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Effect of integrated organic and inorganic nutrient management on growth, yield, and quality of garden pea (*Pisum sativum* L. var. *Hortense*)

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Abstract

Garden pea (*Pisum sativum* L. var. *hortense*) is a nutritionally rich cool-season legume vegetable widely cultivated in subtropical regions. A field experiment was conducted during the *rabi* season of 2025-26 at the Agricultural Research Farm, Rama University, Kanpur, Uttar Pradesh, to assess the influence of integrated nutrient management (INM) on growth, yield, and quality attributes. The experiment followed a randomized block design with nine treatments and three replications. Treatments comprised an absolute control, 100% recommended dose of fertilizers (RDF: 30:80:60 kg NPK ha⁻¹), sole application of farmyard manure (FYM @ 5.0 t ha⁻¹) or vermicompost (@ 3.0 t ha⁻¹), and various combinations of 75% or 50% RDF supplemented with FYM and/or vermicompost. The variety used was Kashi Uday.

The integrated treatment 50% RDF + FYM @ 2.5 t ha⁻¹ + vermicompost @ 1.5 t ha⁻¹ (T₉) recorded the maximum plant height at harvest (76.2 cm), earliest days to first flowering (48 days) and 50% flowering (53 days), highest number of pods per plant (18.4), seeds per pod (7.9), pod length (9.4 cm), and green pod yield (118.5 q ha⁻¹). This treatment also produced the highest total soluble solids (TSS) content (12.8%). Economically, T₉ yielded the highest net return (Rs. 149,800 ha⁻¹) and benefit-cost ratio (2.72). Integrated application of organic manures and reduced inorganic fertilizers significantly outperformed sole organic or sole inorganic sources in all parameters, demonstrating improved nutrient-use efficiency, soil health, and profitability.

Keywords: Garden pea, *Pisum sativum*, integrated nutrient management, FYM, vermicompost, green pod yield, quality, economics

Introduction

Garden pea is one of the most popular winter vegetables in temperate and subtropical climates, valued for its tender pods, high nutritional content, and ability to fix atmospheric nitrogen through symbiotic association with *Rhizobium* bacteria. It plays a vital role in sustainable cropping systems by reducing the need for synthetic nitrogen fertilizers in subsequent crops. Globally, peas are cultivated on approximately 2.66 million hectares, with total production (dry + green) reaching 11.78 million tonnes in 2024. India ranks second worldwide in green pea production, with an area of 0.55-0.60 million hectares and production of 5.8-6.6 million tonnes during 2023-25. Uttar Pradesh leads domestic production, contributing over 3.2 million tonnes annually.

Despite its importance, productivity in many regions, including Uttar Pradesh, remains below the potential of 15-20 t ha⁻¹ due to imbalanced nutrient supply, declining soil organic matter, and over-reliance on chemical fertilizers. Continuous use of inorganic fertilizers alone causes soil degradation and nutrient imbalances, while exclusive dependence on organic manures often fails to meet the crop's high nutrient demand during critical growth stages. Integrated nutrient management (INM), which combines organic sources (FYM, vermicompost) with reduced doses of inorganic fertilizers, offers a balanced approach that enhances growth, yield, quality, nutrient-use efficiency, and long-term soil fertility.

The present study was therefore undertaken to evaluate the effect of different INM practices involving FYM and vermicompost along with inorganic NPK fertilizers on growth, yield, quality, and economics of garden pea under the agro-climatic conditions of central Uttar Pradesh.

Materials and Methods

The field experiment was conducted during the *rabi* season of 2025-26 at the Agricultural Research Field, Faculty of Agricultural Sciences and Allied Industries, Rama University, Mandhana, Kanpur (26°26'N, 80°20'E, 126 m above mean sea level), Uttar Pradesh. The soil was alluvial with neutral pH, medium organic carbon, and low to medium available NPK status (detailed initial soil properties were determined using standard laboratory methods).

