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Effect of integrated nutrient management on growth of chickpea (*Cicer arietinum* L.)

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Abstract

A field experiment was conducted during the Rabi season of 2024-25 at the Agronomy Farm, Rama University, to evaluate the effect of integrated nutrient management on growth, yield, and soil fertility in chickpea (*Cicer arietinum* L.). The study included eight treatments combining different levels of RDF (Recommended Dose of Fertilizers 100%, 75%, 50%) with biofertilizers such as *Rhizobium* and *PSB*, along with ZnSO_4 and sulphur applications. The experiment was laid out in a randomized block design with three replications. Among all treatments, T_7 (75% RDF + *Rhizobium* + *PSB* + ZnSO_4 @ 20 kg/ha + Sulphur @ 40 kg/ha) consistently recorded the highest plant height, dry matter accumulation, branches per plant, and nodules per plant across various growth stages.

Keywords: Chickpea, Integrated nutrient management, rhizobium, PSB, zinc sulphate, soil fertility

Introduction

The most significant winter season (Rabi) grain legume in India is the chickpea (*Cicer arietinum* L.), which is mostly produced rainfed on leftover moisture following the harvest of Kharif crops. One of the main obstacles to chickpea crop development is insufficient soil moisture in the seedbed. This is due to the fact that insufficient soil moisture can hinder seed germination, impede the development of seedlings, and lower crop output in rainfed crops (Sharma 1985) ^[14]. Crop production is increased by pre-sowing irrigation or protective irrigation during crucial stages of crop growth. Rainfed conditions are used to grow almost 90% of the world's chickpeas, which suffer significant production losses due to terminal drought stress. A significant protein component in diets, chickpeas are especially crucial for vegetarian diets. It is mostly consumed as dal, dal flour, and processed whole seeds (boiled, roasted, fried, steaming, etc.). It's used to make sauces, candies, and snacks. As a green vegetable, fresh green seeds are also eaten. Protein (18-22%), carbs (52-70%), fat (4-10%), minerals (calcium, phosphorus, iron, etc.), and vitamins are all abundant in it. Its straw has significant forage value and is a great animal feed (Prasad 2012) ^[11].

In India, chickpeas are produced over an area of around 10.56 mha, yielding 11.37 m tons annually on average (1077 kg ha⁻¹). Its entire area is 5.01 lakh hectares, and its productivity is 1155 kg ha⁻¹, with a production of 5.78 lakh tons (Anonymous 2023-2024) ^[1]. This represents over 70% of the world's total land and 67% of its production. Madhya Pradesh, Rajasthan, Maharashtra, Andhra Pradesh, and Uttar Pradesh are the states that produce the most chickpeas. Utilizing balanced fertilization—applying organic manures, N, P, and K in addition to biofertilizers like *Rhizobium* and *PSB*—is crucial to increasing this crop's yield. *Rhizobium* and PGPR inoculation of pulses stimulates plant growth and increases crop yields. Farm Yard Manure (FYM) is a significant source of nutrients and soil organic matter that the plant may use once it has been broken down by microorganisms (Rana *et al.*, 2013) ^[13]. It is known that bacteria that solubilize phosphorus, such as *Bacillus polymyxa*, *Pseudomonas striata*, and *Pseudomonas fluorescence*, may change the fixed form of phosphorus into forms that are ionic.

Methods and Materials

A field experiment was conducted during rabi season of 2024-25 on loamy sand of in the rural area of Kanpur district of Mandhana, located 10 km from Kanpur in Uttar Pradesh to

Effect of integrated nutrient management on growth of chickpea (*Cicer arietinum* L.). The soil was normal in pH of 7.65, electrical conductivity (EC) of 0.27 dSm⁻¹, organic carbon content of 0.41%, and available nutrients including nitrogen (N), phosphorus (P), and potassium (K) at levels of 217.0, 19.5, and 149.50 kg ha⁻¹, respectively. The experiment was laid out during Rabi season of 2024-25. The study included eight treatments combining different levels of RDF (Recommended Dose of Fertilizers—100%, 75%, 50%) with biofertilizers such as Rhizobium and PSB, along with ZnSO₄ and sulphur applications. The experiment was laid out in a randomized block design with three replications data were gathered on five plants chosen from each plot.

