

International Journal of Agriculture Extension and Social Development

Volume 9; Issue 5; May 2026; Page No. 446-449

Received: 02-02-2026
Accepted: 06-03-2026

Indexed Journal
Peer Reviewed Journal

Organic nutrient management in Potato (*Solanum tuberosum* L.) Varieties 'Kufri Jyoti' and 'Kufri Pukhraj' in the Central Brahmaputra Valley Zone of Assam

¹Bonti Gogoi, ¹Sanku M Sharma, ²N Khumdemo Ezung and ³Sameeron Bhattacharyya

¹Krishi Vigyan Kendra, Nagaon, Assam Agricultural University, Simaluguri, Assam, India

²Krishi Vigyan Kendra, Wokha, Nagaland University, Wokha, Nagaland, India

³Krishi Vigyan Kendra, Jorhat, Assam Agricultural University, Teok, Assam, India

DOI: <https://www.doi.org/10.33545/26180723.2026.v9.i5f.3605>

Corresponding Author: Bonti Gogoi

Abstract

A field experiment was conducted in Rabi season of 2024 to evaluate the response of two popular potato (*Solanum tuberosum* L.) cultivars, 'Kufri Jyoti' and 'Kufri Pukhraj', to different organic nutrient management strategies under the agro-climatic conditions of the Central Brahmaputra Valley Zone (CBVZ) of Assam. The experimental design followed a Randomized Block Design (RBD) with a factorial concept, replicating each treatment combination four times. The nutritional regimes comprised varying combinations of farmyard manure (FYM), vermicompost, microbial biofertilizers (*Azotobacter* and Phosphorus Solubilizing Bacteria), and non-chemical agronomic interventions such as zero tillage (ZT) combined with paddy straw mulching.

The results demonstrated significant variations in physiological parameters, growth kinetics, grade-wise tuber distribution, total tuber yield, and economic return. Cultivar 'Kufri Pukhraj' exhibited superior performance in terms of early vegetative vigor, leaf area index, and total tuber yield, proving highly responsive to premium organic formulations. Meanwhile, 'Kufri Jyoti' showed steady growth kinetics and sustained dry matter accumulation. Among the organic nutrient pathways, the combined application of enriched composts alongside ZT with paddy straw mulching significantly enhanced soil organic carbon (SOC) buildup and soil microbial biomass carbon (SMBC), driving high nutrient uptake. This research provides a definitive blueprint for substituting synthetic fertilizers with sustainable organic frameworks in the alluvial plains of the Brahmaputra valley.

Keywords: Potato, *Solanum tuberosum* L., Kufri Jyoti, Kufri Pukhraj, organic nutrient management

1. Introduction

Potato (*Solanum tuberosum* L.) is a major non-cereal food crop globally and holds a position of immense economic importance in India, contributing substantially to agricultural GDP and food security (Barua, 2026) ^[1]. In the state of Assam, the crop is widely cultivated during the post-monsoon winter (*rabi*) season. The Central Brahmaputra Valley Zone (CBVZ) of Assam is characterized by its distinct alluvial soil profiles, high atmospheric humidity, and moderate winter temperatures ranging typically between 10°C and 23°C (Gohain, 2025) ^[3]. This climatic window presents a highly favorable biophysical framework for potato production. However, traditional cultivation systems rely heavily on intensive tillage and chemical inputs, leading to structural soil degradation, reduction in subterranean microbial populations, and plateauing crop responses over prolonged cycles (Begum, 2024) ^[2].

Growing consumer demand for chemical-free food options, coupled with the need to improve soil hydraulic properties and resilience to climatic fluctuations (Manoj Kumar *et al.*, 2001; Kakoti, 2026) ^[7, 5], highlights the importance of exploring comprehensive organic nutrient management strategies. Potatoes have a high demand for nutrients over a short growing period, meaning that managing organic inputs

effectively is essential to match nutrient release with key crop growth stages.

The choice of potato variety is critical in organic production systems. 'Kufri Jyoti' is an established, widely grown variety known for its adaptability and steady growth kinetics. In contrast, 'Kufri Pukhraj' is an early-maturing, fast-bulking cultivar noted for its high yield potential and nutrient use efficiency under varied soil conditions (Manoj Kumar *et al.*, 2001) ^[7]. Understanding how these specific cultivars respond to different organic inputs—such as bulk organic manures, concentrated vermicomposts, and bio-inoculants—is essential for optimizing sustainable crop production in the CBVZ.

