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# Effect of Vrikshayurveda based natural farming inputs on soil properties, growth, yield and quality of pea

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## ABSTRACT

A pot experiment was conducted during the Rabi season of 2024–25 at the Centre of Advanced Studies in Plant Pathology, College of Agriculture, Govind Ballabh Pant University of Agriculture and Technology (GBPUA&T), Pantnagar, Uttarakhand, to evaluate the effect of Vrikshayurveda-based natural farming inputs on growth, yield, quality and soil properties of pea (*Pisum sativum* L.). The experiment was laid out in a Completely Randomized Design (CRD) with five treatments and three replications using the cultivar Arkel. Treatments comprised an absolute control, recommended dose of fertilizers (20:30:40 kg $N:P_2O_5:K_2O$ $ha^{-1}$) and different combinations of natural farming inputs including Beejamrit, Dashparni ark, Ghanjeevamrit, Panchgavya and Kunapajala. The results revealed that Vrikshayurveda-based inputs significantly improved crop growth, yield attributes, nutrient uptake and soil health. The maximum plant height at harvest (54.7 cm) was recorded under $T_4$, which was statistically at par with RDF (53.2 cm). Early flowering (40.3 days) and pod initiation (45.0 days) were also observed under $T_3$ and $T_4$ compared to the control. Among yield attributes, $T_4$ recorded the highest number of pods per plant (20.0), pod length (6.47 cm), grain weight per plant (64.4 g) and pod yield (6862.2 kg $ha^{-1}$), representing approximately 13% higher yield than RDF (6066 kg $ha^{-1}$) and significantly exceeding the control (4931.1 kg $ha^{-1}$). Grain nutrient content and nutrient uptake were also enhanced under natural farming treatments. Post-harvest soil analysis showed increased organic carbon (0.75%), available nitrogen (194.0 kg $ha^{-1}$), phosphorus (24.8 kg $ha^{-1}$), potassium (161.4 kg $ha^{-1}$) and microbial population under $T_3$ and $T_4$ compared with RDF and control. The study concluded that Vrikshayurveda-based natural farming inputs, particularly $T_4$, effectively improved pea productivity, nutrient uptake and soil fertility, indicating their potential as sustainable and eco-friendly alternatives to chemical fertilizers.

***Keywords:*** Vrikshayurveda, Natural farming, Panchgavya, Kunapajala, Ghanjeevamrit, Dashparni ark

## INTRODUCTION

India is the second-largest producer of vegetables in the world, with vegetable production increasing from 207.21 million tonnes in 2024 to 214.56 million tonnes in 2025. Despite this achievement, the country continues to face challenges related to food and nutritional security due to rising food prices, declining purchasing power and increasing pressure on natural resources. According to FAO (2023), approximately 370.7 million people in India remain undernourished, while a significant proportion of the population is unable to afford a healthy diet. Since the majority of Indian farmers are small and marginal landholders, the adoption of sustainable, low-cost and eco-friendly agricultural technologies has become increasingly important for maintaining productivity and ensuring food security (Singh *et al.,* 2023, Dabral *et al.,* 2025).

Pea (*Pisum sativum* L.) is an important cool-season legume crop cultivated worldwide for its nutritional value and contribution to sustainable agriculture. Pea grains contain about 19.7% protein, 56.6% carbohydrates and 4.4% iron, whereas fresh pods contain about 7.2% protein along with essential vitamins and minerals. In addition to its nutritional significance, pea improves soil fertility through biological nitrogen fixation, thereby reducing dependence on synthetic nitrogen fertilizers and enhancing soil health. However, optimum growth and yield of pea require adequate nutrient availability, particularly nitrogen and phosphorus, which play vital roles in root development, nodulation and pod formation (Chejara *et al.,* 2021).