Results

Growth Characters

1. Plant height (cm)

The plant height data that was collected at 30, 60, 90, and harvest stages of the crop are shown in Table 4.2 and are depicted in Fig. 4.2. According to the results, T₇ (75% RDF + Rhizobium + PSB + ZnSO₄ @ 20 kg ha⁻¹ + Sulphur @ 40 kg ha⁻¹) treatment resulted in the highest plant heights (15.80, 33.51, 45.09, and 40.75 cm) at all growth phases (30, 60, 90 DAS, and harvest). The height of the plants was found to be comparable to all treatments at 30 DAS. By 30 and 60 DAS, there was no discernible variation in the height of the plants across all treatments; however, by 90 DAS, there was a noticeable difference and throughout the harvest phase. The lowest height of plants (14.50, 24.90, 33.62, 30.38 cm) were reported in treatment T₈ (control) at 30, 60, 90, and harvest stages. Similar result reported by Ahemad *et al.*, (2014)^[2] & Beg *et al.*, (2019)^[3]

2. Dry matter accumulation/plant

The dry matter accumulation/plant data collected at 30, 60, 90, and harvest stages of the crop are shown in Table 2. Due to various fertilizer management techniques, the results showed that the dry matter accumulation/plant ranged from 0.58 to 0.63, 3.74 to 5.01, 7.42 to 16.92, and 9.28 to 21.15 g/plant at 30, 60, 90 DAS, and harvest. The application of treatment T₇ (75% RDF + Rhizobium + PSB + ZnSO₄ @ 20 kg ha⁻¹ + Sulphur @ 40 kg ha⁻¹) resulted in the highest dry matter accumulation (21.15 g/plant) at harvest, which was significantly better than control and comparable to T₁ (100% RDF), T₅ (75% RDF + Rhizobium + PSB), and T₆ (75% RDF + Rhizobium + PSB + ZnSO₄ @ 20 kg ha⁻¹).

Treatment T₈ (control) had the lowest dry matter accumulation/plant. Similar result reported by Bhavya *et al.*, (2018)^[4] & Chaudhari *et al.*, (2016)^[5]

3. Number of nodules/plant

The information on the number of nodules per plant at 30, 60, 90, and harvest stages of the crop is shown in Table 3. According to the findings, various fertilizer management techniques at 30, 60, 90 DAS, and harvest stage, respectively, resulted in a range of nodules/plant (2.9 to 3.16, 14.94 to 20.04, 10.45 to 14.028, and 3.7 to 5.01). T₇ (75% RDF + Rhizobium + PSB + ZnSO₄ @ 20 kg ha⁻¹ + Sulphur @ 40 kg ha⁻¹) had the highest number of nodules/plant throughout all growth phases. The number of nodules per plant was equal at the 30 DAS initial growth stage, and it grew steadily from 30 DAS to 60 DAS before decreasing from 60 DAS to harvest stage, respectively. T₇ produced the most nodules per plant across all development phases, whereas the control group produced the fewest nodules across all growth stages. Similar result reported by Gupta *et al.*, (2019)^[7] & Kumar *et al.*, (2015)^[8]

4. Number of branches/plant

The information on the number of branches per plant at 30, 60, 90, and harvest stages of the crop is shown in Table 4. The findings showed that varied fertilizer management approaches at 30, 60, 90 DAS, and harvest, respectively, resulted in a range of branches/plants (2.18 to 2.37, 7.72 to 10.35, 26.15 to 35.07, and 26.95 to 35.10). At every stage of chickpea growth, the number of branches per plant progressively increases under all treatments. T₇ (75% RDF + Rhizobium + PSB + ZnSO₄ @ 20 kg ha⁻¹ + Sulphur @ 40 kg ha⁻¹) produced the most branches per plant throughout all development stages (30, 60, 90, and harvest), whereas T₈ (control) produced the fewest branches per plant across all growth stages. At the harvest stage, T₇ (75% RDF + Rhizobium + PSB + ZnSO₄ @ 20 kg ha⁻¹ + Sulphur @ 40 kg ha⁻¹) had the most branches (35.10) per plant, which was substantially more than T₈ (control), T₂ (75% RDF alone), T₃ (50% RDF), and T₄ (75% RDF + Rhizobium), while T₆, T₅, and T₁ were on par. With the exception of T₂ (75% RDF alone) and T₃ (50% RDF alone), the least number of branches/plant was reported with T₈ (control), which was much lower than all other treatments. Similar result reported by Meena *et al.*, (2018)^[9] & Patel, *et al.*, (2018)^[10]

