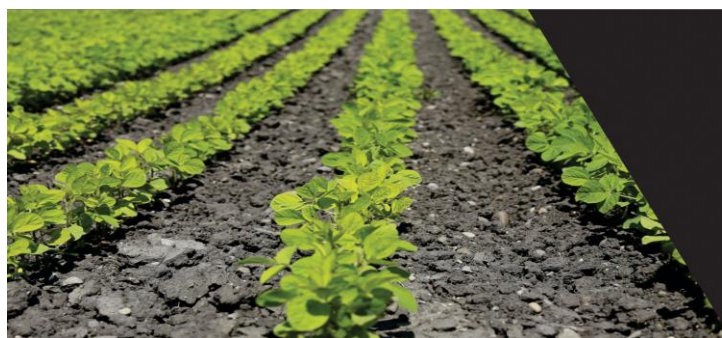




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Sona kumari

Research Scholar, Department of
Soil Science and Agricultural
Chemistry, Faculty of Agriculture,
Prof. Rajendra Singh (Rajju
Bhaiya) University, Prayagraj,
Uttar Pradesh, India

Tarun Kumar

Assistant Professor, Department of
Soil Science and Agricultural
Chemistry, Faculty of Agriculture,
Prof. Rajendra Singh (Rajju
Bhaiya) University, Prayagraj,
Uttar Pradesh, India

Alok kumar

Research Scholar, Department of
Soil Science and Agricultural
Chemistry, Faculty of Agriculture,
Prof. Rajendra Singh (Rajju
Bhaiya) University, Prayagraj,
Uttar Pradesh, India

Avaneesh Kumar Yadav

Research Scholar, Department of
Soil Science and Agricultural
Chemistry, Faculty of Agriculture,
Prof. Rajendra Singh (Rajju
Bhaiya) University, Prayagraj,
Uttar Pradesh, India

Corresponding Author:

Alok kumar

Research Scholar, Department of
Soil Science and Agricultural
Chemistry, Faculty of Agriculture,
Prof. Rajendra Singh (Rajju
Bhaiya) University, Prayagraj,
Uttar Pradesh, India

Influence of NPK Beejamrit and Jeevamrit on Soil Health of Chickpea (*Cicer arietinum* L.)

Sona kumari, Tarun Kumar, Alok kumar and Avaneesh Kumar Yadav

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Abstract

An experiment was conducted during in *Rabi* season (Nov. 2025–Feb. 2026) to study the “Influence of NPK, Beejamrit and Jeevamrit on Soil Health of Chickpea (*Cicer arietinum* L.) Var. *Himmat*.” On Research Farm Prof. Rajendra Singh (Rajju Bhaiya) University, Prayagraj. The experiment was layout in a RBD and replicated of NPK. The excavated soil sample from experimental site before conducting research operation mentioned that soil is significantly highest in treatment. The result shows that application of different levels combination of Beejamrit and Jeevamrit increased growth, yield of Chickpea and improved soil chemical, physical and biological properties. It was recorded from the application of NPK, Jeevamrit and Beejamrit in treatment T₉ (Beejamrit (5 ml/kg) + Jeevamrit (500 l ha⁻¹) + @100 % NPK) minimum bulk density 1.29 Mg m⁻³ at 0-15 cm and 1.32 Mg m⁻³ at 15-30 cm, particle density 2.44 Mg m⁻³ at 0-15 and 2.54 Mg m⁻³ at 15-30 cm, and maximum % pore space 56.23 % at 0-15 cm and 55.06 % at 15-30 cm, water holding capacity 43.2 % at 0-15 cm and 41.2 % at 15-30 cm, pH of soil was recorded 7.24 at 0-15 cm and 7.27 at 15-30 cm, EC of soil was recorded 0.38 dSm⁻¹ at 0-15 cm and 0.36 dSm⁻¹ at 15-30 cm, organic carbon 0.47 % at 0-15 cm and 0.44 % at 15-30 cm, available nitrogen 300.44 kg ha⁻¹ at 0-15 cm and 295.50 kg ha⁻¹ at 15-30 cm, available phosphorus 23.02 kg ha⁻¹ at 0-15 cm and 20.32 kg ha⁻¹ at 15-30 cm, available potassium 212.52 at 0-15 cm and 208.35 kg ha⁻¹ at 15-30 cm.

Keywords: Chickpea, Jeevamrit, Beejamrit, NPK, and Physico-chemical.

