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Influence of seed treatment and foliar spray of zinc and iron enhance soil health of garden pea (*Pisum sativum* L.) var. AP-3

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Abstract

A Field Experiment was titled “Influence of Seed Treatment and Foliar Spray of Zinc and Iron Enhance Soil Health of Garden pea (*Pisum sativum* var. hortense L. cv. AP-3)” was conducted during Rabi Season 2025 -26 at the Soil Science Research Farm, Department of Soil Science, Prof. Rajendra Singh (Rajju Bhaiya) University, Naini, Prayagraj- 211010 (U.P.) India. The experiment was laid out in Randomized Block Design with Nine treatments which are replicated thrice. The result showed that Physico-Chemical Properties of soil was observed Maximum bulk density 1.343 Mg m⁻³ and particle density 2.551 Mg m⁻³ was observed in T₁ (control), highest Pore space 52.32%, Water holding capacity 52.64%, soil pH 7.27%, Electrical Conductivity 0.441 dSm⁻¹ and Organic Carbon 0.535% was recorded in T₄ (Rhizobium @ 30 g + PSB @ 30 g kg⁻¹ seed), highest available Nitrogen 22.81 kg ha⁻¹, available Phosphorous 20.12 kg ha⁻¹ and available Potassium 209.03 kg ha⁻¹ was observed in T₉ (RDF 100% NPK), higher zinc 0.408 mg kg⁻¹ and higher iron 6.40 mg kg⁻¹ was recorded in T₅ (ZnSO₄@ 3 g kg⁻¹ seed) and T₆ (FeSO₄@ 3 g kg⁻¹ seed). Whereas, the results revealed that application of T₄ (Rhizobium @ 30 g + PSB @ 30 g kg⁻¹ seed) is an effective nutrient management strategy for improving soil fertility of garden pea.

Keyword: Garden pea, physico-chemical properties of soil, zinc, iron

Introduction

Garden pea (*Pisum sativum* L.) is one of the most important leguminous vegetable crops grown during the Rabi season in India. It is one of the most important cool-season vegetable crops belonging to the family *Fabaceae*. It is widely cultivated throughout temperate and subtropical regions of the world for its tender green pods and seeds, which are rich in proteins, carbohydrates, vitamins, and minerals. The sweet pea, or garden pea (*Pisum sativum* L. var. Hortense), is a popular vegetable grown for its freshly shelled green seeds. The tender, juvenile, and mature, dry pods of peas are the reason they are farmed. Mature, dried pods are used as pulses, whereas immature pods are used as fresh vegetables. In both cases, the pea seeds are extracted from the pod and utilized as pulses or vegetables (Kumari and Deka, 2021). The garden pea is an annual, cool-season legume belonging to the Leguminosae family, with a chromosome number of (2n=2x=14). It is a self-pollinating crop, ranking as the second most significant food legume worldwide (Duygu and Idikut, 2023). In addition to its nutritional importance, pea cultivation improves soil fertility through biological nitrogen fixation in association with Rhizobium bacteria, thereby reducing the dependence on synthetic nitrogen fertilizers. Subcontinent and occupies a vital position in Indian agriculture due to its nutritional, economic, and ecological importance.

India is both the largest producer and consumer of pulses in the world, accounting for nearly one-fourth of the global pulse acreage and total production. At present, the country consumes approximately 26.0 million tonnes of pulses annually (Kumar *et al.*, 2022) [7]. Uttar Pradesh is the leading pea-producing state contributing nearly half of the country's total production, followed by Madhya Pradesh and Bihar. Since the year 2000, global vegetable production has increased by 71%, reaching 1.17 billion tonnes by 2022. The National Horticulture Board (2024) [2] states that India produced 204.96 million metric tonnes of vegetables across 11.11 million hectares (Anonymous, 2024). Despite the increasing demand for vegetable peas, productivity remains low in many parts of India because of imbalanced fertilization,

micronutrient deficiencies, poor soil health, and inadequate nutrient management strategies (Ahmed *et al.*, 2022) ^[1].

Seed coating is a promising technology in which beneficial microbial cultures and essential micronutrients such as zinc (Zn) and iron (Fe) are applied directly to the seed surface to improve germination, enhance nutrient uptake, and promote root nodulation. Foliar spray during growth stages ensures quick nutrient availability, minimizes nutrient losses from soil and promotes physiological processes leading to higher yield. Therefore, combining seed coating with foliar spray of micronutrients may significantly improve growth, yield and soil sustainability in garden pea production (Oliveira *et al.*, 2016) ^[10].

