



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
NAAS Rating (2026): 5.20
www.agronomyjournals.com
2026; 9(9): 563-566
Received: 02-06-2026
Accepted: 08-07-2026

Kusum Patel
Research Scholar, Department of
Vegetable Science, College of
Agriculture, IGKV, Raipur,
Chhattisgarh, India

Pravin Kumar Sharma
Principal Scientist, Department of
Vegetable Science, College of
Agriculture, IGKV, Raipur,
Chhattisgarh, India

Vandana Yadav
Technical Assistant, Department of
Vegetable Science, College of
Agriculture, IGKV, Raipur,
Chhattisgarh, India

Garima Verma
Research Scholar, Department of
Vegetable Science, College of
Agriculture, IGKV, Raipur,
Chhattisgarh, India

Reecha Sahu
Ph.D. Scholar, Department of
Vegetable Science, College of
Agriculture, IGKV, Raipur,
Chhattisgarh, India

Corresponding Author:
Kusum Patel
Research Scholar, Department of
Vegetable Science, College of
Agriculture, IGKV, Raipur,
Chhattisgarh, India

Economic analysis of varying levels of nitrogen, phosphorus and potassium on potato (*Solanum tuberosum* L.) cultivation under Chhattisgarh Plains

Kusum Patel, Pravin Kumar Sharma, Vandana Yadav, Garima Verma and Reecha Sahu

DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i9h.6555>

Abstract

A field investigation was carried out at the Research cum Demonstrational Farm, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, during the *Rabi* season of 2025-26, to work out the economics of potato (*Solanum tuberosum* L.) cv. Kufri Khyati as influenced by varying levels of nitrogen, phosphorus and potassium. The experiment was laid out in a Randomized Block Design (RBD) with three replications and twelve treatments viz., T₁: 100% NPK as per recommendation, T₂: 75% NPK as per recommendation, T₃: 125% NPK as per recommendation, T₄: 125% N, 100% P and 100% K as per recommendation, T₅: 100% NPK as per YT 35 t ha⁻¹, T₆: 75% NPK as per YT 35 t ha⁻¹, T₇: 125% NPK as per YT 35 t ha⁻¹, T₈: 125% N, 100% P and 100% K as per YT 35 t ha⁻¹, T₉: Without N fertilizer (PK), T₁₀: Without P fertilizer (NK), T₁₁: Without K fertilizer (NP) and T₁₂: Without NPK (absolute control). The economic analysis revealed that the highest gross return (530880.00 Rs ha⁻¹), net return (424134.22 Rs ha⁻¹) and benefit: cost ratio (4.97) were recorded under treatment T₇ (125% NPK as per YT 35 t ha⁻¹), followed by T₈. The highest cost of cultivation (114024.33 Rs ha⁻¹) was recorded under T₃ (125% NPK as per recommendation), while the lowest cost of cultivation, gross return, net return and B:C ratio were recorded under T₁₂ (absolute control). Hence, the results clearly demonstrated that the STCR-based targeted yield approach, generated substantially higher marketable yield and the most remunerative and economically efficient nutrient management strategy for potato.

Keywords: Potato, NPK fertilization, cost of cultivation, net return, benefit: cost ratio, STCR targeted yield

Introduction

Potato (*Solanum tuberosum* L., 2n = 4x = 48) is the fourth most important food crop in the world after maize, wheat and rice, and is popularly regarded as the “king of vegetables” owing to its high productivity per unit area and time (Anonymous, 2021; Miyu *et al.*, 2019) ^[1, 5]. In India, potato occupies about 22.25 lakh hectares with a production of 561.7 lakh tonnes (Anonymous, 2022) ^[2] and India's position as the world's second-largest potato producer. In Chhattisgarh, the area under potato cultivation was 35,611 hectares which produced 6,36,162 tonnes with 17.86 t ha⁻¹ productivity (Anonymous, 2024) ^[3], a level below the national average, indicating considerable scope for improving productivity and profitability through improved cultivation practices.

Being a heavy feeder with a shallow and sparse root system, potato is highly responsive to nitrogen, phosphorus and potassium application, which together govern plant growth development and productivity. Fertilizers, however, constitute one of the costliest variable inputs in potato production, and indiscriminate or blanket application without regard to soil-supplying capacity often results in poor fertilizer-use efficiency and reduced profitability. Balanced and site-specific fertilization, therefore, is essential not only for maximizing tuber yield but also for sustaining farm profitability. Since the cost of cultivation, market price of tubers and the level of fertilizer input jointly determine the profitability of the crop, an economic evaluation of different fertility levels, including the soil test crop response (STCR) based targeted-yield approach, is necessary to identify the fertilizer schedule that gives farmers the best return on investment. Keeping this in view, the present investigation was undertaken to work out the economics of potato cultivation as influenced by varying levels of nitrogen, phosphorus and potassium under

the agro-climatic conditions of the Chhattisgarh plains.