Introduction

Chickpea (*Cicer arietinum* L.), is one of the most significant pulses crops in the world known as gram or Bengal gram. It is a member of Fabaceae family and important for its nutritional quality, high protein contents and its role in the improvement of soil fertility by biological nitrogen fixation (Koul *et al.*, 2022)^[7]. Chickpea is the second most popular grain legume internationally and is grown in over 50 nations around the globe, including the Americas, Australia, Europe, Africa, and Asia. Crop broadly classified in two major types, Desi chickpea (small dark colored seeds) and Kabuli chickpea (large creamcolored seeds) (Zhang *et al.*, 2024)^[18]. India is the world's largest producer and consumer of chickpea and is responsible for a significant portion of the world's production. Chickpea productivity, disease resistance and adaptation to a wide range of agro-climatic conditions have been greatly improved thanks to continued breeding and better crop management (Merga, *et al.*, (2019)^[8]. Chickpea is one of the important leguminous crops because its nutritional content. It contains 17-23% proteins, 14% vitamins, 24-41% raw starch, 50-64% carbohydrates, 3-7% fats, 3.7-13% crude fiber (Yadav *et al.*, 2022)^[17]. The chickpea is a key grain legume crop used for its nutritional and nitrogen fixation properties and cultivated worldwide for these attributes (Koul *et al.*, 2022)^[7]. Beejamrit is a fermented microbial solution, with loads of plant-beneficial microbes and is applied as seed treatment. It is expected that the beneficial microbes would colonize the roots and leaves of the germinating seeds and help in the healthy growth of the plants. Jeevamrit improve soil fertility including application of Jeevamrit (a liquid organic manure) which is one of the most important components for nutrient management. Jeevamrit is a fermented liquid product prepared by mixing up cow dung with cow urine, jaggery, legume flour and handful of live soil (Palekar, 2007)^[11].

Materials and Methods

A field experiment which was carried out at the Soil Science Research Farm, Prof. Rajendra Singh (Rajju Bhaiya) University, Prayagraj, during Rabi season 2025-26. It is situated at 25°24'30" N latitude, 81°51'10" E longitude and 98 meter above the sea level. The details about the experiment site, soil and climate are described in this chapter together with the experimental design, layout plan, culture practice, particulars of treatments, planting material and techniques employed for the parameters. The area of Prayagraj district represents the subtropical belt of the South East of Uttar Pradesh and endowed with extremely hot summer and fairly cold winter. The maximum temperatures of the area is between 25°C-35°C and rarely drops below 4°C-5°C. The relative air humidity is between 20-94%. The average rainfall of this area is around 1100 mm annually. The lowest Relative humidity was to be 48.5% and the lowest was 87.4%. the experiment was layout designed in Randomized Block Design (RBD) with three levels of each NPK, Beejamrit and Jeevamrit. The plot size was 3 x 3 m² for crop seed rate for 65-70 kg ha⁻¹ (*Cicer arietinum* L.). Var. *Himmat*. Basal dose of fertilizer was applied in the respective plots according to the treatment allocation uniform furrow opened by about 5 cm. All the agronomic practices were carried out the uniformity to raise to the crop. Harvesting was done in March. The experiment consisted of 9 treatment combinations, T₁: Absolute control, T₂: NPK @ 100% (20:40:20 kg/ha), T₃: Beejamrit Seed Treatment (5 ml/kg), T₄: Jeevamrit Soil Treatment (500 l/ha), T₅: Beejamrit Seed Treatment (5 ml/kg) + NPK @ 100%, T₆: Jeevamrit Soil Treatment (500 l/ha) + NPK @ 100%, T₇: Beejamrit Seed Treatment (5 ml/kg) + NPK @ 50%, T₈: Jeevamrit Soil Treatment (500 l ha⁻¹) + NPK @ 50%, T₉: Beejamrit Seed Treatment (5 ml/kg) + Jeevamrit (500 l ha⁻¹) + NPK @ 100%. Bulk density, Particle density, Pore space and Water holding capacity analyze Measuring cylinder method given by Muthuvel *et al.*, 1992, Soil pH analyze Digital pH meter given by M. L. Jackson, 1958. Electrical conductivity analyzes Digital conductivity meter given by Wilcox, 1950, Organic carbon analyzes Wet oxidation method given by Walkley and Black, 1947, Available Nitrogen analyze Modified alkaline permanganate oxidation method given by Subbiah and Asija, 1956, Available Phosphorus analyze Olsen's extraction followed by Spectrophotometric method given by Olsen *et al.*, 1954^[9], Available Potassium analyze Neutral normal ammonium acetate extraction followed by Flame photometric given by Toth and Prince, 1949.

Results and discussion

Bulk density (Mg m⁻³)

The data presented in table and fig 1 clearly shows the response bulk density of soil was found to be non-significant in levels of NPK, Beejamrit and Jeevamrit. The maximum bulk density of soil was recorded 1.29 and 1.32 Mg m⁻³ at 0-15 and 15-30 cm in treatment T₁ (Absolute control) followed by 1.27 and 1.30 Mg m⁻³ at 0-15 and 15-30 cm in treatment T₃ (Beejamrit Seed Treatment (5 ml/kg) and minimum bulk density of soil was recorded 1.16 and 1.20 Mg m⁻³ at 0-15 and 15-30 cm in treatment T₉ (Beejamrit (5 ml/kg) + Jeevamrit (500 l ha⁻¹) + NPK @ 100%). This reduction may be attributed to the incorporation of organic

formulations, which improved soil aggregation and increased soil porosity. Addition of organic matter reduced soil compaction and created a loose soil structure, thereby lowering bulk density. (Gulaiya *et al.*, 2023 and Begum *et al.*, 2022)^[5, 1].