Materials and methods

The experiment was laid out during Rabi 2025-26 at the Soil Science Research Farm, Department of Soil Science, PRSU, Naini, Prayagraj-211010 (U.P.). Experiment was laid out in randomized block design with nine treatments replicated three times. Plot size was 2 x 2 m² for crop, seed rate is 75-80 kg ha⁻¹ (*Pisum sativum* L.) Var.AP-3. Treatments consist of nine combination T₁ (control), T₂ (Rhizobium @ 30 g kg⁻¹ seed), T₃ (PSB @ 30 g kg⁻¹ seed), T₄ (Rhizobium @ 30 g + PSB @ 30 g kg⁻¹ seed), T₅ (ZnSO₄@ 3 g kg⁻¹ seed), T₆ (FeSO₄ @ 3 g kg⁻¹ seed), T₇ (Carbendazim @ 2.5 g kg⁻¹ seed), T₈ (Foliar spray of ZnSO₄ and FeSO₄ @ 0.3%), T₉ (RDF 100%). RDF for NPK = 40:80:40 kg ha⁻¹.

The physical properties of the soil samples, namely bulk density (Mg m⁻³), particle density (Mg m⁻³), pore space (%), and water-holding capacity (%), were determined standard analytical procedures described by Muthuvel *et al.* (1992) ^[10]. The chemical properties of the soil samples were analysed using standard analytical procedures. Soil pH (1:2 soil-water suspension) was determined by the method of Jackson (1973) ^[6]. Electrical conductivity (dSm⁻¹) was estimated using the method described by Wilcox (1950). Organic carbon (%) was determined by the Walkley and Black's method (1934). Available nitrogen (kg ha⁻¹) was estimated by the method of Subbiah and Asija (1956) ^[12], while available phosphorus (kg ha⁻¹) was determined using the Olsen *et al.* (1954) ^[11], Available potassium (kg ha⁻¹) was estimated by the method of Toth and Prince (1949) ^[13]. Available Zn and Fe were determined by Lindsay and Norvell (1978) procedure using DTPA extractant ^[15, 16].

Results and discussion

Effect of all treatment on Soil Physical Properties

Bulk density (Mg m-3)

The data presented in table 1 and depicted in fig. 1 clearly shows the bulk density (Mg m-3) of soil as influenced by organic and inorganic source of nutrients. The maximum bulk density of soil was recorded 1.343 Mg m-3 at 0-15 cm

and 1.376 Mg m-3 at 15-30 cm in treatment T₁ (control) followed by 1.315 Mg m-3 at 0-15 cm and 1.348 Mg m-3 at 15-30 cm in treatment T₈ (foliar spray of ZnSO₄ and Fe SO₄) and minimum bulk density of soil was recorded 1.227 Mg m-3 at 0-15 cm and 1.261 Mg m-3 at 15-30 cm in treatment T₄ (Rhizobium @ 30 g + PSB @ 30 g kg⁻¹ seed) respectively. Comparable outcomes were stated by Yadav *et al.* (2021) ^[17].

Particle density (Mg m-3)

The data presented in table 1 and depicted in fig. 1 clearly shows the particle density (Mg m-3) of soil as influenced by organic and inorganic source of nutrients. The maximum particle density of soil was recorded 2.511Mg m-3 at 0 -15 cm and 2.551Mg m-3 at 15- 30 cm was recorded in treatment T₁ (control) which was followed by 2.481Mg m-3 at 0 -15 cm and 2.532 Mg m-3 at 15- 30 cm was recorded in treatment T₈ (ZnSO₄ and FeSO₄ @ 0.3%). Whereas, Minimum 2.339 Mg m-3 at 0 -15 cm and 2.387 Mg m-3 at 15- 30 cm was recorded in treatment T₄ (Rhizobium @ 30 g + PSB @ 30 g kg⁻¹ seed) respectively. Analogous trend was observed by Vasava *et al.* (2020) and Yadav *et al.* (2021) ^[14, 17].

