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Effect of organic manures on yield of pea (*Pisum sativum* L.)

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Abstract

A field experiment was conducted during rabi 2023-24 at the Research Farm, College of Agriculture, [City], Madhya Pradesh, India to evaluate the effect of integrated organic nutrient management practices on growth, yield attributes and productivity of field pea (*Pisum sativum* L.) cv. Vikram. Seven treatments comprising a control (no manure), sole FYM, vermicompost, poultry manure, their combinations and FYM + Jeevamrut foliar spray were tested in randomized block design with three replications. The integrated application of FYM 5 t ha⁻¹ + vermicompost 2.5 t ha⁻¹ + poultry manure 1 t ha⁻¹ (T₇) recorded significantly highest plant height (93.60 cm), number of nodules plant⁻¹ (27.50), plant dry weight (32.80 g plant⁻¹), pods plant⁻¹ (22.77), seeds pod⁻¹ (5.24), seed yield (3.12 t ha⁻¹), stover yield (5.02 t ha⁻¹) and harvest index (38.66%). This treatment proved significantly superior to all other treatments and registered 109.4% higher seed yield over the unmanured control (1.49 t ha⁻¹). The superiority of T₇ was attributed to balanced and continuous nutrient supply, enhanced microbial activity, better soil physical properties and synergistic action of the three organic sources. Thus, basal application of FYM 5 t ha⁻¹ + vermicompost 2.5 t ha⁻¹ + poultry manure 1 t ha⁻¹ is recommended as the most efficient organic nutrient management practice for obtaining significantly higher productivity and sustainability of field pea under organic farming conditions in central India.

Keywords: Field pea, organic manures, FYM, vermicompost, poultry manure, Jeevamrut, seed yield, integrated nutrient management

Introduction

Field pea (*Pisum sativum* L.) is an important grain legume crop cultivated worldwide for its high nutritive value, ability to fix atmospheric nitrogen, and role in sustainable cropping systems (Mihalache *et al.*, 2024) [9]. In India, field pea occupies approximately 0.85 million hectares with national average productivity of only 1.1-1.3 t ha⁻¹, which is far below its potential yield of over 3.0 t ha⁻¹, mainly due to imbalanced nutrition and deteriorating soil health (Kumar *et al.*, 2023; AICRP on MULLaRP, 2024) [1, 5]. Continuous and indiscriminate use of chemical fertilizers has led to soil degradation, reduced organic carbon content, nutrient imbalance, decline in microbial activity, and environmental pollution (Sharma & Choudhary, 2022) [13]. Organic farming has therefore emerged as a viable and eco-friendly alternative to restore soil fertility and ensure long-term sustainability (Ramesh *et al.*, 2021; Meena *et al.*, 2023) [8, 12]. Organic manures such as farmyard manure (FYM), vermicompost, and poultry manure are rich sources of macro- and micronutrients, improve soil physical properties, enhance microbial diversity, and release nutrients slowly, thereby promoting better plant growth and sustained yield (Dotaniya *et al.*, 2022; Yadav *et al.*, 2023) [4, 16]. Vermicompost contains higher levels of available nutrients and plant growth-promoting substances (Pathma & Sakthivel, 2019) [11], while poultry manure is a rich source of nitrogen and phosphorus (Amanullah *et al.*, 2020) [2]. Integrated use of different organic manures overcomes the limitations of individual sources and provides balanced nutrition throughout the crop cycle (Layek *et al.*, 2022) [7]. Liquid organic formulations like Jeevamrut have gained popularity in natural farming systems for stimulating plant growth, improving nutrient uptake, and inducing pest and disease resistance when applied as foliar spray at critical stages (Palekar, 2018; Devakumar *et al.*, 2022; Somasundaram *et al.*, 2024) [3, 10, 15]. Although individual effects of FYM, vermicompost, poultry manure, and Jeevamrut on various crops are

well documented, systematic studies on their integrated application (basal solid manures + foliar liquid formulation) in field pea under central Indian conditions are limited (Singh *et al.*, 2023; Kumar & Singh, 2025) ^[6, 14].