The excessive and imbalanced use of chemical fertilizers in modern agriculture has resulted in declining soil fertility, nutrient-use inefficiency and environmental degradation. Consequently, increasing attention is being given to environmentally friendly alternatives such as natural farming inputs. Traditional formulations like Beejamrit improve seed germination and protect seedlings from soil-borne pathogens (Vyankatrao, 2019), while Panchgavya and Jeevamrit stimulate microbial activity, nutrient availability and crop productivity (Golakiya *et al.,* 2019). Similarly, Kunapajala and Dashparni ark function as plant growth promoters and natural biopesticides, enhancing plant health and resilience against pests and diseases (Nene, 2018; Palekar, 2006).

These formulations are integral components of Vrikshayurveda, the ancient Indian science of plant health management that advocates ecological balance, sustainable resource utilization and holistic crop production (Rananavare and Chitnis, 2024; Ahuja *et al*., 2018). Considering the growing need for sustainable nutrient management strategies, the present investigation was undertaken to assess the effect of Vrikshayurveda-based natural farming inputs on soil properties, growth, yield and quality of pea under controlled conditions. The study aims to identify suitable natural input combinations capable of enhancing crop productivity, improving soil health and promoting environmentally sustainable agricultural practices.

## MATERIALS AND METHODS

### Experimental Site and Soil Characteristics

A pot experiment was conducted under glasshouse conditions during the Rabi season of 2024–25 (November 2024 to March 2025) at the Centre of Advanced Studies in Plant Pathology, College of Agriculture, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India. The region is characterized by a humid subtropical climate with cool winters and occasional frost. About 85–90% of the annual rainfall is received during the southwest monsoon period from June to September. The experimental soil belonged to the Beni silty clay loam series, classified as Typic Hapludoll under Mollisols. Initial soil analysis revealed a neutral reaction (pH 7.45), electrical conductivity of 0.47 dS $m^{-1}$, organic carbon content of 0.64%, available nitrogen of 198.58 kg $ha^{-1}$, available phosphorus of 25.2 kg $ha^{-1}$ and available potassium of 179.35 kg $ha^{-1}$. The soil also contained $10.97 \times 10^8$ CFU $g^{-1}$ bacteria, $23.82 \times 10^3$ CFU $g^{-1}$ fungi and $14.39 \times 10^5$ CFU $g^{-1}$ actinomycetes.

### Experimental Design and Treatments

The experiment was laid out in a Completely Randomized Design (CRD) with three replications and five treatments. The treatments consisted of $T_1$: absolute control; $T_2$: recommended dose of fertilizer (20:30:40 kg N:$P_2O_5$ :$K_2O$ $ha^{-1}$); $T_3$: Beejamrit as basal treatment along with Dashparni ark (3%) and Ghanjeevamrit (10%) at 12-day intervals after seedling emergence (DIASe), Panchgavya (10%) at 20-day intervals and Kunapajala (5%) at 25-day intervals; $T_4$: Beejamrit as basal treatment along with Dashparni ark (3%) and Ghanjeevamrit (10%) at 20-day intervals, Panchgavya (10%) at 30-day intervals and Kunapajala (5%) at 30-day intervals; and $T_5$: Beejamrit as basal treatment along with Dashparni ark (3%) and Ghanjeevamrit (10%) at 30-day intervals, Panchgavya (10%) at 40-day intervals and Kunapajala (5%) at 35-day intervals.

### Crop Establishment and Cultural Practices

Seeds of pea variety 'Arkel' were obtained from the Vegetable Research Centre, GBPUA&T, Pantnagar. Pots of 5 kg capacity were filled with air-dried and sieved soil. In the RDF treatment, nutrients were supplied through urea, single superphosphate and muriate of potash, with half of the nitrogen applied as basal and the remaining half top-dressed at 30 days after sowing (DAS). Except for the RDF and absolute control treatments, seeds were treated by soaking in a 25% Beejamrit solution for 6 h before sowing. Nine seeds were sown in each pot in three rows. Thinning was carried out at 30 DAS by removing three weak seedlings per pot. Irrigation was applied weekly, while manual weeding was undertaken at 20-day intervals. Foliar applications of natural farming inputs were carried out using calibrated hand sprayers according to the respective treatment schedules.