Pore space (%)

The data presented in table 1 and depicted in fig. 1 clearly shows the pore space (%) of soil as influenced by organic and inorganic source of nutrients. The maximum pore space of soil was recorded 52.64% at 0-15 cm and 51.16% at 15-30 cm was recorded in treatment T₄(Rhizobium @ 30 g + PSB @ 30 g kg⁻¹ seed) which was followed by 51.16% at 0 -15 cm and 50.93% at 15-30 cm was recorded in treatment T₂(Rhizobium @ 30 g kg⁻¹ seed). Whereas, Minimum 45.81% at 0 -15 cm and 42.40% at 15- 30 cm was recorded in treatment T₁(Control) respectively. Equivalent results were observed by Hussain *et al.* (2022) ^[4].

Water holding capacity (%)

The data presented in table 1 and depicted in fig. 1 clearly shows the water holding capacity (%) of soil as influenced by organic and inorganic source of nutrients. The maximum water holding capacity of soil was recorded 52.32% at 0 -15 cm and 50.47% at 15- 30 cm was recorded in treatment T₄ (Rhizobium @ 30 g + PSB @ 30 g kg⁻¹ seed) which was followed by 51.77% at 0 -15 cm and 50.16% at 15- 30 cm was recorded in treatment T₂ (Rhizobium @ 30 g kg⁻¹seed). Whereas, Minimum 43.21% at 0 -15 cm and 42.57% at 15- 30 cm was recorded in treatment T₁(Control) respectively. The results were comparable to previous studies by Vasava *et al.* (2020) and Yadav *et al.* (2021) ^[14, 17].

Table 1: Effect of all treatments on bulk density (Mg m-3), Particle density (Mg m-3), Pore space (%) and Water holding capacity (%) of soil

Treatments	Bulk density (Mg m ⁻³)		Particle density (Mg m ⁻³)		Pore space (%)		Water holding capacity (%)	
	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
T ₁ Control	1.343	1.376	2.511	2.551	45.81	42.40	43.21	42.57
T ₂ Rhizobium @ 30 g kg ⁻¹ seed TreatmentT	1.273	1.283	2.349	2.440	51.16	50.93	50.77	49.16
T ₃ PSB @ 30 g k ⁻¹ seed TreatmentT	1.283	1.294	2.376	2.473	48.68	44.74	47.93	44.63
T ₄ Rhizobium @ 30 g + PSB @ 30 g kg ⁻¹ seed	1.227	1.261	2.339	2.387	52.64	51.16	52.32	50.47
T ₅ ZnSO ₄ @ 3 g kg ⁻¹ seed TreatmentT	1.293	1.311	2.429	2.503	47.61	46.41	46.43	45.02
T ₆ FeSO ₄ @ 3 g kg ⁻¹ seed TreatmentT	1.306	1.316	2.448	2.519	50.93	49.21	47.80	49.05

T ₇	Carbendazim @ 2.5 g kg ⁻¹ seed	1.301	1.309	2.383	2.476	49.96	48.61	48.93	48.39
T ₈	Foliar spray of ZnSO ₄ and FeSO ₄ @ 0.3%	1.315	1.348	2.481	2.532	46.07	45.63	45.87	43.75
T ₉	RDF 100%	1.280	1.292	2.366	2.457	48.53	46.51	47.41	46.38
	F-Test	NS	NS	NS	NS	S	S	S	S
	S.Ed. (±)	-	-	-	-	0.83	1.40	1.41	1.27
	C.D. at 0.5%	-	-	-	-	1.77	2.98	3.01	2.70