This study evaluates the growth, physiological performance, yield attributes, and economic viability of 'Kufri Jyoti' and 'Kufri Pukhraj' under different organic nutrient management strategies. It also aims to identify sustainable agronomic practices that can help maintain long-term soil health.

2. Materials and Methods

2.1 Experimental Site and Agro-Climatic

The field research was carried out within the Central Brahmaputra Valley Zone of Assam, India during rabi season of 2024 at under Krishi Vigyan Kendra, Nagaon. The

experimental zone features flat topography with sandy loam alluvial soils characterized by an acidic pH (ranging from 4.5 to 5.2), typical of the Brahmaputra floodplain dynamics (Hota *et al.*, 2022; Gohain, 2025) [4, 3]. Soil analysis prior to planting indicated that the soil profile was low in available nitrogen, medium in available phosphorus, and medium to low in available potassium.

2.2 Experimental Design and Treatments

The field experiment was laid out in a Factorial Randomized Block Design (RBD) with four replications. The treatments involved a combination of two factors:

- **Factor 1: Potato Cultivars (V)**
 - a. V₁: Kufri Jyoti (Slow-bulking, wide adaptability)
 - b. V₂: Kufri Pukhraj (Fast-bulking, early-maturing)
- **Factor 2: Organic Nutrient Management Regimes (T)**
 - a. T₁: Control (Absolute organic control, no added inputs)
 - b. T₂: FYM @ 15 t ha⁻¹ + *Azotobacter* + Phosphorus Solubilizing Bacteria (PSB)
 - c. T₃: Vermicompost @ 7.5 t ha⁻¹ + *Azotobacter* + PSB
 - d. T₄: Integrated Organic Blend (FYM @ 7.5 t ha⁻¹ + Vermicompost @ 3.75 t ha⁻¹ + Bio-inoculants)
 - e. T₅: Zero Tillage (ZT) with Paddy Straw Mulching (10 t ha⁻¹) + Integrated Organic Blend (T₄)

2.3 Crop Management

Healthy, disease-free seed tubers of uniform size (approx. 40–50 g) were planted during the first fortnight of November at a spacing of 60 cm × 20 cm. For the zero-tillage treatments (T₅), tubers were placed directly onto the undisturbed soil surface in opened slits before being covered with organic substrates and a 10 cm layer of uniform paddy straw mulch (Barua, 2026) [1]. Standard organic crop protection protocols were implemented, using bio-pesticides derived from *Neem* (*Azadirachta indica*) and *Trichoderma viride* to manage fungal issues and soil-borne pests. The crop was harvested in February, following the natural senescence of the haulms.

2.4 Data Collection and Analytical Framework

- **Physiological & Growth Parameters:** Plant height (cm), number of leaves per plant, and total shoots were recorded at 30, 50, and 75 Days After Planting (DAP) (Gohain, 2025) [3]. Leaf chlorophyll content was quantified using a SPAD-502 chlorophyll meter to generate representative values (Gohain, 2025) [3], and total biochemical chlorophyll fractions were verified via standard extraction methodologies.
- **Yield Attributes:** At maturity, tubers from net plots were harvested and sorted into three distinct marketing classes: Small (<25 g), Medium (25–75 g), and Large (>75 g) (Barua, 2026) [1]. Total tuber yield was expressed in metric tons per hectare (t ha⁻¹).
- **Soil and Plant Nutrient Analysis:** Soil Organic Carbon (SOC) was determined using the Walkley and Black method, and Soil Microbial Biomass Carbon (SMBC) was assessed via the chloroform fumigation-extraction method (Barua, 2026) [1]. Nitrogen (N), phosphorus (P), and potassium (K) content in haulms and tubers were analyzed using standard analytical techniques (Barua, 2026) [1].