**Preparation of Natural Farming Inputs**

Beejamrit was prepared by fermenting Badri cow dung (50 g), cow urine (50 mL), lime (2 g) and soil collected beneath Ficus benghalensis. Ghanjeevamrit was prepared by mixing cow dung (100 g), soil (100 g), jaggery (1 kg), pulse flour (1 kg) and cow urine (1 L), followed by incubation under shade for 48 h. Panchgavya was prepared through a 45-day fermentation process involving cow dung (100 g), ghee (100 mL), cow urine (500 mL), milk (200 mL), curd (100 mL) and one ripe banana. Kunapajala was prepared using cow dung (100 g), cow urine (300 mL), mustard cake (20 g), jaggery (10 g), sprouted urad (10 g), locally available weeds [Lantana camara, Parthenium hysterophorus and Alternanthera sessilis (25 g each)], paddy husk extract, milk (200 mL) and buttermilk (200 mL), followed by fermentation for 20–25 days. Dashparni ark was prepared using leaves of ten locally available plant species, namely Azadirachta indica, Ocimum basilicum, Ricinus communis, Mangifera indica, Nyctanthes arbor-tristis, Psidium guajava, Saraca asoca, Pimenta racemosa, Hibiscus rosa-sinensis and Murraya koenigii, along with cow urine, jaggery, garlic, turmeric and chilli.

**Observations Recorded and Analytical Methods**

Plant growth, yield and quality parameters including plant height, number of branches, days to first flowering, days to first pod formation, number of pods per plant, pod length, number of grains per pod, grain weight per plant and pod yield per plant were recorded at appropriate growth stages. Nitrogen content in grain and straw was determined using the Kjeldahl method, phosphorus by the vanado-molybdophosphoric yellow colour method and potassium by flame photometry.

**Soil Sampling and Analysis**

Soil samples were collected before sowing and after harvest and analyzed for chemical and microbiological properties using standard procedures. Soil pH and electrical conductivity were determined using glass electrode pH meter and conductivity meter methods, respectively. Organic carbon was estimated by the modified Walkley and Black (1934) method. Available nitrogen, phosphorus and potassium were determined by the alkaline $KMnO_4$ method, Olsen's extraction method and ammonium acetate extraction method, respectively. Total bacterial, fungal and actinomycete populations were estimated using Nutrient Agar, Martin's Rose Bengal Agar and Kenknight Agar media, respectively.

**Soil analysis**

The pre-sowing and post-harvest soil properties were analyzed for Chemical and Microbiological parameters using standard protocols described in Table 1. The initial soil samples had neutral reaction (7.45) with moderate salinity (0.47 dS/m) and medium organic content (0.70%). The initial soil had low nitrogen, high phosphorous and medium potassium content.

**Table 1.** Chemical and microbiological properties soil were analyzed before sowing and after harvest of crop using the standard outlined methods

| Parameters | Initial Value | Methods |
|---|---|---|
| pH (1:2 soil water suspension) | 7.45 | Glass electrode pH meter (Jackson, 1973) |
| Electrical conductivity (dS $m^{-1}$) | 0.47 | Bower & Wilcox (1965) |
| Organic carbon (%) | 0.64 | Modified Walkey and Black method (Jackson, 1973) |
| Available Nitrogen (N kg $ha^{-1}$) | 198.58 | Alkaline KMnO4 method (Subbiah and Asija, 1956) |
| Available Phosphorus ($P_2O_5$ kg $ha^{-1}$) | 25.2 | Olsen's extraction method (Olsen *et al.,* 1954) |
| Available Potassium ($K_2O$ kg $ha^{-1}$) | 179.35 | Ammonium acetate method (Perur, 1973) |
| Total bacteria (CFU $g^{-1}$) | $10.97 \times 10^8$ | Using Nutrient Agar medium (Atlas and Parks, 1993) |
| Total fungi (CFU $g^{-1}$) | $23.82 \times 10^3$ | Using Martin's Rose Bengal Agar media (Martin, 1950) |
| Total actinomycetes (CFU $g^{-1}$) | $14.39 \times 10^5$ | Using Kenknight Agar medium (Cappuccino and Shaman, 1996) |