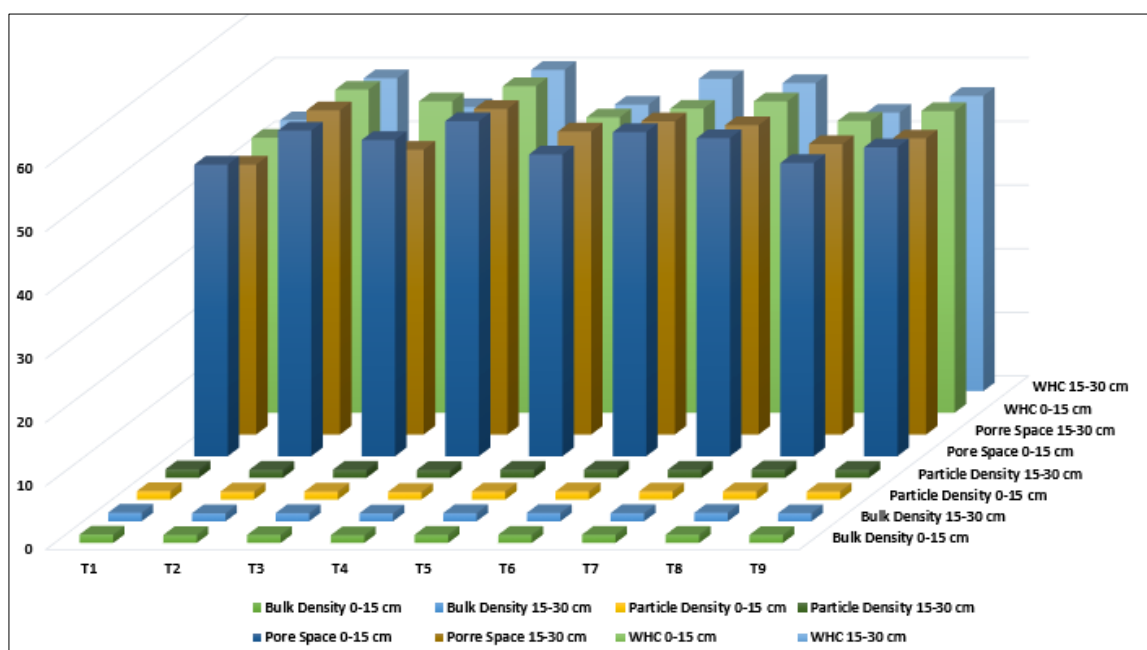


Fig 1: Effect of all treatments on bulk density (Mg m⁻³), Particle density (Mg m⁻³), Pore space (%) and Water holding capacity (%) of soil.

Effect of all treatment on Soil chemical Properties

Soil pH (1:2.5) w/v

The data presented in table 2 and depicted in fig. 2 clearly shows the pH of soil as influenced by organic and inorganic source of nutrients. The maximum pH of soil was recorded 7.27 at 0 -15 cm and 7.39 at 15- 30 cm was recorded in treatment T₄ (Rhizobium @ 30 g + PSB @ 30 g kg⁻¹ seed) which was followed by 7.20 at 0 -15 cm and 7.36 at 15- 30 cm was recorded in treatment T₂ (Rhizobium @ 30 g kg⁻¹ seed). Whereas, Minimum 6.98% at 0 -15 cm and 7.13% at 15- 30 cm was recorded in treatment T₁ (Control) respectively. Corresponding results were obtained in earlier studies by Hussain *et al.* (2022) ^[4].

Soil EC (dSm-1)

The data presented in table 2 and depicted in fig. 2 clearly shows the EC of soil as influenced by organic and inorganic source of nutrients. The maximum EC of soil was recorded 0.441 dSm⁻¹ at 0 -15 cm and 0.461 dSm⁻¹ 15- 30 cm was recorded in treatment T₄ (Rhizobium @ 30 g + PSB @ 30 g kg⁻¹ seed) which was followed by 0.428 dSm⁻¹ at 0 -15 cm

and 0.441 dSm⁻¹ at 15- 30 cm was recorded in treatment T₂ (Rhizobium @ 30 g kg⁻¹ seed). Whereas, Minimum 0.328 dSm⁻¹ at 0 -15 cm and 0.343 dSm⁻¹ at 15- 30 cm was recorded in treatment T₁ (Control) respectively. A closely related phenomenon has been described by Hussain *et al.* (2022) ^[4].

Organic carbon (%)

The data presented in table 2 and depicted in fig. 2 clearly shows the organic carbon (%) of soil as influenced by organic and inorganic source of nutrients. The maximum organic carbon of soil was recorded 0.535% at 0 -15 cm and 0.513% at 15- 30 cm was recorded in treatment T₄ (Rhizobium @ 30 g + PSB @ 30 g kg⁻¹ seed) which was followed by 0.515% at 0 -15 cm and 0.505% at 15- 30 cm was recorded in treatment T₂ (Rhizobium @ 30 g kg⁻¹ seed). Whereas, Minimum 0.468% at 0 -15 cm and 0.454% at 15- 30 cm was recorded in treatment T₁ (Control) respectively. The pattern resembled that reported previously by Vasava *et al.* (2020) and Yadav *et al.* (2021) ^[14, 17].

