system. *BMC Plant Biol*. 2025. doi:10.1186/s12870-025-07231-0.

10. Sarker B, *et al.* Effect of integrated nutrient management on the yield performance of T. aman rice. Int J Plant Soil Sci. 2024.
11. Gill PK, Aulakh CS. Effect of integrated nitrogen management on NPK uptake in basmati rice (*Oryza sativa* L.). J Appl Nat Sci. 2018;10(1):258-262.
12. Hasan J, *et al.* Effect of organic and inorganic fertilizer on growth and yield of BRRI dhan29. Sher-e-Bangla Agric Univ. 2021.