Materials and Methods

The field experiment was conducted during the *Rabi* season of 2025-26 at the Research cum Demonstrational Farm, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, using the potato variety Kufri Khyati. The soil of the experimental site was clay-loam (locally known as “Dorsa”), initial pH of soil (6.9), initial soil organic carbon (0.42%) and initial available nitrogen (196.75 kg ha⁻¹), initial available phosphorus (20.63 kg ha⁻¹) and potassium (236.51 kg ha⁻¹). The experiment was laid out in a Randomized Block Design (RBD) with three replications and twelve treatments, viz., T₁: 100% NPK as per recommendation, T₂: 75% NPK as per recommendation, T₃: 125% NPK as per recommendation, T₄: 125% N, 100% P and 100% K as per recommendation, T₅: 100% NPK as per YT 35 t ha⁻¹, T₆: 75% NPK as per YT 35 t ha⁻¹, T₇: 125% NPK as per YT 35 t ha⁻¹, T₈: 125% N, 100% P and 100% K as per YT 35 t ha⁻¹, T₉: Without N fertilizer (PK), T₁₀: Without P fertilizer (NK), T₁₁: Without K fertilizer (NP) and T₁₂: Without NPK (absolute control), where the recommended dose was 150:100:100 kg NPK ha⁻¹ and the dose as per a yield target (YT) of 35 t ha⁻¹ was 160:50:60 kg NPK ha⁻¹. The crop was planted on 1st December 2025 at a spacing of 60 cm × 20 cm.

Economic analysis

The cost of cultivation was worked out by summing the expenditure incurred on seed tubers, fertilizers, labour, field preparation and irrigation, computed on the basis of prevailing input costs and standard rates fixed by the State Government. Gross return was calculated by multiplying the total tuber yield obtained from each treatment with the prevailing market price of potato (Rs 14,000 t⁻¹). Net return was derived by subtracting the cost of cultivation from the gross return, and the benefit: cost (B:C) ratio was computed as the ratio of gross return to the cost of cultivation, following the formulae given below:

Gross return (Rs ha⁻¹) = Yield (t ha⁻¹) × Price of produce (Rs t⁻¹)

Net return (Rs ha⁻¹) = Gross return (Rs ha⁻¹) – Cost of cultivation (Rs ha⁻¹)

Benefit: Cost ratio = Gross return (Rs ha⁻¹) / Cost of cultivation (Rs ha⁻¹)

Results

The data pertaining to cost of cultivation, gross return, net return and benefit: cost ratio of potato as influenced by varying levels of N, P and K, computed on the basis of the prevailing cost of inputs and market price of the produce, are presented in Table 1. A breakdown of the cost components (seed, fertilizer and general cultivation cost) contributing to the total cost of cultivation under each treatment is presented separately in Table 2.

Cost of cultivation (Rs ha⁻¹)

The data presented in Table 1 revealed that the cost of cultivation varied from Rs 95,325.35 ha⁻¹ (T₁₂) to Rs 114,024.33 ha⁻¹ (T₃), reflecting a consistent upward trend with increasing levels of fertilizer application. The highest cost of cultivation (Rs 114,024.33 ha⁻¹) was recorded under treatment T₃ (125% NPK as per recommendation), primarily on account of the higher quantity of fertilizer applied, followed by T₄ (Rs 110,766.45 ha⁻¹) and T₁ (Rs 110,284.53 ha⁻¹). In contrast, the lowest cost of cultivation was recorded under T₁₂ (absolute control), where no expenditure was incurred on fertilizers. Among the fertilized treatments, the

STCR-based targeted-yield treatments (T₅-T₈) consistently required a lower fertilizer outlay than their corresponding recommendation-based counterparts (T₁-T₄) at the same percentage level, since the targeted-yield dose of phosphorus and potassium (50 and 60 kg ha⁻¹, respectively) was appreciably lower than the general recommended dose (100 kg ha⁻¹ each). Similar increases in cost of cultivation with increasing fertilizer dose were reported by Yadav *et al.* (2020) [8], who observed the highest cultivation cost with 150% RDF of NPK and by Singh *et al.* (2018) [7], who reported that cost of cultivation rose progressively up to 100% RDF of NPK. This consistent trend across independent investigations confirms that fertilizer expenditure is the principal cost driver differentiating treatments once other cultural operations are held constant.