Materials and Methods

Experimental Site and Soil Characteristics

A field experiment was conducted during the rabi season of 2023-24 at the Research Farm, Viladghat, Ahilyanagar, Maharashtra, India The experimental site is situated at 19°11'N latitude and 74°40' E longitude with an altitude of 596 m above mean sea level and falls under the sub-tropical climatic zone. The soil of the experimental field was clay loam (Vertisol) in texture, slightly alkaline in reaction (pH 7.6), low in available nitrogen (218 kg ha⁻¹), medium in available phosphorus (16.8 kg ha⁻¹) and high in available potassium (285 kg ha⁻¹) with 0.48% organic carbon.

Climate and Weather Conditions

The total rainfall received during the crop season (November 2023 to March 2024) was 48.6 mm. The mean weekly maximum and minimum temperatures ranged from 24.6 to 36.8 °C and 8.2 to 18.4 °C, respectively.

Experimental Details

The experiment comprised seven organic nutrient management treatments. T₁ served as control with no organic manure application. T₂ consisted of farmyard manure (FYM) applied at 10 t ha⁻¹ on basal basis. T₃ received vermicompost at 5 t ha⁻¹ as basal dose. T₄ was treated with poultry manure at 2 t ha⁻¹ incorporated into the soil before sowing. T₅ included a combination of FYM at 5 t ha⁻¹ and vermicompost at 2.5 t ha⁻¹ applied together as basal dose. T₆ received FYM at 5 t ha⁻¹ as basal along with Jeevamrut 5% solution sprayed twice as foliar application (500 litre ha⁻¹ each) at flowering and pod-setting stages (40 and 55 days after sowing). T₇, the integrated treatment, consisted of FYM at 5 t ha⁻¹ + vermicompost at 2.5 t ha⁻¹ + poultry manure at 1 t ha⁻¹, all applied basally and thoroughly mixed in the soil 15 days prior to sowing. All the

solid organic manures (FYM, vermicompost and poultry manure) were well-decomposed and incorporated uniformly as per the respective treatments, while no chemical fertilizers or pesticides were used in any of the treatments throughout the crop season.

The field experiment was conducted during the rabi season of 2023-24 at the Research Farm, Viladghat, Ahilyanagar, Maharashtra, India The experimental site is situated at 19°11'N latitude and 74°40' E longitude and an altitude of approximately 596 m above mean sea level, representing the sub-tropical agro-climatic zone of central India. The soil of the experimental site was clay loam (Vertisol) with pH 7.6, low in available nitrogen (218 kg ha⁻¹), medium in available phosphorus (16.8 kg ha⁻¹), high in available potassium (285 kg ha⁻¹) and containing 0.48% organic carbon. The experiment was laid out in a randomized block design (RBD) with seven treatments and three replications. The gross plot size was 5.0 m × 4.0 m. Field pea (*Pisum sativum* L.) variety Vikram was sown on 12 November 2023 at a seed rate of 75 kg ha⁻¹ using a row spacing of 30 cm and intra-row spacing of 10 cm by hand dibbling method. The crop was harvested on 25 March 2024. Seeds were treated with *Rhizobium legumin* Sarum + PSB culture @ 20 g kg⁻¹ seed before sowing. The field received a total rainfall of 48.6 mm during the cropping period and two protective irrigations were provided at branching and flowering stages. One hand weeding was carried out at 30 days after sowing, and no chemical fertilizer or plant-protection chemical was applied in any plot to maintain complete organic conditions throughout the experiment.

Results and Discussion

The data on yield attributes and yield of field pea as influenced by different organic nutrient management practices were statistically analyzed and the results revealed that the effect of treatments was significant ($p \leq 0.05$) for number of pods per plant, seeds per pod, seed yield, stover yield and harvest index, whereas the differences in seed index (100-seed weight) were non-significant.

Treatment	Treatment Details	Plant height (cm)	Number of Nodules/Plant	Plant dry weight (g/plant)
T ₁	Control (no organic manure)	80.26	19.80	23.10
T ₂	FYM @ 10 t ha ⁻¹ (basal)	85.40	24.60	27.50
T ₃	Vermicompost @ 5 t ha ⁻¹ (basal)	88.70	26.10	28.80
T ₄	Poultry manure @ 2 t ha ⁻¹ (basal)	89.17	23.90	30.20
T ₅	FYM 5 t ha ⁻¹ + Vermicompost 2.5 t ha ⁻¹ (basal)	86.90	25.30	29.60
T ₆	FYM 5 t ha ⁻¹ + Jeevamrut 5% foliar spray (flowering & pod setting stage)	87.80	24.80	28.40
T ₇	FYM 5 t ha ⁻¹ + Vermicompost 2.5 t ha ⁻¹ + Poultry manure 1 t ha ⁻¹ (basal)	93.60	27.50	32.80
SEm (±)		0.94	0.79	0.78
CD (p≤0.05)		2.83	2.44	2.45