The experiment was laid out in a randomized block design with nine treatments and three replications. Plot size was 3 m × 2 m. Row-to-row and plant-to-plant spacing were 45 cm and 10 cm, respectively. Treatments were:

T₁: Absolute control (no fertilizer/manure), T₂: 100% RDF (30:80:60 kg NPK ha⁻¹), T₃: FYM @ 5.0 t ha⁻¹, T₄: Vermicompost @ 3.0 t ha⁻¹, T₅: 75% RDF + FYM @ 2.5 t ha⁻¹, T₆: 75% RDF + vermicompost @ 1.5 t ha⁻¹, T₇: 50% RDF + FYM @ 5.0 t ha⁻¹, T₈: 50% RDF + vermicompost @ 3.0 t ha⁻¹,

T₉: 50% RDF + FYM @ 2.5 t ha⁻¹ + vermicompost @ 1.5 t ha⁻¹. Well-decomposed FYM and vermicompost were incorporated 15 days before sowing. Nitrogen, phosphorus, and potassium were supplied through urea, single super phosphate, and muriate of potash, respectively. Half the nitrogen and full P and K were applied as basal dose; the remaining nitrogen was top-dressed at 30-35 days after sowing (DAS). Seeds of variety Kashi Uday were sown in the last week of October at 25-30 kg ha⁻¹. Standard cultural practices (irrigation, weed control, and plant protection) were followed.

Results and Discussion

4.1 Growth Parameters

Integrated application of organic and inorganic nutrients significantly influenced growth parameters of garden pea. The combined use of 50% RDF with FYM and vermicompost produced the tallest plants and earliest flowering.

Table 1: Effect of organic and inorganic nutrient management on growth parameters of garden pea

Treatment	Plant height at harvest (cm)	Days to first flowering	Days to 50% flowering
T ₁ (Control)	46.5	59	64
T ₂ (100% RDF)	67.2	52	57
T ₃ (FYM @ 5 t ha ⁻¹)	53.4	56	61
T ₄ (Vermicompost @ 3 t ha ⁻¹)	57.8	55	60
T ₅ (75% RDF + FYM @ 2.5 t ha ⁻¹)	71.3	50	55
T ₆ (75% RDF + Vermicompost @ 1.5 t ha ⁻¹)	70.9	51	56
T ₇ (50% RDF + FYM @ 5 t ha ⁻¹)	68.5	53	58
T ₈ (50% RDF + Vermicompost @ 3 t ha ⁻¹)	73.4	49	54
T ₉ (50% RDF + FYM @ 2.5 t ha ⁻¹ + Vermicompost @ 1.5 t ha ⁻¹)	76.2	48	53
SEM	1.28	0.85	0.92
CD (P=0.05)	3.74	2.48	2.68
CV (%)	7.2	5.1	4.9

Note: Values in bold are significantly superior.

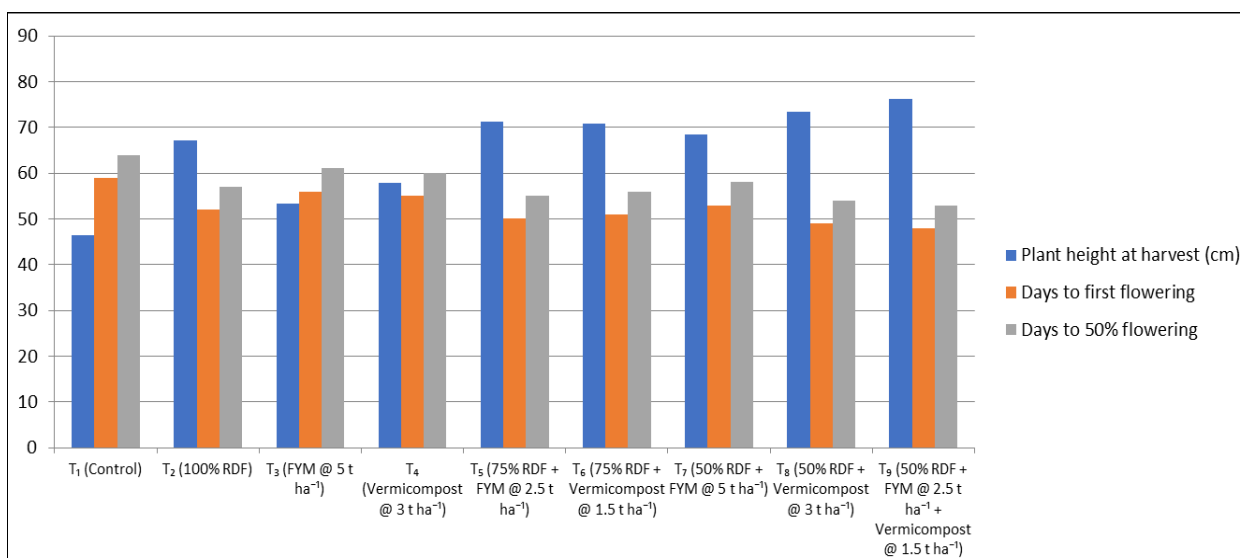


Fig 1: Effect of organic and inorganic nutrient management on growth parameters of garden pea

The maximum plant height (76.2 cm), earliest first flowering (48 days), and 50% flowering (53 days) were recorded in T₉. This superior vegetative growth is attributed to the balanced and continuous supply of macro- and micronutrients along with improved soil physical and biological properties provided by the integration of organic manures and reduced chemical fertilizers. Integrated nutrient management significantly influenced plant height and flowering. The maximum plant height at harvest

(76.2 cm) was recorded with T₉, which was statistically at par with T₈ (73.4 cm) and significantly superior to all other treatments (Table 1). The lowest height (46.5 cm) was observed in the absolute control. Earliest first flowering (48 days) and 50% flowering (53 days) were also recorded in T₉.