Table 2: Effect of all treatments on pH, EC (dSm⁻¹), and Organic carbon (%) of soil.

Treatments		pH		EC (dSm ⁻¹)		Organic carbon (%)	
		0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
T ₁	Control	6.98	7.13	0.328	0.343	0.468	0.454
T ₂	Rhizobium @ 30 g kg ⁻¹ seed Treatment	7.20	7.36	0.428	0.441	0.515	0.505
T ₃	PSB @ 30 g kg ⁻¹ seed Treatment	7.16	7.27	0.351	0.388	0.504	0.495
T ₄	Rhizobium @ 30 g + PSB @ 30 g kg ⁻¹ seed	7.27	7.39	0.441	0.461	0.535	0.513
T ₅	ZnSO ₄ @ 3 g kg ⁻¹ seed Treatment	7.13	7.33	0.362	0.374	0.482	0.462
T ₆	FeSO ₄ @ 3 g kg ⁻¹ seed Treatment	7.18	7.25	0.403	0.421	0.491	0.471
T ₇	Carbendazim @ 2.5 g kg ⁻¹ seed	7.19	7.26	0.394	0.407	0.487	0.477
T ₈	Foliar spray of ZnSO ₄ and FeSO ₄ @ 0.3%	7.06	7.15	0.351	0.354	0.479	0.465

T ₉	RDF 100%	7.14	7.28	0.383	0.397	0.486	0.446
	F-Test	S	S	S	S	S	S
	S.Ed. (±)	0.068	0.051	0.019	0.019	0.015	0.014
	C.D. at 0.5%	0.206	0.155	0.057	0.057	0.045	0.044

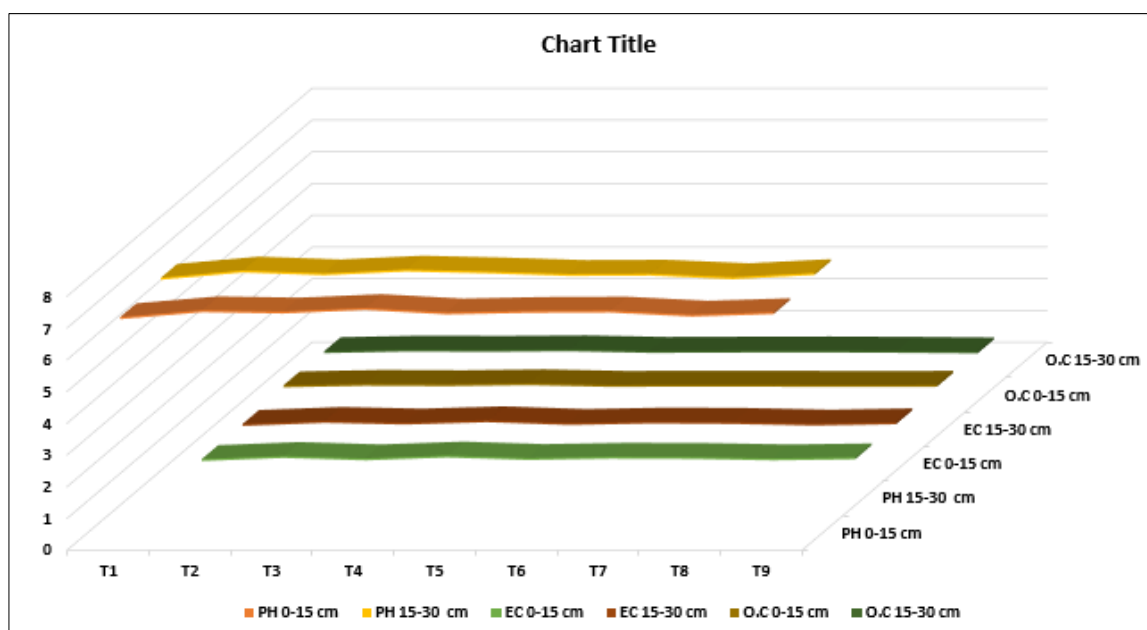


Fig 2: Effect of all treatments on pH, EC (dSm-1), and Organic carbon (%) of soil.