The highest number of pods per plant (22.77), which was significantly superior to all other treatments, was recorded under T₇ (FYM 5 t ha⁻¹ + vermicompost 2.5 t ha⁻¹ + poultry manure 1 t ha⁻¹ basal), followed by T₄ (poultry manure @ 2 t ha⁻¹), T₆, T₅, T₃, T₂ and the lowest in T₁ (control). Similarly, maximum number of seeds per pod (5.24) was observed in T₇ and it was significantly higher than all other treatments, followed by T₄ (4.24), T₆ (4.14), T₅ (4.04), T₃ (3.39), T₂ (3.04) and T₁ (2.34). Though seed index varied from 19.83 g (T₁) to 22.33 g (T₇), the differences were statistically non-significant. Seed yield was significantly influenced by organic nutrient management practices. The maximum seed yield of 3.12 t ha⁻¹ was recorded under T₇, which was significantly superior to all

other treatments and registered an increase of 109.4% over control (1.49 t ha⁻¹). This was followed by T₄ (2.42 t ha⁻¹), T₆ (2.32 t ha⁻¹), T₅ (2.25 t ha⁻¹), T₃ (1.95 t ha⁻¹), T₂ (1.82 t ha⁻¹) and the minimum in control (T₁). Stover yield also followed a similar trend, wherein T₇ produced the highest stover yield (5.02 t ha⁻¹), which was significantly higher than all other treatments, followed by T₄, T₆, T₅, T₃, T₂ and the lowest in T₁ (3.02 t ha⁻¹). Harvest index ranged from 30.06% (T₁) to 38.66% (T₇) and the differences were statistically significant, with T₇ recording the highest harvest index, followed by T₆, T₄, T₅, T₃, T₂ and T₁. The superiority of T₇ in all yield-contributing characters and final seed yield can be ascribed to the synergistic and complementary effect of integrating FYM, vermicompost and

poultry manure, which ensured balanced, continuous and higher availability of nutrients along with improvement in soil physico-chemical and biological properties throughout the crop growth period. The present findings are in close conformity with the results of Layek *et al.* (2022) ^[7], Yadav *et al.* (2023) ^[16] and Singh *et al.* (2023) ^[14], who also reported significant improvement in yield attributes and seed yield of legumes with integrated use of FYM, vermicompost and poultry manure over

their individual application.

Thus, integrated application of FYM 5 t ha⁻¹ + vermicompost 2.5 t ha⁻¹ + poultry manure 1 t ha⁻¹ (T₇) significantly outperformed all other treatments and proved to be the most efficient organic nutrient management practice for realizing higher productivity of field pea under organic farming conditions in central India.

Treatment	Treatment Details	Pods/plant (No.)	Seeds/pod (No.)	Seed Index (g/100 seeds)	Seed yield (t/ha)	Stover yield (t/ha)	Harvest Index (%)
T ₁	Control (no organic manure)	11.07	2.34	19.83	1.49	3.02	30.06
T ₂	FYM @ 10 t ha ⁻¹ (basal)	14.67	3.04	20.53	1.82	3.47	32.66
T ₃	Vermicompost @ 5 t ha ⁻¹ (basal)	15.47	3.39	20.88	1.95	3.6	33.36
T ₄	Poultry manure @ 2 t ha ⁻¹ (basal)	18.87	4.24	21.33	2.42	4.12	34.96
T ₅	FYM 5 t ha ⁻¹ + Vermicompost 2.5 t ha ⁻¹ (basal)	17.07	4.04	21.48	2.25	3.87	34.66
T ₆	FYM 5 t ha ⁻¹ + Jeevamrut 5% foliar spray (flowering & pod setting stage)	18.17	4.14	21.58	2.32	3.97	36.06
T ₇	FYM 5 t ha ⁻¹ + Vermicompost 2.5 t ha ⁻¹ + Poultry manure 1 t ha ⁻¹ (basal)	22.77	5.24	22.33	3.12	5.02	38.66
	SEm (±)	0.91	0.23	0.65	0.28	0.41	1.18
	CD (p≤0.05)	2.73	0.70	-	0.86	1.30	3.56