3. Results and Discussion

3.1 Growth Dynamics and Physiological Expressions

The vegetative and physiological parameters varied significantly between the two cultivars. 'Kufri Pukhraj' (V₂) displayed higher early plant height, leaf count, and shoot production compared to 'Kufri Jyoti' (V₁) across all growth stages. SPAD chlorophyll readings at 50 DAP indicated that 'Kufri Pukhraj' maintained higher chlorophyll levels during its peak vegetative phase, contributing to its rapid bulking ability (Manoj Kumar *et al.*, 2001; Gohain, 2025) [7, 3]. Among the nutrient management strategies, treatment T₅ (Zero Tillage + Paddy Straw Mulch + Integrated Organic Blend) resulted in the highest growth metrics. The inclusion of paddy straw mulching helped moderate soil moisture and temperature, creating favorable conditions for soil microbial activity and continuous nutrient mineralization (Lal *et al.*, 2022; Barua, 2026) [6, 1].

Table 1: Plant Growth Parameters and Physiological Traits at Peak Growth Stages (50 DAP)

Treatment	Cultivar	Plant Height (cm)	Number of Leaves per Plant	Number of Shoots per Hill	SPAD Chlorophyll Value	Tuber Dry Matter at Harvest (%)
T ₁ (Control)	Kufri Jyoti	32.4	22.5	3.1	35.4	18.2
	Kufri Pukhraj	36.8	26.1	3.4	38.2	16.5
T ₂ (FYM + Bio)	Kufri Jyoti	41.2	31.8	3.8	40.1	18.9
	Kufri Pukhraj	46.5	38.2	4.2	43.6	17.1
T ₃ (VC + Bio)	Kufri Jyoti	43.7	34.2	4.0	42.8	19.1
	Kufri Pukhraj	49.1	41.6	4.5	45.9	17.4
T ₄ (Organic Blend)	Kufri Jyoti	46.0	38.5	4.3	44.2	19.5
	Kufri Pukhraj	52.4	45.9	4.9	48.1	17.8
T ₅ (ZT + Mulch + Blend)	Kufri Jyoti	51.3	44.1	4.8	48.5	20.1
	Kufri Pukhraj	58.9	53.4	5.5	52.3	18.4
CD (P=0.05)	Cultivar (V)	1.8	1.5	0.2	1.1	0.4
	Treatment (T)	2.6	2.2	0.3	1.6	0.6

- **Morphological Superiority:** The data indicates that 'Kufri Pukhraj' responds robustly to organic fertilization during early vegetative growth. At 50 Days After Planting (DAP), it achieved a maximum height of 58.9 cm under treatment T₅, noticeably outperforming 'Kufri

Jyoti' (51.3 cm). This fast early canopy development explains its strong performance as an early-maturing, fast-bulking variety.

- **Physiological Efficiency:** The combination of an integrated organic blend with zero tillage and straw

mulching (T₅) led to the highest SPAD chlorophyll values (52.3 in 'Kufri Pukhraj' and 48.5 in 'Kufri Jyoti'). This points to efficient nitrogen mineralization from the organic inputs, which directly supports chlorophyll synthesis and helps maintain photosynthesis during critical bulking periods.

- **Dry Matter Allocation:** While 'Kufri Pukhraj' produced higher overall growth metrics and tuber yields, 'Kufri Jyoti' consistently maintained higher dry matter accumulation in its tubers across all treatments, peaking at 20.1% in T₅. This characteristic highlights 'Kufri Jyoti's strong processing quality and cooking

texture, even when grown using entirely organic production methods.

3.2 Tuber Grade Distribution and Yield

Tuber grade distribution was significantly affected by both cultivar choice and nutrient application. 'Kufri Pukhraj' produced a higher percentage of large-grade tubers (>75 g), which is consistent with its characteristics as a fast-bulking variety (Manoj Kumar *et al.*, 2001) [7]. 'Kufri Jyoti' produced a more balanced distribution of medium-grade tubers (25–75 g), making it highly suitable for general market table purposes.

Table 2: Grade-wise Tuber Distribution and Yield Attributes

Treatment	Cultivar	Yield of Small Tubers (<25 g, t ha ⁻¹)	Yield of Medium Tubers (25-75 g, t ha ⁻¹)	Yield of Large Tubers (>75 g, t ha ⁻¹)	Total Tuber Yield (t ha ⁻¹)
T ₁ (Control)	Kufri Jyoti	1.82	7.10	3.12	12.04
	Kufri Pukhraj	1.45	7.85	4.80	14.10
T ₂ (FYM + Bio)	Kufri Jyoti	1.95	10.40	5.22	17.57
	Kufri Pukhraj	1.30	11.20	7.90	20.40
T ₃ (VC + Bio)	Kufri Jyoti	1.60	11.15	6.45	19.20
	Kufri Pukhraj	1.12	12.05	9.10	22.27
T ₄ (Organic Blend)	Kufri Jyoti	1.50	12.30	7.20	21.00
	Kufri Pukhraj	1.05	13.40	10.55	25.00
T ₅ (ZT + Mulch + Blend)	Kufri Jyoti	1.22	13.90	9.80	24.92
	Kufri Pukhraj	0.92	14.85	13.95	29.72
CD (P=0.05)	Cultivar (V)	0.14	0.62	0.71	1.15
	Treatment (T)	0.22	0.94	1.12	1.68

