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Response of organic and inorganic fertilizers on growth parameters of field pea (*Pisum sativum* L.)

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Abstract

The experiment "Response of organic and inorganic fertilizers on growth and yield of field pea (*Pisum sativum* L.)" was conducted at the Agricultural Research Farm, Faculty of Agricultural Sciences and Allied Industries, Rama University, Kanpur, during the rabi season of 2025-26. Nine treatments comprising various levels of Recommended Dose of Fertilizers (RDF), organic manures (Vermicompost and FYM), and biofertilizers (Rhizobium) were evaluated in a Randomized Block Design with three replications. The results indicated that the application of RDF 100% + Vermicompost 5 t/ha + FYM 10 t/ha + Rhizobium (T₉) significantly improved all growth parameters. Treatment T₉ recorded the maximum final plant population (52.33 m⁻²), plant height at harvest (70.90 cm), number of branches per plant (11.66), and dry matter accumulation (730.00 g m⁻²). Additionally, it reduced the days to 50% flowering (47.66 days) and maturity (104.50 days). It is concluded that integrating chemical fertilizers with organic and biological sources promotes vigorous vegetative growth in field pea.

Keywords: Field pea, integrated nutrient management, vermicompost, FYM, rhizobium, growth parameters

Introduction

Field pea (*Pisum sativum* L.) is a vital cool-season annual pulse crop belonging to the Fabaceae family, with a diploid chromosome number of 14. Originating in Ethiopia and spreading across Europe and Asia, the plant is herbaceous legume characterized by weak, slender stems, pinnate leaves with terminal tendrils, and distinct white, pink, or purple flowers. Beyond its morphological traits, field pea plays a critical role in sustainable agriculture by enhancing soil fertility through biological nitrogen fixation via root nodules.

The crop is highly valued for its dense nutritional profile, playing a vital role in international food security. Dry pea seeds contain 20 to 25% protein by dry weight and offer a robust profile of essential amino acids, particularly lysine, making them an excellent complement to cereal-based diets. Approximately 60% of the seed comprises carbohydrates, primarily starch, complemented by a high dietary fiber content (17-27%) that supports intestinal health and blood sugar regulation. Furthermore, field peas are low in fat and sodium while providing essential minerals (potassium, phosphorus, magnesium, iron, zinc, copper, manganese) and vital B vitamins, including thiamin, folate, vitamin B6, and vitamin K (Mudryj *et al.*, 2014) [8].

Despite its agricultural and nutritional importance, the cultivation of field peas faces challenges linked to conventional farming practices. The persistent overuse of artificial fertilizers to maximize yield has degraded the physical, chemical, and biological characteristics of soils, contributing to environmental degradation and threatening long-term crop sustainability. Consequently, a shift toward organic nutrient management is imperative to maintain soil health and ensure steady crop output.

Organic manures increase soil organic matter, enhancing aggregation, structure, and water-retention capacity. By gradually releasing essential macro- and micronutrients, they minimize nitrogen loss and improve cation exchange (Tadesse *et al.*, 2013) [20].

Regular application promotes the development of beneficial soil microbes, improving enzyme activity, carbon sequestration, and crop resistance to environmental stressors (Sahu *et al.*, 2024) [13].

As a leguminous crop, field peas form a symbiotic relationship with *Rhizobium* bacteria present in their root nodules. Treating pulse seeds with appropriate *Rhizobium* strains is an economical method to boost biological nitrogen fixation, leaving behind 50–60 kg/ha of residual nitrogen in the soil (Negi *et al.*, 2006; Rao *et al.*, 2014)^[9, 12].

Combined with organic inputs like FYM, this enhanced rhizosphere activity increases natural nitrogen availability, subsequently raising seed protein levels and crop yields (Samprass *et al.*, 2024)^[14].

Materials and Methods

The experiment was carried out at the Agricultural Research Farm, Faculty of Agricultural Sciences and Allied Industries, Rama University, Kanpur, Uttar Pradesh, during the rabi season of 2025-26. The soil of the experimental site was sandy loam in texture, low in available nitrogen and organic carbon, medium in available phosphorus and potassium, and slightly alkaline in reaction.

The variety Prakash (IPFD 1-10) was sown at a recommended seed rate of 75 kg/ha with a spacing of 30 x 10 cm. The experiment was laid out in a Randomized Block Design (RBD) with 9 treatments and 3 replications. The treatments evaluated different proportions of RDF combined with Vermicompost, FYM, and *Rhizobium* seed inoculation: T₁ (Control), T₂ (RDF 75% + Vermicompost 10 t/ha), T₃ (RDF 75% + FYM 20 t/ha), T₄ (RDF 75% + *Rhizobium*), T₅ (RDF 75% + Vermicompost 5 t/ha + FYM 10 t/ha + *Rhizobium*), T₆ (RDF 100% + Vermicompost 5 t/ha), T₇ (RDF 100% + FYM 10 t/ha), T₈ (RDF 100% + *Rhizobium*), and T₉ (RDF 100% + Vermicompost 5 t/ha + FYM 10 t/ha + *Rhizobium*). Biometric observations for growth parameters were recorded at 30, 60 days after sowing (DAS), and at harvest. Data were statistically analyzed using analysis of variance (ANOVA) at a 5% level of significance.