Particle density (Mg m⁻³)

The data presented in table and fig 1 clearly shows the response the particle density of soil non-significant yield with the levels of NPK, Beejamrit and Jeevamrit. The highest particle density of soil was observed. 2.44 and 2.54 Mg m⁻³ at 0-15 and 15-30 cm in treatment T₁ (Absolute control) followed by 2.43 and 2.53 Mg m⁻³ at 0-15 and 15-30 cm in treatment T₃ (Beejamrit Seed Treatment (5 ml/kg) and minimum particle density of soil was recorded 2.22 and 2.31 Mg m⁻³ at 0-15 and 15-30 cm in treatment T₉ (Beejamrit (5 ml/kg) + Jeevamrit (500 l ha⁻¹) + NPK @ 100%). The lowest particle density was observed in T₉, while the highest was found in T₁. This decrease might be due to the higher accumulation of organic matter in soil as organic particles possess lower density than mineral particles. Enhanced microbial activity and humus formation also contributed to this reduction. (Gulaiya *et al.*, 2023 and Begum *et al.*, 2022)^[5, 1].

Pore space (%)

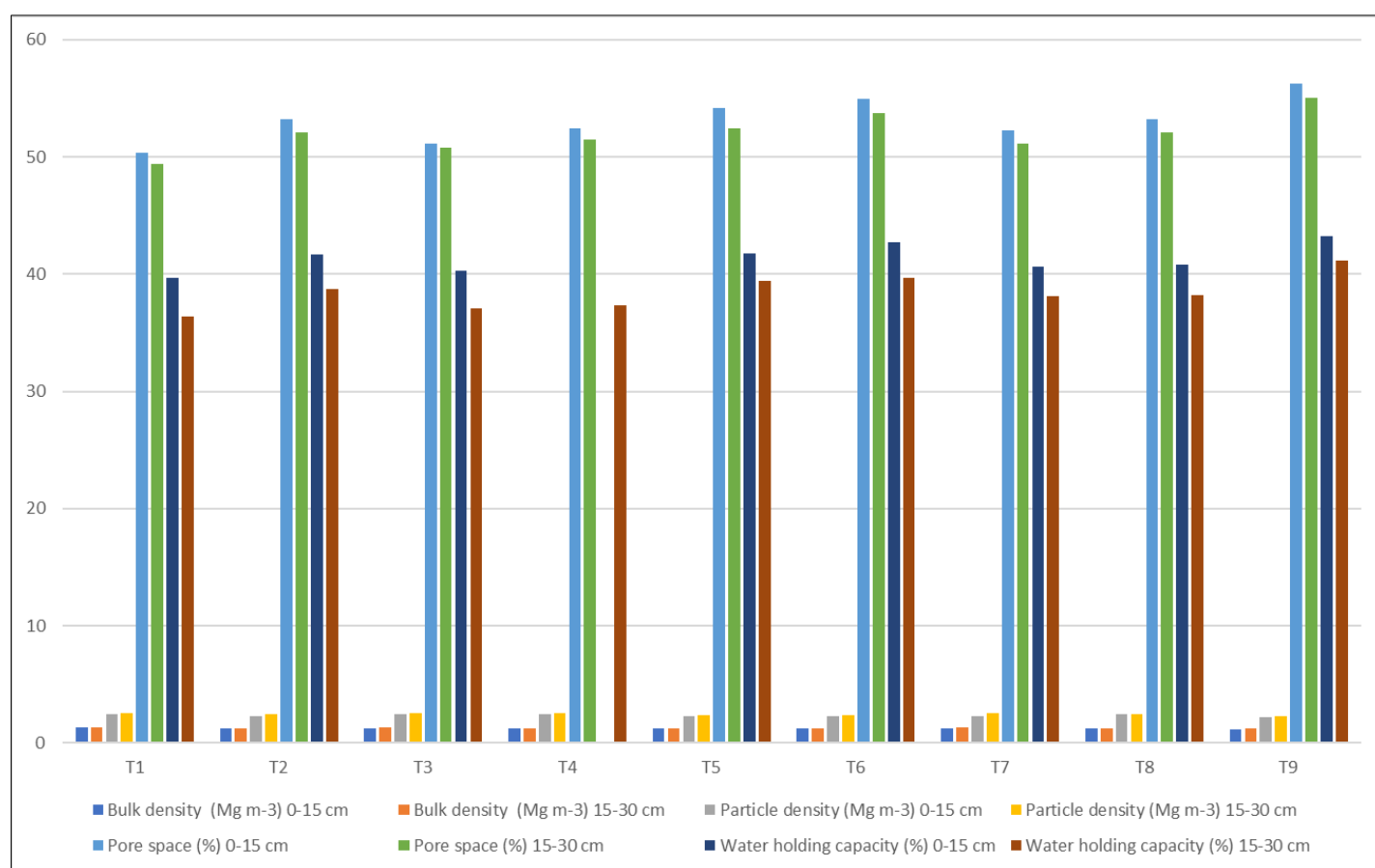
The data presented in table and Fig. 1 it is evident that the NPK, Beejamrit and Jeevamrit had significant influence on the pore space (%) of soil. The maximum pore space of soil was recorded 56.23 and 55.06% at 0-15 and 15-30 cm in treatment T₉ (Beejamrit (5 ml/kg) + Jeevamrit (500 l ha⁻¹) + NPK @ 100%) followed by 54.92 and 53.76% at 0-15 and 15-30 cm in treatment T₆ (Jeevamrit (500 l ha⁻¹) + NPK @ 100%) and minimum pore space of soil was recorded 50.38 and 49.43% at 0-15 and 15-30 cm in treatment T₁ (Absolute control). Treatment T₉ recorded the highest pore space, while the control showed the lowest value. Increased pore space may be due to better soil aggregation and improvement in soil structure caused by organic amendments. Reduced bulk density also enhanced the formation of macro and micropores in the soil. (Gulaiya *et al.*, 2023 and Begum *et al.*, 2022)^[5, 1].