Gross return (Rs ha⁻¹)

Gross return, computed as the product of total tuber yield and the prevailing market price, differed widely among treatments, ranging from Rs 142,893.33 ha⁻¹ (T₁₂) to Rs 530,880.00 ha⁻¹ (T₇). The highest gross return (Rs 530,880.00 ha⁻¹) was recorded under T₇ (125% NPK as per YT 35 t ha⁻¹), followed by T₈ (Rs 512,586.67 ha⁻¹) and T₃ (Rs 479,126.67 ha⁻¹), while the lowest gross return was recorded under the absolute control (T₁₂). The markedly higher gross return under the STCR-based targeted-yield treatments, despite their comparatively lower fertilizer cost, can be attributed to the balanced, site-specific nature of nutrient supply under the targeted-yield approach, which more closely matched the soil-supplying capacity and crop demand, thereby translating into a greater total tuber yield and, consequently, a higher gross monetary value of produce. This finding is consistent with Devi *et al.* (2023) [4], who reported that fertilizer management based on a targeted yield of 35 t ha⁻¹ (200:62.5:75 kg NPK ha⁻¹) produced the highest gross return among the treatments they evaluated, and with Nagar *et al.* (2023) [6], who observed that a 125% QUEFTS-based NPK dose gave the highest gross income compared with a conventional 100% RDF treatment.

Net return (Rs ha⁻¹)

Net return, representing the actual profit accruing to the farmer after deducting the cost of cultivation from the gross return, followed a pattern broadly similar to that of gross return (Table 1). The highest net return (Rs 4,24,134.22 ha⁻¹) was recorded under T₇ (125% NPK as per YT 35 t ha⁻¹), followed by T₈ (Rs 4,07,610.92 ha⁻¹) and T₃ (Rs 3,65,102.34 ha⁻¹), whereas the lowest net return (Rs 47,567.98 ha⁻¹) was recorded under the unfertilized control (T₁₂). Notably, although T₃ (125% NPK as per recommendation) incurred the highest absolute cost of cultivation among all treatments, its net return was lower than that of T₇ and T₈, both of which achieved a substantially higher tuber yield at a comparatively lower cultivation cost. This clearly demonstrates that profitability in potato cultivation is governed less by the large quantity of fertilizer applied and more by how efficiently the applied nutrients are converted into marketable yield. The nutrient-omission treatments (T₉, T₁₀ and T₁₁) recorded markedly depressed net returns compared with the fully fertilized treatments, underscoring the critical and largely non-substitutable contribution of nitrogen, phosphorus and potassium, in that order of magnitude of yield loss, to the profitability of potato cultivation. Comparable trends of maximum net return under balanced or targeted-yield-based NPK application have been reported by Singh *et al.* (2018) [7], Yadav *et al.* (2020) [8] and Devi *et al.* (2023) [4].

Benefit: Cost ratio

The benefit: cost ratio, which expresses the monetary return generated per rupee invested in cultivation, was found to be maximum (4.97) under T₇ (125% NPK as per YT 35 t ha⁻¹), followed by T₈ (4.88) and T₅ (4.27), while the minimum B:C ratio (1.50) was recorded under the absolute control (T₁₂). It is noteworthy that all four STCR-based targeted-yield treatments (T₅, T₆, T₇ and T₈) recorded B:C ratios exceeding 3.5, and three of them (T₅, T₇ and T₈) exceeded 4.0, whereas among the recommendation-based treatments only T₃ and T₄ crossed a B:C ratio of 4.0. This indicates that the targeted-yield approach

delivered superior economic efficiency across almost its entire range of fertilizer levels, rather than only at a single optimum dose. The higher B:C ratio recorded under the yield-target-based treatments may be attributed to the balanced application of nutrients in the soil. These findings are in close agreement with Singh *et al.* (2018) ^[7], Yadav *et al.* (2020) ^[8], Devi *et al.* (2023) ^[4] and Nagar *et al.* (2023) ^[6], they also reported the highest benefit: cost ratio under a balanced, need-based fertilizer application rather than under the highest absolute level of NPK applied.

Table 1: Effect of varying levels of N, P and K on economics of potato

Treatment	Total tuber yield (t ha ⁻¹)	Cost of cultivation (Rs ha ⁻¹)	Gross return (Rs ha ⁻¹)	Net return (Rs ha ⁻¹)	B:C ratio
T ₁ : 100% NPK as per recommendation	29.59	110284.53	414260.00	303975.47	3.76
T ₂ : 75% NPK as per recommendation	24.22	106544.74	339033.33	232488.60	3.18
T ₃ : 125% NPK as per recommendation	34.22	114024.33	479126.67	365102.34	4.20
T ₄ : 125% N, 100% P and 100% K as per recommendation	33.37	110766.45	467226.67	356460.21	4.22
T ₅ : 100% NPK as per YT 35 t ha ⁻¹	31.87	104461.69	446180.00	341718.31	4.27
T ₆ : 75% NPK as per YT 35 t ha ⁻¹	26.07	102177.61	364933.33	262755.72	3.57
T ₇ : 125% NPK as per YT 35 t ha ⁻¹	37.92	106745.78	530880.00	424134.22	4.97
T ₈ : 125% N, 100% P and 100% K as per YT 35 t ha ⁻¹	36.61	104975.74	512586.67	407610.92	4.88
T ₉ : Without N fertilizer (PK) as per recommendation	12.14	108356.85	169960.00	61603.15	1.57
T ₁₀ : Without P fertilizer (NK) as per recommendation	16.78	102897.03	234873.33	131976.30	2.28
T ₁₁ : Without K fertilizer (NP) as per recommendation	17.91	104640.53	250786.67	146146.13	2.40
T ₁₂ : Without NPK (absolute control)	10.21	95325.35	142893.33	47567.98	1.50