Available nitrogen (kg ha-1)

The data presented in table 3 and depicted in fig. 3 clearly shows the available nitrogen (kg ha-1) of soil as influenced by organic and inorganic source of nutrients. The maximum available nitrogen of soil was recorded 311.53 kg/ha at 0 -15 cm and 309.19 kg/ha at 15- 30 cm in treatment T₉ (RDF 100% NPK) which was followed by 306.23 kg ha-1 at 0 -15 cm and 302.89 kg ha-1 at 15- 30 cm in treatment T₄ with application of (Rhizobium @ 30 g + PSB @ 30 g kg-1 seed). Whereas, Minimum 256.47kg ha-1 at 0 -15 cm and 253.14 kg ha-1 at 15- 30 cm treatment T₁ (Control) respectively. Similar findings were observed by Hussain *et al.* (2022)^[4].

Available phosphorus (kg ha-1)

The data presented in table 3 and depicted in fig. 3 clearly shows the available phosphorus (kg ha-1) of soil as influenced by organic and inorganic source of nutrients. The maximum available phosphorus of soil was recorded 20.12 kg ha-1at 0 -15 cm and 19.17 kg ha-1 at 15- 30 cm was recorded in treatment T₉ with application of (RDF 100% NPK) which was followed by 19.86 kg ha-1 at 0 -15 cm and 18.89 kg ha-1 at 15- 30 cm was recorded in treatment T₄ (Rhizobium@ 30 g + PSB @ 30 g kg-1seed). Whereas, Minimum 14.77 kg ha-1 at 0 -15 cm and 13.97 kg ha-1 at 15- 30 cm was recorded in T₁(Control) respectively. Equivalent outcomes were demonstrated by Vasava *et al.* (2020) and Yadav *et al.* (2021)^[14, 17].

Available potassium (kg ha-1)

The data presented in table 3 and depicted in fig. 3 clearly shows the available potassium (kg ha-1) of soil as influenced by organic and inorganic source of nutrients. The maximum available potassium of soil was recorded 209.03 kg ha-1 at 0 -15 cm and 197.48 kg ha-1 at 15- 30 cm was recorded in treatment T₉ with application of (RDF 100%

NPK) which was followed by 206.12 kg ha-1 at 0 -15 cm and 195.46 kg ha-1 at 15- 30 cm was recorded in treatment T₄ with application of (Rhizobium 30 g kg-1 + PSB 30 g kg-1 seed). Whereas, Minimum 195.87 kg ha-1 at 0 -15 cm and 176.20 kg ha-1at 15- 30 cm was recorded in T₁ (Control). The observations were congruent with previous findings by Hussain *et al.* (2022)^[4].

Available Zinc (mg kg-1)

The data presented in table 3 and depicted in fig. 3 clearly shows the available potassium (kg ha-1) of soil as influenced by organic and inorganic source of nutrients. The maximum available zinc of soil was recorded 20.12 mg kg-1at 0 -15 cm and 19.17 mg kg-1at 15- 30 cm was recorded in treatment T₅ (ZnSO4 3 g kg-1 seed) which was followed by 19.86 mg kg-1at 0 -15 cm and 18.89 mg kg-1at 15- 30 cm was recorded in treatment T₄ with application of (Rhizobium @ 30 g + PSB @ 30 g kg-1 seed). Whereas, Minimum 14.77 mg kg-1 at 0 -15 cm and 13.97 mg kg-1at 15- 30 cm was recorded in T₁ (Control). These findings are in agreement with the observations reported by Vasava *et al.* (2020) and Yadav *et al.* (2021)^[14, 17].

Available Iron (mg kg-1)

The data presented in table 3 and depicted in fig. 3 clearly shows the available potassium (kg ha-1) of soil as influenced by organic and inorganic source of nutrients. The maximum available zinc of soil was recorded 6.40 mg kg-1 at 0 -15 cm and 5.49 mg kg-1 at 15- 30 cm was recorded in treatment T₆ (FeSO4 @ g kg-1 seed) which was followed by 6.26 mg kg-1 at 0 -15 cm and 5.15 mg kg-1 at 15- 30 cm was recorded in treatment T₄ (Rhizobium @ 30 g kg-1 + PSB @ 30 g kg-1 seed). Whereas, Minimum 4.69 mg kg-1 at 0 -15 cm and 3.88 mg kg-1 at 15- 30 cm was recorded in treatment T₁(Control). The result were comparable to those reported in previous studies by Hussain *et al.*, (2022)^[4].