Water holding capacity (%)

These data table and fig.1 clearly reveal that the water holding capacity of soil was influenced by the NPK, Beejamrit and Jeevamrit. The response of water holding capacity of soil was found to be significant in levels of NPK, Beejamrit and Jeevamrit. The maximum water holding capacity of soil was recorded 43.2 and 41.2% at 0-15 and 15-30 cm in treatment T₉ (Beejamrit (5 ml/kg) + Jeevamrit (500 l ha⁻¹) + NPK @ 100%) followed by 42.7 and 39.7% at 0-15 and 15-30 cm in treatment T₆ (Jeevamrit (500 l ha⁻¹) + NPK @ 100%) and minimum water holding capacity of soil was recorded 39.7 and 36.4% at 0-15 and 15-30 cm in treatment T₁ (Absolute control). The highest value was recorded in T₉. This improvement may be attributed to increased soil organic carbon and better aggregation, which enhanced moisture retention capacity of soil. Organic matter acts like a sponge and improves the storage of water in soil micropores. (Gulaiya *et al.*, 2023 and Begum *et al.*, 2022)^[5, 1].

Table 1: Influence of NPK, Beejamrit and Jeevamrit on Bulk density (Mg m^{-3}), Particle density (Mg m^{-3}), Pore space (%) and WHC (%) 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	Absolute control	1.29	1.32	2.44	2.54	50.38	49.43	39.7	36.4
T ₂	NPK @ 100%	1.22	1.24	2.31	2.42	53.26	52.09	41.7	38.7
T ₃	Beejamrit Seed Treatment (5 ml/kg)	1.27	1.31	2.43	2.53	51.15	50.76	40.3	37.1
T ₄	Jeevamrit Soil Treatment (500 l ha ⁻¹)	1.25	1.26	2.42	2.51	52.47	51.52	40.4	37.3
T ₅	Beejamrit (5 ml/kg) + NPK @ 100%	1.20	1.25	2.28	2.36	54.20	52.47	41.8	39.4
T ₆	Jeevamrit (500 l ha ⁻¹) + NPK @ 100%	1.19	1.23	2.23	2.33	54.92	53.76	42.7	39.7
T ₇	Beejamrit (5 ml/kg) + NPK @ 50%	1.24	1.28	2.27	2.49	52.23	51.15	40.6	38.1
T ₈	Jeevamrit (500 l ha ⁻¹) + NPK @ 50%	1.23	1.27	2.41	2.43	53.23	52.08	40.8	38.2
T ₉	Beejamrit (5 ml/kg) + Jeevamrit (500 l ha ⁻¹) + NPK @ 100%	1.16	1.20	2.22	2.31	56.23	55.06	43.2	41.2
F-Test		NS	NS	NS	NS	S	S	S	S
S.Ed. ($\pm$)		-	-	-	-	0.33	0.31	0.48	0.05
C.D. at 0.5%		-	-	-	-	0.79	0.66	1.02	0.11

**Fig 1:** Influence of NPK, Beejamrit and Jeevamrit on Bulk density (Mg m^{-3}), Particle density (Mg m^{-3}), Pore space (%) and WHC (%) of soil.**Soil pH (1:2.5) w/v**