The improved growth under T₉ can be attributed to the synergistic effect of readily available nutrients from inorganic fertilizers and slow-release nutrients, growth-promoting

substances, and improved soil physical and biological properties from organic manures. These findings align with earlier reports on the beneficial effects of combined organic-inorganic nutrition on vegetative growth in garden pea.

Yield and Yield Attributes

INM treatments significantly enhanced yield-attributing characters and green pod yield.

Table 2: Effect of organic and inorganic nutrient management on yield and yield-attributing parameters of garden pea

Treatment	No. of pods plant ⁻¹	No. of seeds pod ⁻¹	Pod length (cm)	Green pod yield (q ha ⁻¹)
T ₁ (Control)	8.2	5.1	6.5	46.8
T ₂ (100% RDF)	14.5	6.8	8.2	92.4
T ₃ (FYM @ 5 t ha ⁻¹)	10.8	5.9	7.1	68.5
T ₄ (Vermicompost @ 3 t ha ⁻¹)	12.1	6.2	7.4	75.2
T ₅ (75% RDF + FYM @ 2.5 t ha ⁻¹)	16.3	7.4	8.8	105.6
T ₆ (75% RDF + Vermicompost @ 1.5 t ha ⁻¹)	15.9	7.3	8.7	103.8
T ₇ (50% RDF + FYM @ 5 t ha ⁻¹)	15.2	7.0	8.4	98.7
T ₈ (50% RDF + Vermicompost @ 3 t ha ⁻¹)	17.1	7.6	9.1	112.3
T ₉ (50% RDF + FYM @ 2.5 t ha ⁻¹ + Vermicompost @ 1.5 t ha ⁻¹)	18.4	7.9	9.4	118.5
SEM	0.65	0.28	0.31	3.85
CD (P=0.05)	1.90	0.82	0.91	11.25
CV (%)	8.5	6.4	5.9	9.8