Table 3: Effect of all treatment on Available nitrogen (kg ha-1), Available phosphorus (kg ha-1), Available potassium (kg ha-1), Available

Treatments		Available nitrogen (kg ha ⁻¹)		Available phosphorus (kg ha ⁻¹)		Available potassium (kg ha ⁻¹)		Available Zinc (mg kg ⁻¹)		Available Iron (mg kg ⁻¹)	
		0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
T ₁	Control	256.47	253.14	14.77	13.97	195.87	176.20	14.77	13.97	4.69	3.88
T ₂	Rhizobium @ 30 g kg ⁻¹ seed	304.99	281.66	16.53	16.57	199.14	180.21	18.86	17.89	5.77	4.82
T ₃	PSB @ 30 g k ⁻¹ seed TreatmentT	292.76	291.43	18.86	17.89	199.25	189.46	18.34	14.91	5.43	4.27
T ₄	Rhizobium @ 30 g + PSB @ 30 g kg ⁻¹ seed	306.23	302.89	19.86	18.89	206.12	195.46	19.86	18.89	6.26	5.15
T ₅	ZnSO ₄ @ 3 g kg ⁻¹ seed	263.50	260.50	17.90	14.91	203.57	187.94	20.12	19.17	5.23	5.09
T ₆	FeSO ₄ @ 3 g kg ⁻¹ seed	284.62	281.95	18.34	18.46	201.51	193.79	16.53	16.57	6.40	5.49
T ₇	Carbendazim @ 2.5 g kg ⁻¹ seed	264.17	262.17	17.54	17.56	205.70	188.60	17.54	17.56	5.23	4.95
T ₈	Foliar spray of ZnSO ₄ and FeSO ₄ @ 0.3%	270.16	267.49	15.55	15.87	204.47	185.46	15.55	15.87	5.34	4.70
T ₉	RDF 100%	311.53	309.19	20.12	19.17	209.03	197.48	17.90	14.88	4.83	4.81
	F-Test	S	S	S	S	S	S	S	S	S	S
	S.Ed. (±)	10.22	11.43	0.073	0.61	1.22	1.39	0.012	0.002	0.13	0.26
	C.D. at 0.5%	30.78	34.41	2.20	1.85	3.67	4.20	0.037	0.012	0.40	0.80