The data presented in table and fig. 2 clearly shows the pH of soil as influenced by NPK, Beejamrit and Jeevamrit. The maximum pH of soil was recorded 7.24 and 7.27 at 0-15 and 15-30 cm in treatment T₁ (Absolute control) followed by 7.18 and 7.21 at 0-15 and 15-30 cm in was T₃ (Beejamrit Seed Treatment (5 ml/kg)) and minimum pH of soil was recorded 6.54 and 6.87 at 0-15 and 15-30 cm in treatment T₉ (Beejamrit (5 ml/kg) + Jeevamrit (500 l ha⁻¹) + NPK @ 100%). The integrated application of organic formulations T₉ brings the soil pH closer to a slightly acidic to neutral range. This reduction is highly beneficial for alkaline or neutral soils as it enhances the bioavailability of fixed soil nutrients, particularly phosphorus and micronutrients due to increased microbial activity and acid-induced solubilization. (Patel *et al.*, 2024, Gulaiya *et al.*, 2023, Bhanusri *et al.*, 2024 and

Begum *et al.*, 2022) [10, 5, 2, 1].

Soil EC (dSm^{-1})

The data presented in table and fig. 2 clearly shows the EC of soil as influenced by NPK, Beejamrit and Jeevamrit. The maximum EC of soil was recorded 0.38 and 0.36 dSm^{-1} at 0-15 and 15-30 cm in treatment T₉ (Beejamrit (5 ml/kg) + Jeevamrit (500 l ha⁻¹) + NPK @ 100%) followed by 0.36 and 0.34 dSm^{-1} at 0-15 and 15-30 cm in treatment T₆ (Jeevamrit (500 l ha⁻¹) + NPK @ 100%) and minimum EC of soil was recorded 0.28 and 0.26 dSm^{-1} at 0-15 and 15-30 cm in treatment T₁ (Absolute control). The highest EC was observed in T₉. This increase may be due to the greater availability of soluble salts and ions released from fertilizers and decomposition of organic inputs, which enhanced ionic concentration in the soil solution. (Begum *et al.*, 2022) [1].

Organic carbon (%)

The data presented in table and depicted in fig. 2 clearly shows the Organic carbon of soil as influenced by NPK, Beejamrit and Jeevamrit. The maximum organic carbon of soil was recorded 0.47 and 0.44 % at 0-15 and 15-30 cm in treatment T₉ (Beejamrit (5 ml/kg) + Jeevamrit (500 l ha⁻¹) + NPK @ 100%) followed by 0.45 and 0.43 % at 0-15 and 15-30 cm in treatment T₆ (Jeevamrit (500 l ha⁻¹) + NPK @ 100%) and minimum organic carbon of soil

was recorded 0.31 and 0.30 % at 0-15 and 15-30 cm in treatment T₁ (Absolute control). The maximum organic carbon was recorded in T₉, while the minimum was found in the control. This increase may be due to continuous addition of organic residues, enhanced root biomass and microbial activity, leading to greater humus formation and carbon accumulation in soil. Patel *et al.*, 2024, Gulaiya *et al.*, 2023, Bhanusri *et al.*, 2024 and Begum *et al.*, 2022)^[10, 5, 2, 1].

Table 2: Influence of NPK, Beejamrit and Jeevamrit on pH, EC (dSm⁻¹) and Organic carbon (%) of soi

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	Absolute control	7.24	7.27	0.28	0.26	0.31	0.30
T ₂	NPK @ 100 %	6.76	6.79	0.32	0.30	0.36	0.34
T ₃	Beejamrit Seed Treatment (5ml/kg)	7.18	7.21	0.34	0.33	0.43	0.42
T ₄	Jeevamrit Soil Treatment (500 l/ha)	6.98	7.12	0.29	0.27	0.34	0.33
T ₅	Beejamrit (5ml/kg) + NPK @ 100 %	6.62	6.75	0.33	0.31	0.40	0.38
T ₆	Jeevamrit (500 l/ha) + NPK @ 100 %	6.63	6.66	0.36	0.34	0.45	0.43
T ₇	Beejamrit (5ml/kg) + NPK @ 50 %	6.90	7.10	0.35	0.32	0.42	0.41
T ₈	Jeevamrit (500 l/ha) + NPK @ 50 %	6.83	7.03	0.30	0.28	0.38	0.36
T ₉	Beejamrit (5ml/kg) + Jeevamrit (500 l/ha) + NPK @ 100 %	6.54	6.87	0.38	0.36	0.47	0.44
F-Test		NS	NS	NS	NS	NS	NS
S.Ed. (±)		-	-	-	-	-	-
C.D. at 0.5%		-	-	-	-	-	-