**Table 2.** Effects of natural farming inputs on pea growth and yield parameters

| Treatments | Plant height (cm) | Number of branches per plant | Number of pods per plant | Pod length (cm) | Number of grains per pod | Grain weight (g plant$^{-1}$) | Pod yield (kg ha$^{-1}$) |
|---|---|---|---|---|---|---|---|
| | At Harvest | At Harvest | Total | At Harvest | Total | Total | Total |
| $T_1$ | 49.2 | 4.7 | 12.33 | 5.77 | 19.29 | 44.5 | 4931.11 |
| T2 | 53.2 | 4.3 | 18.33 | 6.41 | 21.49 | 56.2 | 6065.98 |
| T3 | 52.7 | 5.3 | 17.67 | 6.1 | 22.78 | 61.5 | 6533.64 |
| T4 | 54.7 | 5 | 20 | 6.47 | 21.87 | 64.4 | 6862.22 |
| T5 | 49.5 | 5 | 17.67 | 6.02 | 22.8 | 58.6 | 6489.01 |
| S.E(m) ± | 0.7 | 0.45 | 0.91 | 0.2 | 0.92 | 0.7 | 57.8 |
| CD (5%) | 2.2 | NS | 2.89 | NS | NS | 2.3 | 184.51 |

**Statistical Analysis**

The experimental data were subjected to analysis of variance (ANOVA) appropriate for a Completely Randomized Design (CRD). Treatment means were compared using the Least Significant Difference (LSD) test at the 5% level of significance following the procedure described by Gomez and Gomez (1984).

## RESULTS AND DISCUSSION

**Effect of natural farming inputs on pea growth, yield and quality**

At harvest, the tallest plants were observed in $T_4$ (54.7 cm), which was statistically at par with RDF: $T_2$ (53.2 cm) and $T_3$ (52.7 cm), while the lowest plant height was recorded in the control, $T_1$ (49.2 cm). The number of branches per plant was maximum in $T_3$ (5.3), followed by $T_4$ (5.0), whereas the minimum value was in $T_1$ (4.7) as described in Table 2. Earliest flowering was recorded in $T_3$ (40.3 days), closely followed by $T_4$ (40.7 days), while the lowest was observed in the control $T_1$ (42.3 days). Similarly, pod initiation was earliest in $T_4$ (45.0 days) and lowest in $T_1$ (47.7 days), indicating the positive influence of natural inputs in accelerating reproductive development.

The yield parameters of pea as shown in Table 2 were significantly influenced by natural farming inputs. The highest number of pods per plant was recorded in $T_4$ (20.0), statistically at par with $T_2$ (18.3) and $T_3$ (17.7). Pod length was maximum in $T_5$ (6.85 cm), which was statistically similar to $T_4$ (6.73 cm), $T_3$ (6.53 cm) and $T_2$ (6.31 cm). Grain weight per plant was significantly superior in $T_4$ (64.4 g), followed by $T_3$ (61.5 g), with the minimum in $T_1$ (44.5 g). The total pod yield per plant was also maximum in $T_4$ (6862.2 kg ha$^{-1}$), which was about 13% higher than RDF (6066 kg ha$^{-1}$). Overall, $T_4$ consistently outperformed other treatments across yield traits, whereas the control recorded the lowest values.