Table 1: Effect of various treatments on plants height at different growth stages of chick pea crop.

Treatments	Plants height (cm)			
	30 DAS	60 DAS	90 DAS	At harvest
T ₁ : 100% RDF	15.50	31.50	42.53	38.43
T ₂ : 75% RDF	14.70	27.40	36.99	33.43
T ₃ : 50% RDF	14.60	26.90	36.32	32.82
T ₄ : 75% RDF + Rhizobium	15.00	27.70	37.40	33.79
T ₅ : 75% RDF + Rhizobium + PSB	15.20	28.60	38.61	34.89
T ₆ : 75% RDF + Rhizobium + PSB + ZnSO ₄ @ 20 kg ha ⁻¹	15.60	31.20	42.12	38.06
T ₇ : 75% RDF + Rhizobium + PSB + ZnSO ₄ @ 20 kg ha ⁻¹ + Sulphur @ 40 kg ha ⁻¹	15.80	33.51	45.09	40.75
T ₈ : Control	14.50	24.90	33.62	30.38
SEm ±	0.78	1.31	1.95	1.97
CD at 5%	2.37	3.96	5.90	5.99

Table 2: Effect of various treatments on Dry matter accumulation at different growth stages of chick pea crop.

Treatments	Dry matter accumulation/Plant			
	30 DAS	60 DAS	90 DAS	At harvest
T ₁ : 100% RDF	0.62	4.73	13.76	17.20
T ₂ : 75% RDF	0.59	4.11	10.76	13.46
T ₃ : 50% RDF	0.58	4.04	7.97	9.96
T ₄ : 75% RDF + Rhizobium	0.60	4.16	11.94	14.93
T ₅ : 75% RDF + Rhizobium + PSB	0.61	4.30	12.54	15.67
T ₆ : 75% RDF + Rhizobium + PSB + ZnSO ₄ @ 20 kg ha ⁻¹	0.62	4.68	13.60	17.00
T ₇ : 75% RDF + Rhizobium + PSB + ZnSO ₄ @ 20 kg ha ⁻¹ + Sulphur @ 40 kg ha ⁻¹	0.63	5.01	16.92	21.15
T ₈ : Control	0.58	3.74	7.42	9.28
SEm +	0.03	0.20	0.66	0.59
CD at 5%	0.09	0.62	2.00	1.79

Table 3: Effect of various treatments on number of nodules/plant in chickpea.

Treatments	Number of nodules/plant			
	30 DAS	60 DAS	90 DAS	At harvest
T ₁ : 100% RDF	3.1	18.9	13.23	4.72
T ₂ : 75% RDF	2.94	16.44	11.50	4.11
T ₃ : 50% RDF	2.92	16.14	11.29	4.03
T ₄ : 75% RDF + Rhizobium	3.00	16.62	11.63	4.15
T ₅ : 75% RDF + Rhizobium + PSB	3.04	17.16	12.01	4.29
T ₆ : 75% RDF + Rhizobium + PSB + ZnSO ₄ @ 20 kg ha ⁻¹	3.12	18.72	13.10	4.68
T ₇ : 75% RDF + Rhizobium + PSB + ZnSO ₄ @ 20 kg ha ⁻¹ + Sulphur @ 40 kg ha ⁻¹	3.16	20.04	14.02	5.01
T ₈ : Control	2.9	14.94	10.45	3.73
SEm +	0.12	0.73	0.45	0.19
CD at 5%	0.36	2.20	1.38	0.58

Table 4: Effect of various treatments on number of branches/plant in chickpea.