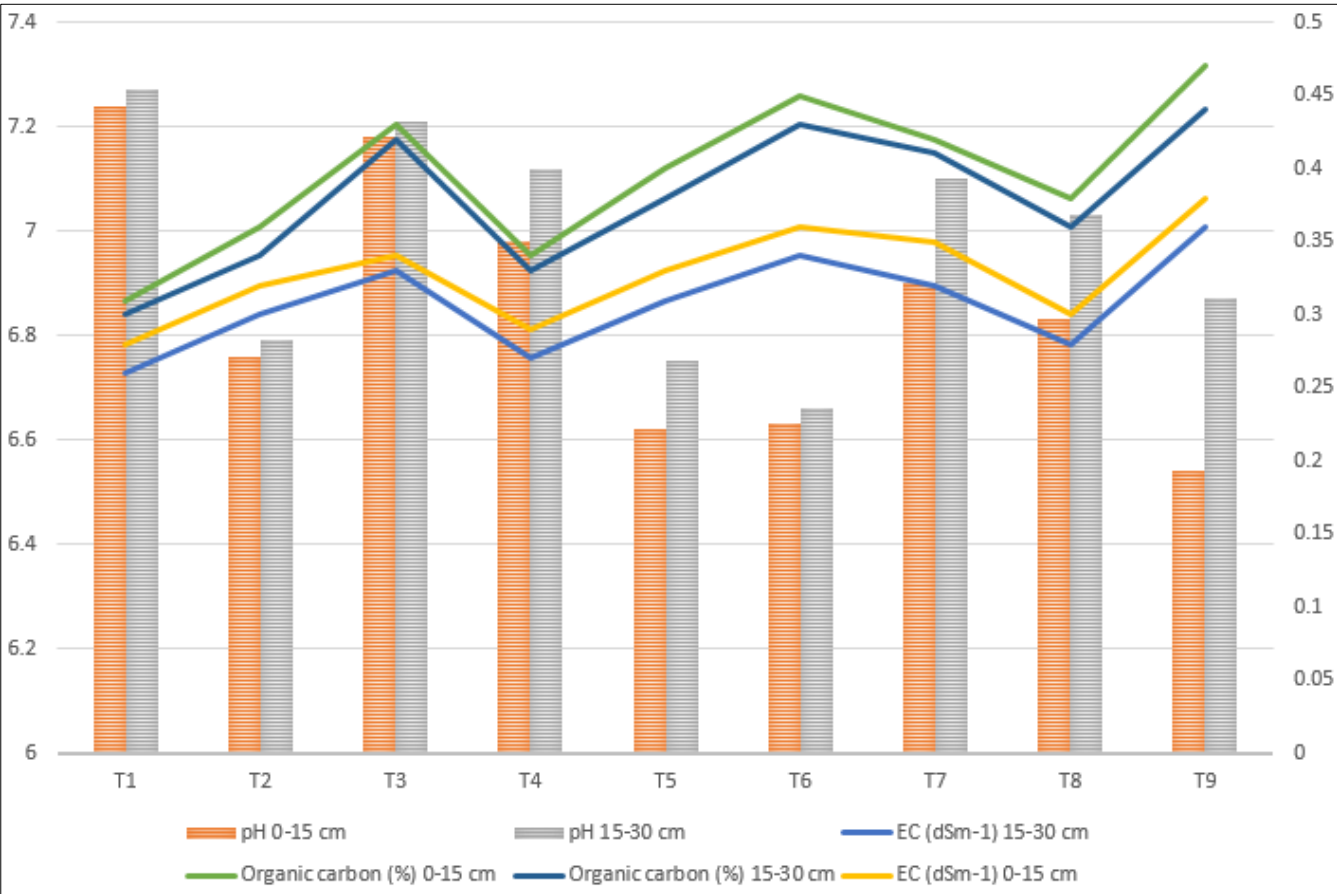


Fig 2: Influence of NPK, Beejamrit and Jeevamrit on pH, EC (dSm⁻¹) and Organic carbon (%) of soil

Available Nitrogen (kg ha⁻¹)

The data presented in table and fig. 3 clearly shows the available nitrogen (kg ha⁻¹) of soil as influenced by NPK, Beejamrit and Jeevamrit. The maximum available nitrogen of soil was recorded 300.44 and 295.50 kg ha⁻¹ at 0-15 and 15-30 cm in treatment T₉ (Beejamrit (5 ml/kg) + Jeevamrit (500 l ha⁻¹) + NPK @ 100%) followed by 278.33 and 275.88 kg ha⁻¹ at 0-15 and 15-30 cm in treatment Jeevamrit (500 l/ha) + NPK @ 100 % and minimum

available nitrogen of soil was recorded 230.22 and 226.55 kg ha⁻¹ at 0-15 and 15-30 cm in treatment T₁ (Absolute control). This enhancement may be attributed to mineralization of organic matter, improved microbial activity and direct nitrogen supply through fertilizers, which increased nutrient availability in soil. (Patel *et al.*, 2024, Gulaiya *et al.*, 2023, Bhanusri *et al.*, 2024 and Begum *et al.*, 2022)^[10, 5, 2, 1].