The nutrient content of pea grains and straw as shown in Fig. 1 varied significantly under different treatments. In straw, the highest nitrogen was recorded in $T_2$ (2.56%), followed by $T_3$ (2.42%). Phosphorus content in straw was maximum in $T_4$ (0.28%), statistically at par with $T_2$ (0.24%) and $T_5$ (0.25%). Potassium content in straw was highest in $T_4$ (2.49%), at par with $T_2$ (2.39%), $T_3$ (2.30%) and $T_5$ (2.45%). In grains, nitrogen content was highest in $T_2$ (3.15%) having at par values to $T_3$ (3.12%) and $T_4$ (3.09%). Phosphorus content in grains was maximum in $T_4$ (0.36%), statistically similar to $T_2$ (0.32%). Potassium content in grains was significantly higher in $T_4$ (2.24%) statistically similar to $T_2$ (2.16%), $T_3$ (2.13%) and $T_5$ (2.13%). Nutrient uptake followed a similar pattern: in straw, maximum N, P and K uptake was observed in $T_2$ (25.26, 2.41 and 79.89 kg ha$^{-1}$, respectively) and $T_4$ (22.89, 2.84 and 88.61 kg ha$^{-1}$, respectively). In grains, nutrient uptake was highest in $T_4$ (N: 110.07, P: 12.76, K: 23.03 kg ha$^{-1}$), significantly superior to all other treatments. Overall, $T_4$ consistently enhanced nutrient content and uptake in both grains and straw, whereas control recorded the lowest values.

**Effect of natural farming inputs on soil properties**

Post-harvest soil analysis under pea revealed significant differences among treatments that are shown in Table 3. Soil pH remained statistically non-significant, ranging from 7.23 in $T_3$ to 7.56 in $T_4$. Electrical conductivity (EC) showed significantly higher value in $T_3$ (0.68 dS m$^{-1}$) and $T_2$ (0.67 dS m$^{-1}$), both at par to each other and significantly higher to