Table 2: Break-up of cost of cultivation of potato under different treatments

Treatment	Seed cost (Rs ha ⁻¹)	Fertilizer cost (Rs ha ⁻¹)	Cultivation cost (Rs ha ⁻¹)	Total cost (Rs ha ⁻¹)
T ₁	40000	14959.18	55325.35	110284.53
T ₂	40000	11219.39	55325.35	106544.74
T ₃	40000	18698.98	55325.35	114024.33
T ₄	40000	15441.10	55325.35	110766.45
T ₅	40000	9136.34	55325.35	104461.69
T ₆	40000	6852.26	55325.35	102177.61
T ₇	40000	11420.43	55325.35	106745.78
T ₈	40000	9650.39	55325.35	104975.74
T ₉	40000	13031.50	55325.35	108356.85
T ₁₀	40000	7571.68	55325.35	102897.03
T ₁₁	40000	9315.18	55325.35	104640.53
T ₁₂	40000	0.00	55325.35	95325.35

Conclusion

The present investigation revealed that the economics of potato cultivation was significantly influenced by varying levels of nitrogen, phosphorus and potassium fertilization. While the cost of cultivation rose consistently with an increase in fertilizer dose, the gross return, net return and benefit: cost ratio did not follow the same linear pattern, indicating that maximum fertilizer application does not necessarily translate into maximum profitability. Application of 125% NPK as per the soil test crop response (STCR)-based targeted yield of 35 t ha⁻¹ (T₇; 200:62.5:75 kg N:P₂O₅:K₂O ha⁻¹) proved to be the most economically efficient treatment, recording the highest gross return (Rs 530,880.00 ha⁻¹), net return (Rs 424,134.22 ha⁻¹) and benefit: cost ratio (4.97), followed by T₈. On the other hand, complete withdrawal of NPK (absolute control) resulted in drastically reduced returns and the lowest B:C ratio (1.50), reaffirming the indispensable role of balanced fertilization in sustaining the profitability of potato cultivation. It may therefore be concluded that adoption of the STCR-based targeted-yield approach, rather than a uniform blanket recommendation, offers potato growers of the Chhattisgarh plains a more remunerative, resource-efficient and economically sustainable pathway to

enhanced farm income. Nevertheless, since the present findings are based on a single season of field evaluation, multi-location and multi-season trials are recommended before the STCR-based targeted-yield fertilizer schedule is extended for large-scale farmer adoption in the region.

References

- Food and Agriculture Organization of the United Nations. FAOSTAT database. 2021.
- Ministry of Agriculture and Farmers Welfare, Government of India. Horticultural Statistics at a Glance. New Delhi: Ministry of Agriculture and Farmers Welfare; 2022. p. 134.
- Directorate of Horticulture and Farm Forestry, Nawa Raipur Atal Nagar, Chhattisgarh. Horticulture Statistics Division. 2024. p. 8.
- Devi S, Sharma PK, Gupta P, Kharsan M, Dubey R. Effect of different levels of NPK fertilizer on economics of potato (*Solanum tuberosum* L.). The Pharma Innovation Journal. 2023;12(3):5033-5036.
- Miyu M, Sarma P, Warade SD, Hazarika BN, Debnath P, Ramjan M, *et al.* Effect of foliar application of micronutrients on potato (*Solanum tuberosum* L.) cv. Kufri Jyoti for growth,

- yields and quality attributes. International Journal of Chemical Studies. 2019;7(3):4813-4817.
6. Nagar BL, Bairwa RK, Singh J, Yadav DL. Validation of QUEFTS model for nutrient management of potato (*Solanum tuberosum* L.) in humid south-eastern plains of Rajasthan. Indian Journal of Agricultural Sciences. 2023;93(7):786-789.
 7. Singh B, Singh SK, Kaur R, Pratap R. Effect of nitrogen, phosphorus and potassium on growth and yield of potato (*Solanum tuberosum* L.). International Journal of Agricultural Sciences. 2018;10(5):5319-5321.
 8. Yadav SK, Singh RK, Singh SK, Yadav S, Bakade RR. Site specific nutrient management in potato through nutrient omission plot technique. Journal of Agri Search. 2020;7(2):59-62.