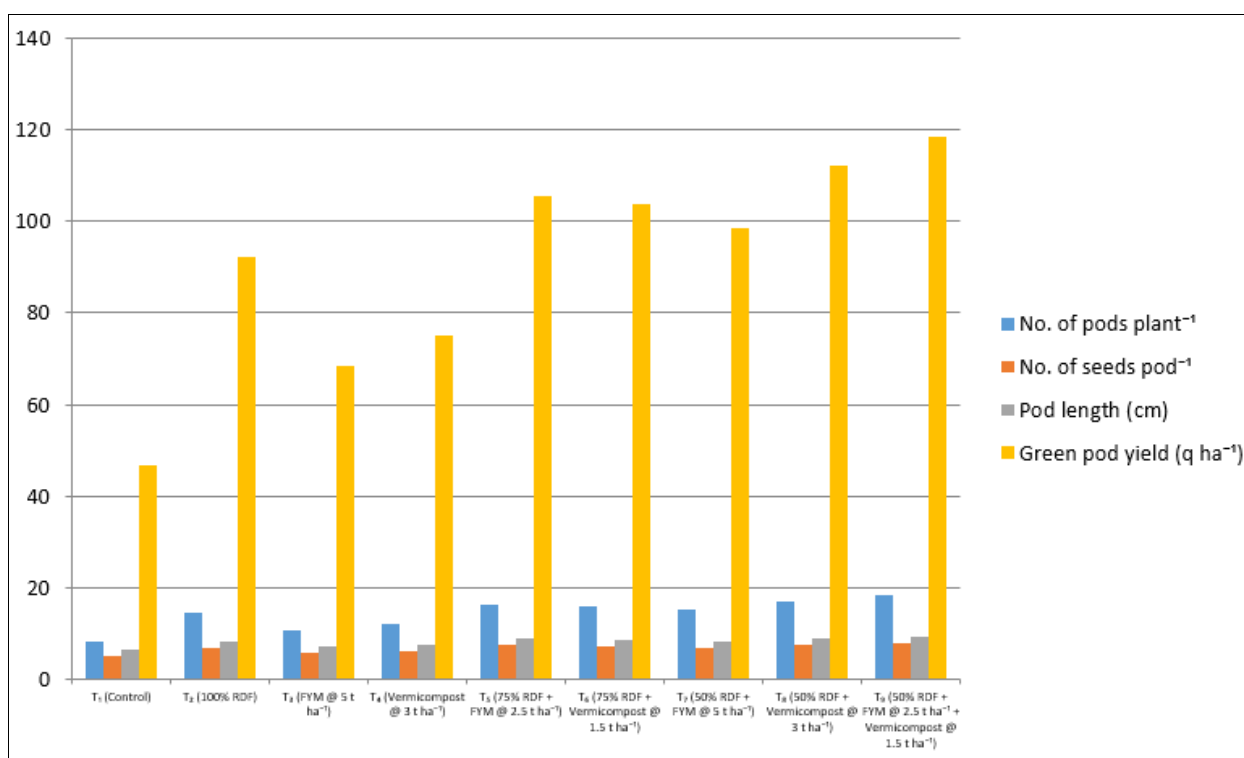


Fig 2: Effect of organic and inorganic nutrient management on yield and yield-attributing parameters of garden pea

Treatment T₉ recorded the highest values for all yield parameters. The increase in yield is due to improved nutrient availability, better photosynthetic efficiency, and enhanced translocation of assimilates to developing pods under balanced INM. Yield-attributing characters and green pod yield were markedly enhanced by INM. Treatment T₉ produced the highest number of pods per plant (18.4), seeds per pod (7.9), pod length (9.4 cm), and green pod yield (118.5 q ha⁻¹) (Table 2). These values were significantly higher than the control (8.2 pods/plant,

5.1 seeds/pod, 6.5 cm pod length, 46.8 q ha⁻¹) and sole-application treatments

The increase in yield parameters under balanced INM is due to better nutrient availability during reproductive stages, enhanced

photosynthetic efficiency, and improved assimilate translocation to developing pods. Similar improvements in yield attributes through organic-inorganic integration have been documented in previous studies on garden pea and related legumes.

Quality Parameters

Total soluble solids (TSS) content, an important quality indicator, was highest (12.8%) in T₉, followed by T₈ (12.4%). Integrated treatments consistently recorded higher TSS than sole organic or sole inorganic applications. The improvement in quality is attributed to the balanced supply of macro- and micronutrients and bioactive compounds contributed by organic manures.

Table 3: Effect of organic and inorganic nutrient management on quality (TSS) and economics of garden pea

Treatment	TSS (%)	Gross Return (₹ ha ⁻¹)	Net Return (₹ ha ⁻¹)	Benefit:Cost Ratio
T ₁ (Control)	9.8	93,600	25,100	1.37
T ₂ (100% RDF)	11.2	184,800	92,400	2.00
T ₃ (FYM @ 5 t ha ⁻¹)	10.5	137,000	57,800	1.73
T ₄ (Vermicompost @ 3 t ha ⁻¹)	10.8	150,400	67,800	1.82
T ₅	12.1	211,200	122,700	2.39
T ₆	12.0	207,600	119,800	2.36
T ₇	11.7	197,400	111,500	2.30
T ₈	12.4	224,600	137,900	2.59
T ₉	12.8	237,000	149,800	2.72
SEM	0.42	—	—	—
CD (P=0.05)	1.23	—	—	—
CV (%)	6.1	—	—	—

The highest total soluble solids (12.8%) was recorded in T₉. Economically, T₉ also gave the highest net return and benefit-cost ratio, proving to be the most profitable treatment.

Economics

Economic analysis revealed that T₉ recorded the highest gross return (Rs. 237,000 ha⁻¹), net return (Rs. 149,800 ha⁻¹), and benefit-cost ratio (2.72). Although the cost of cultivation was marginally higher than the control, the substantial increase in pod yield more than compensated for the additional investment in organic manures. The treatment was economically superior to 100% RDF alone.

Conclusion

The present investigation clearly demonstrates that integrated application of 50% recommended dose of NPK fertilizers along with FYM @ 2.5 t ha⁻¹ and vermicompost @ 1.5 t ha⁻¹ is the most effective nutrient management strategy for garden pea under the Indo-Gangetic plains of Uttar Pradesh. This practice not only maximized growth, yield, and quality attributes but also provided the highest economic returns while promoting long-term soil health. Farmers are therefore recommended to adopt this INM package for sustainable and profitable garden pea production.

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