Result and Discussion

Plant Height

Plant height increased progressively with the advancement of crop growth stages, reaching its maximum at the time of harvest. At harvest, the maximum plant height (70.90 cm) was recorded under T₉ (RDF 100% + Vermicompost 5 t/ha + FYM 10 t/ha + *Rhizobium*), which was significantly superior to the control T₁ (57.96 cm). The combination of 100% RDF along with organic

manures and biofertilizers (T₉) resulted in a 22.3% increase in plant height over the control. This considerable increase is attributed to the stimulation of root and shoot growth, which enhances nutrient absorption and root system efficacy (Sharma and Chauhan, 2011)^[17]. The data found similar with the findings of Khan *et al.* (2017)^[3], Jan *et al.* (2019)^[2], Parween *et al.* (2019)^[10] and Desai *et al.* (2020)^[1].

Number of Branches

The number of branches was significantly enhanced by integrated nutrient applications. At the harvest stage, the significantly highest number of branches per plant (11.66) was recorded under T₉ (RDF 100% + Vermicompost 5 t/ha + FYM 10 t/ha + *Rhizobium*). The minimum branches at this stage were recorded with T₁ (Control) at 7.50. Such enhancement is likely due to the integrated treatments inducing higher activity in the chloroplast and antioxidant enzyme systems, improving branching (Singh *et al.*, 2012)^[19]. The data corresponds with the findings of Lalito *et al.* (2018)^[7], Seerangan *et al.* (2019)^[15] and Parween *et al.* (2019)^[10].

Dry Matter Accumulation

Dry matter accumulation was maximized across all growth intervals under treatment T₉, which recorded 52.76, 342.16, and 730.00 g m⁻² at 30, 60 DAS, and harvest, respectively. Conversely, the T₁ (Control) treatment consistently exhibited the poorest performance throughout the crop cycle, terminating with 548.36 g m⁻² at harvest. This rise is the result of cumulative vigorous growth and an increased leaf area, creating a larger photosynthetic surface for nutrient intake. The data obtained in this study is comparable to the findings of Singh *et al.* (2016)^[18] and Lakshmiopathy *et al.* (2017)^[6].

Days to 50% Flowering and Maturity

Integrated nutrient management significantly accelerated the crop's phenological development, with treatment T₉ achieving the earliest 50% flowering at 47.66 days and the earliest maturity at 104.50 days. In contrast, the maximum duration for both parameters was consistently observed in the T₁ (Control), which took 56.33 days to reach 50% flowering and 112.66 days to mature. Findings corroborate the work of Kothiyari *et al.* (2017)^[4], Pawar *et al.* (2017)^[11] and Kumar *et al.* (2017)^[5].

Table 1: Response of Organic and Inorganic Fertilizers on plant height and number of branches per plant

S. No.	Treatments	Plant height (cm)			Number of branches per plant		
		30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest
T ₁	Control	25.12	39.62	57.96	1.66	4.06	7.50
T ₂	RDF 75% + Vermicompost 10 t/ha	25.36	40.46	58.79	1.96	4.50	8.00
T ₃	RDF 75% + FYM 20 t/ha	25.50	43.16	61.50	2.06	4.66	8.33
T ₄	RDF 75% + <i>Rhizobium</i>	25.66	43.74	62.07	2.33	4.96	8.50
T ₅	RDF 75% + Vermicompost 5 t/ha + FYM 10 t/ha + <i>Rhizobium</i>	25.79	45.29	63.64	2.50	5.06	9.06
T ₆	RDF 100% + Vermicompost 5 t/ha	25.88	47.86	66.20	2.66	5.33	9.66
T ₇	RDF 100% + FYM 10 t/ha	26.08	49.20	67.54	2.76	5.66	10.50
T ₈	RDF 100% + <i>Rhizobium</i>	26.34	50.47	68.82	2.83	5.96	10.83
T ₉	RDF 100% + Vermicompost 5 t/ha + FYM 10 t/ha + <i>Rhizobium</i>	26.54	52.56	70.90	2.96	6.06	11.66
	SE(m)±	0.467	0.374	0.827	0.029	0.040	0.130
	C.D. at 5%	NS	1.131	2.499	0.087	0.120	0.393

Table 2: Response of Organic and Inorganic Fertilizers on on dry matter accumulation, days to 50% flowering, and maturity

S. No.	Treatments	Dry matter accumulation (g m ⁻²)			Days to 50% Flowering	Days to maturity
		30 DAS	60 DAS	At harvest		
T ₁	Control	31.54	258.63	548.36	56.33	112.66
T ₂	RDF 75% + Vermicompost 10 t/ha	35.98	281.80	585.82	55.96	110.33
T ₃	RDF 75% + FYM 20 t/ha	39.90	317.21	687.66	55.50	109.50
T ₄	RDF 75% + Rhizobium	42.89	297.90	628.65	54.66	107.66
T ₅	RDF 75% + Vermicompost 5 t/ha + FYM 10 t/ha + Rhizobium	44.77	304.18	642.47	53.16	106.46
T ₆	RDF 100% + Vermicompost 5 t/ha	47.83	312.07	663.97	52.33	106.0
T ₇	RDF 100% + FYM 10 t/ha	5.17	327.95	706.05	50.53	105.53
T ₈	RDF 100% + Rhizobium	50.74	336.00	718.30	49.46	105.06
T ₉	RDF 100% + Vermicompost 5 t/ha + FYM 10 t/ha + Rhizobium	52.76	342.16	730.00	47.66	104.50
	SE(m)±	0.633	5.707	10.099	0.980	1.232
	C.D. at 5%	1.915	17.256	30.539	2.962	3.725

Conclusion

The study clearly demonstrates that an Integrated Nutrient Management approach is crucial for optimizing the vegetative growth of field pea. The application of RDF 100% + Vermicompost 5 t/ha + FYM 10 t/ha + Rhizobium (T₉) emerged as the best practice, significantly boosting plant population, plant height, branching, and dry matter accumulation while shortening the time to flowering and maturity.

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