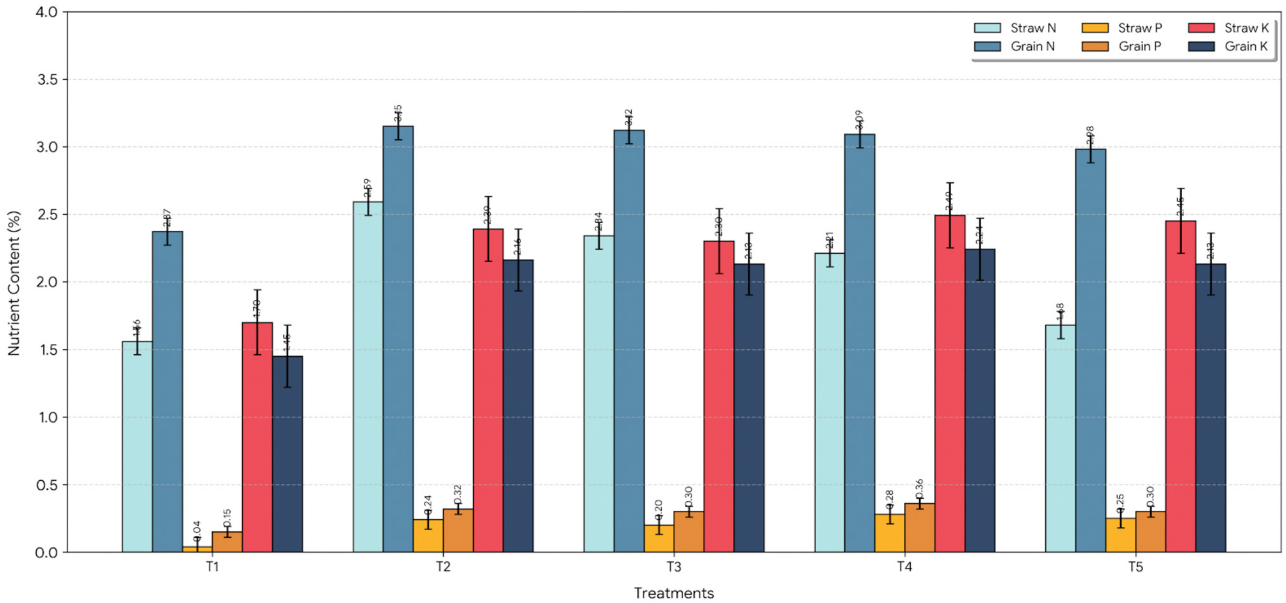


**Fig. 1.** Comprehensive N, P and K content of Pea Grains and straw across all treatments

**Table 3.** Effects of natural farming inputs on chemical soil properties

| Treatments | pH | EC | OC (%) | Available N (kg $ha^{-1}$) | Available $P_2O_5$ (kg $ha^{-1}$) | Available K (kg $ha^{-1}$) |
|---|---|---|---|---|---|---|
| $T_1$ | 7.43 | 0.40 | 0.70 | 174.1 | 18.3 | 138.0 |
| T2 | 7.54 | 0.67 | 0.70 | 176.9 | 22.9 | 154.2 |
| T3 | 7.23 | 0.68 | 0.75 | 181.6 | 24.8 | 157.1 |
| T4 | 7.56 | 0.55 | 0.72 | 193.8 | 23.6 | 161.4 |
| T5 | 7.43 | 0.53 | 0.71 | 194.4 | 20.7 | 145.4 |
| S.E(m) ± | 0.11 | 0.01 | 0.04 | 2.1 | 0.8 | 2.2 |
| CD (5%) | NS | 0.02 | NS | 6.7 | 2.5 | 7.0 |

other treatments. Organic carbon content in $T_5$ (0.71%) is 7.4% higher than RDF. Available nitrogen ranged from 174.1 kg $ha^{-1}$ in $T_1$ to 194.0 kg $ha^{-1}$ in $T_5$, $T_5$ is statistically at par with $T_4$ (193.8 kg $ha^{-1}$) and both are significantly higher than RDF (176.9 kg $ha^{-1}$). Available phosphorus was in $T_3$ (24.8 kg $ha^{-1}$) is at par with $T_2$ (22.9 kg $ha^{-1}$) and $T_4$ (23.6 kg $ha^{-1}$), while the lowest was observed in $T_1$ (18.3 kg $ha^{-1}$). Available potassium is significantly higher in $T_4$ (161.4 kg $ha^{-1}$) which is statistically similar to $T_3$ (157.1 kg $ha^{-1}$) and $T_2$ (154.2 kg $ha^{-1}$), while significantly higher than $T_5$ (145.4 kg $ha^{-1}$) and $T_1$ (138.0 kg $ha^{-1}$).

Microbial populations in soil also improved under natural inputs, with significantly high bacterial count in $T_3$ ($27.9 \times 10^8$ CFU $g^{-1}$), fungal population in $T_4$ ($7.9 \times 10^3$ CFU $g^{-1}$) and actinomycetes in again $T_4$ ($8.9 \times 10^5$ CFU $g^{-1}$). Overall, natural farming inputs, particularly $T_3$ and $T_4$, enhanced soil fertility and microbial activity compared to RDF and control as described in Fig 2.

## Discussion

The superior performance of pea under Vrikshayurveda based natural farming inputs, particularly in $T_4$, was attributed to the synergistic effect of microbial inoculation, organic matter enrichment and bioactive compounds present in formulations like Panchgavya, Ghanjeevamrit and Kunapajala. The increase in plant height, branching and early flowering in $T_3$ and $T_4$ is supported by the findings of Gowthamchand *et al.* (2020), who reported that Beejamrit and Panchgavya sprays significantly enhanced vegetative growth in French bean due to hormonal stimulation and better nutrient uptake. The higher pod number, grain weight and yield in $T_4$ agreed with the results of Dutta *et al.* (2018), where Panchgavya sprays improved green pod yield in pea and with Ruban *et al.* (2019), who found Panchgavya enhanced fruit set in brinjal. The improvement in protein content and nutrient uptake in grains and straw aligned with Choudhary *et al.* (2017), who observed higher N, P, K uptake and