Available Phosphorus (kg ha⁻¹)

The data presented in table and fig. 3 clearly shows the available phosphorus (kg ha⁻¹) of soil as influenced by NPK, Beejamrit and Jeevamrit. The maximum available phosphorus of soil was recorded 23.02 and 20.32 kg ha⁻¹ at 0-15 and 15-30 cm in treatment T₉ (Beejamrit (5 ml/kg) + Jeevamrit (500 l ha⁻¹) + NPK @ 100%) followed by 21.78 and 18.10 kg ha⁻¹ at 0-15 and 15-30 cm in treatment T₆ (Jeevamrit (500 l ha⁻¹) + NPK @ 100%) and minimum available phosphorus of soil was recorded 16.79 and 13.93 kg ha⁻¹ at 0-15 and 15-30 cm in treatment T₁ (Absolute control). The highest phosphorus content was observed in T₉. Organic acids produced during decomposition may have solubilized fixed phosphorus, thereby increasing its availability to plants. Improved microbial activity also contributed to phosphorus mineralization. (Patel *et al.*, 2024, Gulaiya *et al.*, 2023, Bhanusri *et al.*, 2024 and Begum *et al.*, 2022)^[10, 5, 2, 1].

Available Potassium (kg ha⁻¹)

The data presented in table and fig. 3 clearly shows the available potassium (kg ha⁻¹) of soil as influenced by NPK, Beejamrit and Jeevamrit. The maximum available potassium of soil was recorded 212.52 and 208.35 kg ha⁻¹ at 0-15 and 15-30 cm in treatment T₉ (Beejamrit (5 ml/kg) + Jeevamrit (500 l ha⁻¹) + NPK @ 100%) followed by 204.50 and 200.22 kg ha⁻¹ at 0-15 and 15-30 cm in treatment T₆ (Jeevamrit (500 l ha⁻¹) + NPK @ 100%) and minimum available potassium of soil was recorded 188.85 and 185.15 kg ha⁻¹ at 0-15 and 15-30 cm in treatment T₁ (Absolute control). This improvement may be due to release of potassium from organic matter decomposition and enhanced solubilization of native soil potassium by microbial activity. (Patel *et al.*, 2024, Gulaiya *et al.*, 2023, Bhanusri *et al.*, 2024 and Begum *et al.*, 2022)^[10, 5, 2, 1].

Table 3: Influence of NPK, Beejamrit and Jeevamrit on Nitrogen (kg ha⁻¹), Phosphorus (kg ha⁻¹) and Potassium (kg ha⁻¹) of soil.

Treatments		Available nitrogen (kg ha ⁻¹)		Available phosphorus (kg ha ⁻¹)		Available potassium (kg ha ⁻¹)	
		0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
T ₁	Absolute control	230.22	226.55	16.79	13.93	188.85	185.15
T ₂	NPK @ 100 %	277.41	273.81	21.11	17.12	200.02	196.10
T ₃	Beejamrit Seed Treatment (5ml/kg)	263.49	259.13	17.50	15.92	192.63	188.85
T ₄	Jeevamrit Soil Treatment (500 l/ha)	245.37	241.33	17.19	14.78	193.74	188.96
T ₅	Beejamrit (5ml/kg) + NPK @ 100 %	260.38	256.14	21.29	17.56	203.17	199.15
T ₆	Jeevamrit (500 l/ha) + NPK @ 100 %	278.33	275.88	21.78	18.10	204.50	200.22
T ₇	Beejamrit (5ml/kg) + NPK @ 50 %	250.62	246.43	19.13	16.58	195.77	191.93
T ₈	Jeevamrit (500 l/ha) + NPK @ 50 %	275.87	270.83	19.52	17.12	197.93	194.05
T ₉	Beejamrit (5ml/kg) + Jeevamrit (500 l/ha) + NPK @ 100 %	300.44	295.50	23.02	20.32	212.52	208.35
F-Test		S	S	S	S	S	S
S.Ed. (±)		0.12	0.11	0.11	0.10	0.73	1.15
SSC.D. at 0.5%		0.26	0.24	0.25	0.21	1.57	2.46