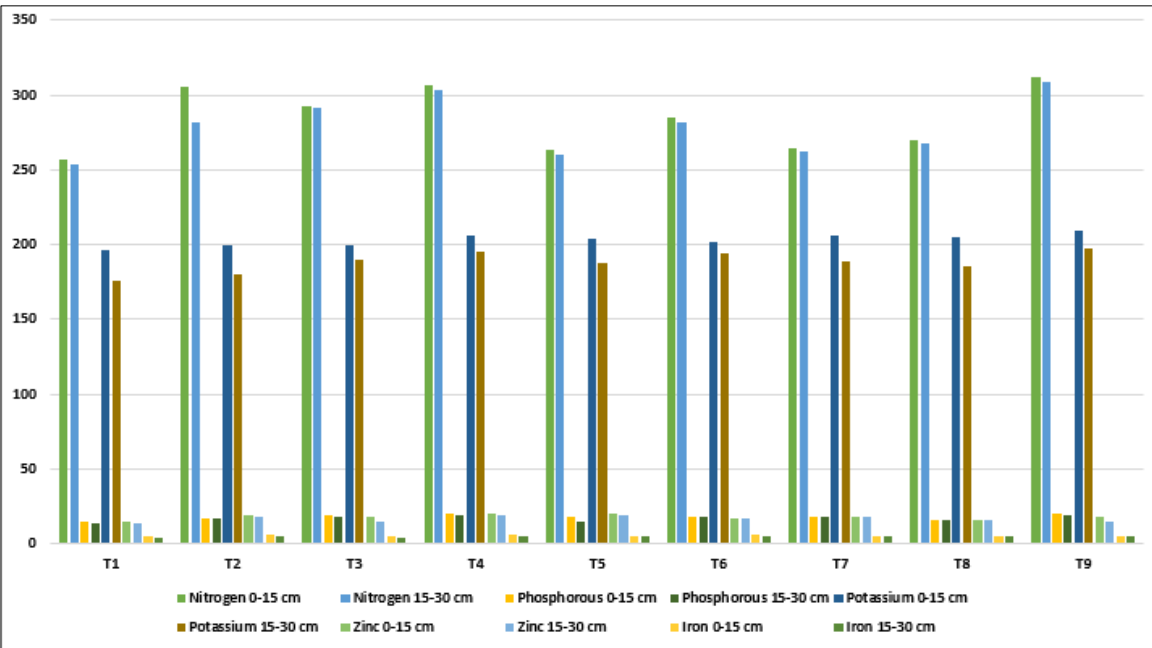


Fig 3: Effect of all treatment on Available nitrogen (kg ha-1), Available phosphorus (kg ha-1), Available potassium (kg ha-1), Available Zinc (mg kg-1) and Iron (mg kg-1) in soil.

Conclusion

According to the results revealed the Treatment 4 (Rhizobium @ 30 g + PSB @ 30 g kg-1 seed) was observed superior in improving soil health and T₉ (100% RDF NPK) proved superior by recording the highest plant growth and pod yield. Therefore, application of 100% RDF may be recommended for profitable cultivation of garden pea.

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Competing Interests

The authors declare that there are no conflicts of interest regarding the publication of this paper.

References

1. Ahmed OZ, Rispail N, Ojiewo CO, Rubiales D. Pea breeding for resistance to rhizospheric pathogens. Plants. 2022;11(19):2664.
2. National Horticulture Board. Indian Horticulture Database. Ministry of Agriculture and Farmers Welfare, Government of India; 2024.
3. Fisher RA. The design of experiments. Edinburgh: Oliver & Boyd; 1935.
4. Hussain M, Ali A, Ahmad S, Iqbal MA. Influence of foliar zinc and boron on yield and quality of chickpea. The Pharma Innovation Journal. 2022;11(5):1550-1554.
5. Ishtiaq M, Hussain I, Bhatti KH, Maqbool M, Ahmed KS, Ajaib M, *et al.* Study of impacts of brickkiln emanations on soil quality of agriculture lands in selected areas of District Bhimber, Azad Jammu and Kashmir, Pakistan. PLoS One. 2022;17(2):e0258438.

6. Jackson ML. Soil chemical analysis. New Delhi: Prentice Hall of India Pvt. Ltd.; 1973. p. 498.
7. Kumar P, David AA, Thomas T, Reddy IS. Impact of integrated nutrient management on physico-chemical properties of soil in pea (*Pisum sativum* L.) var. GS 10. International Journal of Plant & Soil Science. 2022;34(20):521-526.
8. Kumar R, Mishra RK, Singh M. Symbiotic efficiency of *Rhizobium leguminosarum* in garden pea (*Pisum sativum* L.) under varied agro-climatic conditions. Journal of Food Legumes. 2011;24(3):194-198.
9. Muthuvel P, Radhakrishnan C, Malika N. Laboratory manual for soil and plant analysis. Coimbatore: Tamil Nadu Agricultural University; 1992. p. 12-15.
10. Oliveira JA, Ribeiro MS, Silva RP. Seed coating technology and micronutrient delivery to legume crops. Journal of Soil Science and Plant Nutrition. 2016;16(3):612-624.
11. Olsen SR, Cole CV, Watanabe FS, Dean LA. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. Circular of United States Department of Agriculture. 1954;939:1-19.
12. Subbiah BV, Asija GL. A rapid procedure for the estimation of available nitrogen in soils. Current Science. 1956;25(8):259-260.
13. Toth SJ, Prince AL. Estimation of available potassium in soil profiles by flame photometry. Soil Science. 1949;67(6):439-446.
14. Vasava HB, Aspinall D, Vestergaard RJ. Quantitative assessment of soil physical and chemical attributes using proximally sensed data. Soil and Tillage Research. 2020;199:104525.
15. Walkley A, Black IA. An examination of the Degtjareff method for determining soil organic matter, and a proposed modification of the chromic acid titration method. Soil Science. 1934;37(1):29-38.
16. Wilcox LV. Electrical conductivity of soil extracts. Agricultural Research Administration. 1950;22(4):11-14.
17. Yadav SL, Ram B, Yadav GN, Samota SD, Yadav RK, Kumar A, Singh K, Dhakad U. Effect of fertility levels and foliar nutrition in fieldpea (*Pisum sativum*) under south-eastern Rajasthan. Indian Journal of Agronomy. 2023;68(2):188-193.