The T₅ treatment combination resulted in the highest overall yield, with 'Kufri Pukhraj' producing a maximum total tuber yield of 29.72 t ha⁻¹. This represents a significant increase compared to conventional organic practices. The combination of zero tillage and mulching improved moisture retention and increased the proportion of large, marketable tubers (>75 g) by over 40% relative to the control, confirming trends observed in similar agro-climatic studies in the region (Barua, 2026) [1].

3.3 Nutrient Uptake and Soil Health Dynamics

Nutrient uptake (N, P, and K) in both haulms and tubers was higher in the T₅ treatment. The addition of bio-inoculants (*Azotobacter* and PSB) enhanced nitrogen fixation and phosphorus solubilization within the rhizosphere, matching the high nutrient demands of the crop (Begum, 2024) [2]. Soil health assessments after harvest showed that the zero tillage framework with paddy straw mulching (T₅) led to a 10.5% buildup of Soil Organic Carbon (SOC) and a significant increase in Soil Microbial Biomass Carbon (SMBC) compared to the unmulched treatments (T₁ to T₄). This increase in microbial biomass helps sustain biochemical cycling and improves the availability of essential plant nutrients (Hota *et al.*, 2022; Barua, 2026) [4, 1].

4. Conclusion

This study shows that organic nutrient management strategies can support high productivity in potato cultivation within the Central Brahmaputra Valley Zone of Assam. The early-maturing variety 'Kufri Pukhraj' achieved high yields (29.72 t ha⁻¹) when managed with an integrated organic framework combined with zero tillage and paddy straw

mulching. 'Kufri Jyoti' also performed reliably, showing good suitability for sustainable production systems. The combination of farmyard manure, vermicompost, microbial biofertilizers, and paddy straw mulching under zero tillage improved crop yields while enhancing soil organic carbon reserves and microbial activity. This integrated approach offers a practical framework for farmers in the Brahmaputra valley to transition toward sustainable, chemical-free potato production without sacrificing market yield.

References

1. Barua HJ. Zero tillage with paddy straw mulching is a promising technique for enhancing the yield and quality of potatoes. *Front Sustain Food Syst.* 2026;10:1705474.
2. Begum S. Diversity of mycoflora in the rhizosphere: A comparative study under organic and conventional farming practices. *J Assam down town Univ.* 2024;3(2):45-52.
3. Gohain T. A study on growth, yield, and quality traits of potato (*Solanum tuberosum* L.) varieties under the agro-climatic conditions of Nagaland, India. *Environ Ecol.* 2025;43(4):1005-1012.
4. Hota S, Mishra V, Mourya KK, Giri K, Kumar D, Jha PK, *et al.* Land use, landform, and soil management as determinants of soil physicochemical properties and microbial abundance of Lower Brahmaputra Valley, India. *Sustainability.* 2022;14(4):2241. doi:10.3390/su14042241.
5. Kakoti D. Assessment of impact, vulnerability, and farm households' adaptation in the context of climate change: A study on six agro-climatic zones of Assam, India. *Agric Res Sustain.* 2026;2(1):122-131.

6. Lal MK, Tiwari RK, Kumar A, Dey A, Kumar R, Kumar D, *et al.* Mechanistic concept of physiological, biochemical, and molecular responses of the potato crop to heat and drought stress. *Plants*. 2022;11(21):2857. doi:10.3390/plants11212857.
7. Kumar M, Trehan SP, Jatav MK, Lal SS. Efficacy of potato (*Solanum tuberosum*) cultivars under varying levels of nitrogen and growth duration in eastern Indo-Gangetic plains. *Indian J Agron*. 2001;54(1):63-68. doi:10.59797/ija.v54i1.4768.