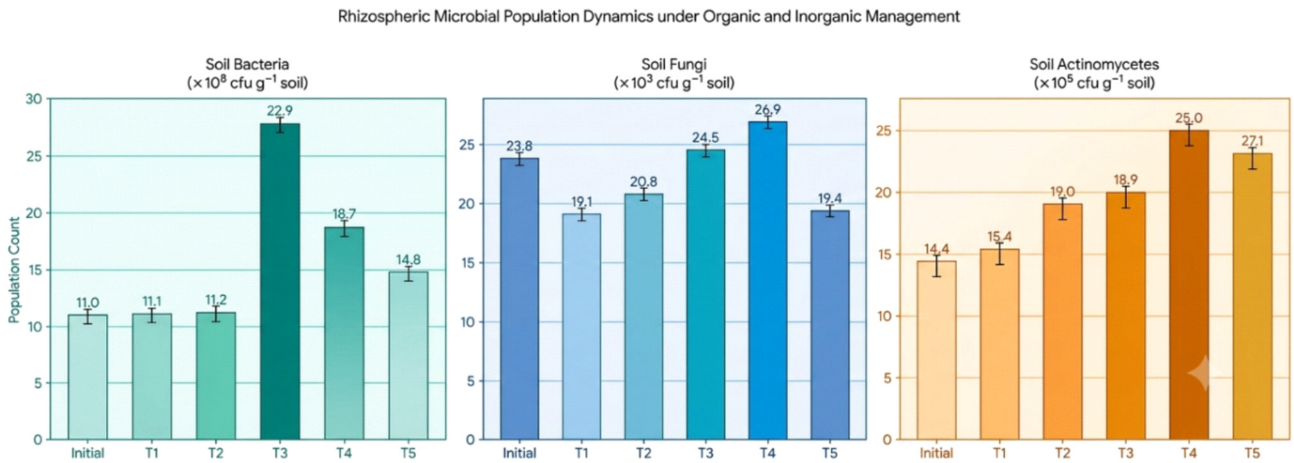


**Fig. 2.** Bacteria, Fungi and Actinomycetes population in post-harvest soil of pea

protein content in blackgram after Panchgavya application and with Ram *et al.* (2024), who reported increased seed yield in Ashwagandha when Kunapajala was integrated with other natural inputs.

The enhanced soil fertility under $T_3$ and $T_4$ can be explained by the rich microbial diversity and organic carbon provided by these inputs, which promoted mineralization and nutrient cycling. Similar effects were noted by Korat and Mathukia (2022), where natural farming performed at par with conventional farming through chemical fertilizers in maintaining soil nutrient status in chickpea–wheat cropping systems. Frequent applications of $T_3$ enriched microbial counts, while applications of $T_4$ ensured sustained nutrient release, together resulting in improved crop growth and soil health. Overall, these results suggest that Vrikshayurveda based inputs act as bio-stimulants and nutrient reservoirs, improving both productivity and sustainability in pea cultivation.

## CONCLUSION

The present investigation revealed that Vrikshayurveda based natural farming inputs significantly enhanced growth, yield, quality and soil fertility in pea. Among the treatments, $T_4$ (Beejamrit- basal + Dashparni ark (3%) and Ghanjeevamrit (10%) at every 20 DIASe + Panchgavya (10%) at every 30 DIASe + Kunapajala (5%) at every 30 DIASe) consistently outperformed others and recorded significantly high plant height, early flowering, maximum pod number, grain weight and yield in pea, it also significantly improved protein content and nutrient uptake. Post-harvest soil analysis showed that natural inputs, particularly $T_3$ and $T_4$, enriched organic carbon, available NPK and microbial populations, thereby sustaining soil health. These findings establish that natural farming inputs are effective alternatives to chemical fertilizers, capable of improving crop productivity while maintaining ecological balance. Adoption of such Vrikshayurveda based practices can contribute to sustainable agriculture, reduced dependency on synthetic inputs and long-term soil fertility restoration.

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### Competing Interests

The authors declare that they have no competing interests. The first author carried out the experimental work and data collection under the supervision of the second author. The third and corresponding author assisted in manuscript preparation, editing, and data analysis but had no involvement in conducting the experiment or generating the experimental data and results.

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