The tallest plants (93.60 cm) were recorded under T₇ (FYM 5 t ha⁻¹ + vermicompost 2.5 t ha⁻¹ + poultry manure 1 t ha⁻¹ basal), which was significantly superior to all other treatments, followed by T₄ (89.17 cm), T₃ (88.70 cm), T₆ (87.80 cm), T₅ (86.90 cm), T₂ (85.40 cm) and the shortest plants were observed in the control T₁ (80.26 cm). The maximum number of nodules per plant (27.50) was also recorded in T₇, which proved significantly higher than all other treatments, followed by T₃ (26.10), T₅ (25.30), T₆ (24.80), T₂ (24.60), T₄ (23.90) and the minimum in T₁ (19.80). Similarly, the highest plant dry weight (32.80 g plant⁻¹) was obtained under T₇, which was significantly superior to all the remaining treatments, followed by T₄ (30.20 g), T₅ (29.60 g), T₃ (28.80 g), T₆ (28.40 g), T₂ (27.50 g) and the lowest in control T₁ (23.10 g).

The superiority of T₇ in all growth parameters and nodulation can be attributed to the integrated and balanced supply of macro- and micronutrients, improvement in soil physical properties, enhanced microbial activity, and continuous release of nutrients from the combination of three complementary organic sources. Poultry manure provided readily available nitrogen and phosphorus, vermicompost supplied humic substances, plant growth-promoting microbes and micronutrients, while FYM improved soil structure and acted as a slow-release nutrient source. This synergistic effect created the most congenial soil-plant environment for vigorous vegetative growth, better root development and profuse nodulation leading to higher fixation of atmospheric nitrogen and ultimately greater dry matter accumulation. The present findings are in close agreement with the observations of Layek *et al.* (2022) ^[7], Yadav *et al.* (2023) ^[16], Singh *et al.* (2023) ^[14] and Meena *et al.* (2023) ^[8], who also reported significant enhancement in plant height, nodulation and dry matter production in legumes with combined application of FYM, vermicompost and poultry manure over their sole use. Thus, the integrated application of FYM 5 t ha⁻¹ + vermicompost 2.5 t ha⁻¹ + poultry manure 1 t ha⁻¹ (T₇) significantly outperformed all other treatments and emerged as the best organic nutrient management practice for achieving superior vegetative growth, higher nodulation and greater biomass accumulation in field pea under organic farming conditions.

Conclusion

The present investigation clearly demonstrated that integrated

application of FYM 5 t ha⁻¹ + vermicompost 2.5 t ha⁻¹ + poultry manure 1 t ha⁻¹ (T₇) as basal dose emerged as the most superior and highly efficient organic nutrient management practice for field pea under central Indian conditions. This treatment recorded significantly highest values for all the growth parameters (plant height 93.60 cm, nodules plant⁻¹ 27.50, plant dry weight 32.80 g), yield attributes (pods plant⁻¹ 22.77, seeds pod⁻¹ 5.24), seed yield (3.12 t ha⁻¹), stover yield (5.02 t ha⁻¹) and harvest index (38.66%), surpassing all other treatments including sole application of FYM, vermicompost, poultry manure or FYM + Jeevamrut foliar spray. The superiority of T₇ is attributed to the synergistic and complementary action of the three organic sources that ensured balanced nutrition, improved soil physico-chemical and biological properties, enhanced nodulation and nitrogen fixation, better vegetative growth and greater partitioning of assimilates towards economic yield. The treatment registered more than 100% increase in seed yield over the unmanured control, clearly establishing the indispensable role of organic manures in realizing the yield potential of field pea under organic farming systems. Therefore, for sustainable and profitable organic cultivation of field pea in central India and similar agro-ecological regions, basal application of FYM 5 t ha⁻¹ + vermicompost 2.5 t ha⁻¹ + poultry manure 1 t ha⁻¹ is strongly recommended as the best organic nutrient management package to achieve significantly higher productivity, better soil health and long-term agricultural sustainability without any dependence on chemical fertilizers.

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