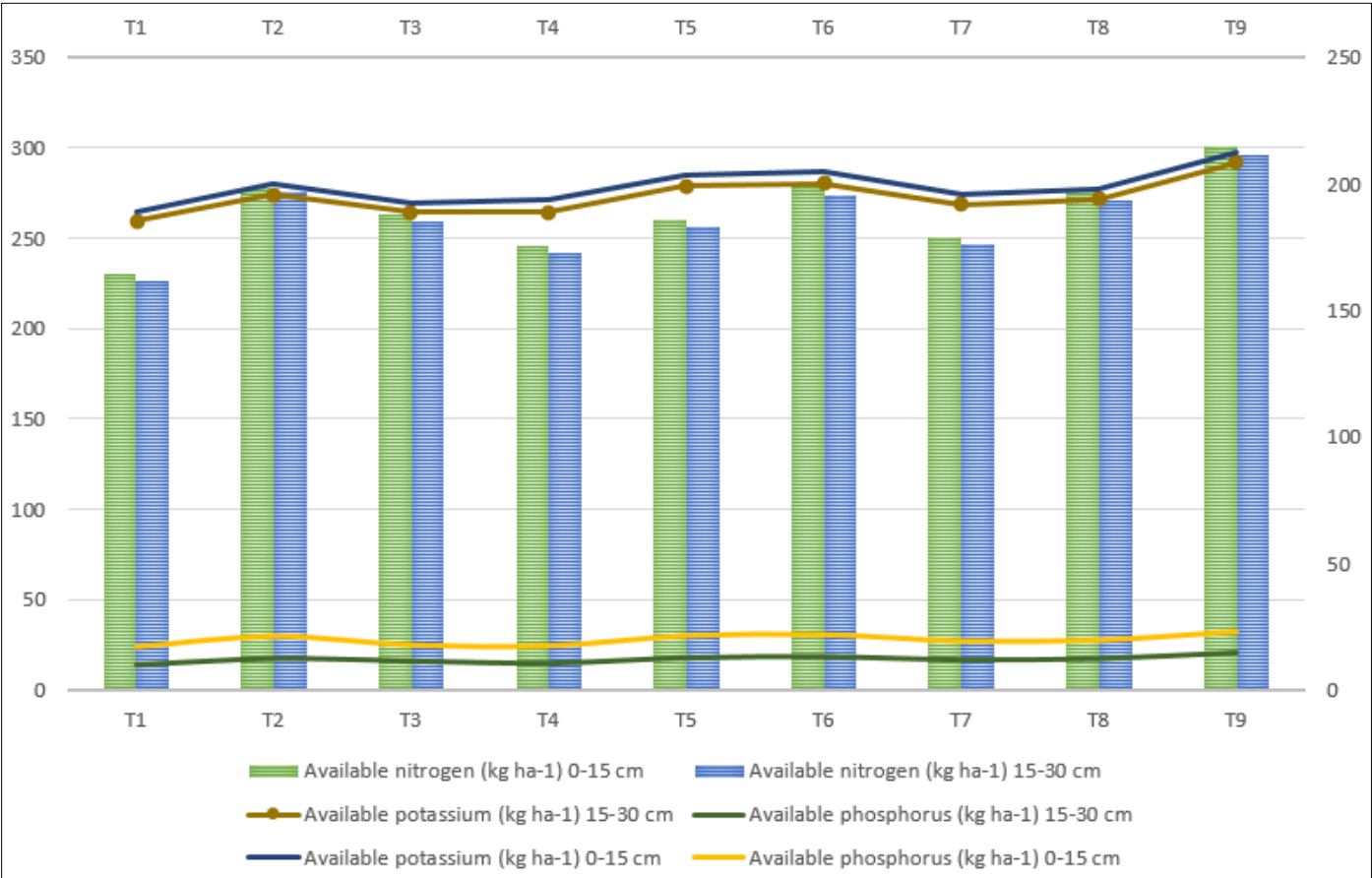


Fig 3: Influence of NPK, Beejamrit and Jeevamrit on Nitrogen (kg ha⁻¹), Phosphorus (kg ha⁻¹) and Potassium (kg ha⁻¹) of soil

Conclusion

The present investigation showed that recommended doses of NPK fertilizer along with integrated application of organic formulations (Beejamrit and Jeevamrit) significantly increased the soil physico-chemical properties and nutrient availability in chickpea cultivation. The treatment T₉ (Beejamrit (5 ml kg⁻¹ seed) + Jeevamrit (500 l ha⁻¹) + 100% NPK) showed excellent improvement in soil quality parameters. Among the treatments, T₉ recorded the lowest bulk density and particle density, while exhibiting the highest pore space and water holding capacity, indicating improved soil physical condition. The findings suggest that the combined use of Beejamrit and Jeevamrit with 100% recommended NPK fertilizer promotes better nutrient cycling, improves soil fertility status and sustains soil health. Thus, the nutrient management system, which combines the use of organic bio-stimulants and inorganic fertilizers can be proposed as an effective and sustainable approach to improve soil productivity and ensure long-term soil quality in the cropping system of chickpea in agro-climatic condition of Prayagraj.

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Conflict of Interest

Not Applicable

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