Treatments	number of branches/plant			
	30 DAS	60 DAS	90 DAS	At harvest
T ₁ : 100% RDF	2.33	9.77	33.08	33.10
T ₂ : 75% RDF	2.21	8.49	28.77	29.77
T ₃ : 50% RDF	2.19	8.34	28.25	28.50
T ₄ : 75% RDF + Rhizobium	2.25	8.59	29.09	30.55
T ₅ : 75% RDF + Rhizobium + PSB	2.28	8.87	30.03	32.95
T ₆ : 75% RDF + Rhizobium + PSB + ZnSO ₄ @ 20 kg ha ⁻¹	2.34	9.67	32.76	33.33
T ₇ : 75% RDF + Rhizobium + PSB + ZnSO ₄ @ 20 kg ha ⁻¹ + Sulphur @ 40 kg ha ⁻¹	2.37	10.35	35.07	35.10
T ₈ : Control	2.18	7.72	26.15	26.95
SEm +	0.09	0.38	1.21	1.02
CD at 5%	0.26	1.14	3.68	3.08

Conclusion

In conclusion, treatment T₇ (75% RDF + Rhizobium + PSB + ZnSO₄ @ 20 kg/ha + Sulphur @ 40 kg/ha) consistently outperformed all other treatments across all observed growth stages in terms of plant height, dry matter accumulation, number of nodules, and branches per plant. This integrated nutrient management approach significantly enhanced chickpea growth and development compared to the control (T₈), which showed the lowest performance in all parameters. Notably, while early-stage differences among treatments were minimal, the advantages of T₇ became more pronounced by 90 DAS and at harvest, indicating its effectiveness in promoting sustained crop vigor and productivity.

References

- Anonymous. Annual report. Directorate of Maize Research; New Delhi; 2024.
- Ahemad M, Kibret M. Mechanisms and applications of plant growth promoting rhizobacteria: current perspective. J King Saud Univ Sci. 2014;26:1-20.
- Beg MA, Singh JK. Effect of biofertilizer and fertility levels on growth, yield and nutrient removal of cowpea under Kashmir condition. Indian J Agric Sci. 2019;79 (5):388-390.
- Bhavya G, Shaker K, Chandra G, Jayasree, Reddy M, Malla. Nutrient uptake and yield of green gram (*Vigna radiata* L.) as influenced by phosphorus fertilization, organic manures and biofertilizers. Int J Chem Stud. 2018;6 (3):32-35.
- Chaudhari SN, Thanki JD, Chaudhari VD, Varma C. Yield attributes, yield and quality of black greengram (*Vigna radiata* L.) as influenced by organic manures, biofertilizer and phosphorus fertilization. Bioscan. 2016;11 (1):431-433.
- Das S, Pareek BL, Kumawat A, Dhikwal SR. Effect of phosphorus and biofertilizer on productivity of chickpea (*Cicer arietinum* L.) in north western Rajasthan, India. Legume Res. 2013;36 (6):511-514.
- Gupta SC, Singh RP, Verma R. Response of chickpea to P levels from different sources with various PSB species. Legume Res. 2019;32:212-214.
- Kumar D, Arvadiya K, Desai KL, Usadadiya VP, Patel AM. Growth and yield of chickpea (*Cicer arietinum* L.) as influenced by graded levels of fertilizers and biofertilizer. 2015;10 (1):335-338.

9. Meena DD, Thomas T, Rao PS. Effect of different levels of NPK, rhizobium and FYM on soil properties, growth and yield of cowpea (*Vigna unguiculata* L.). Int J Chem Stud. 2018;6 (3):2117-2119.
10. Patel HF, Maheriya VD, Attar SK, Patel HR. Nutrient uptake and yield of kharif green gram as influenced by levels of sulphur, phosphorus and PSB inoculation. Legume Res. 2018;41 (3):405-409.
11. Prasad R. Textbook of field crops production. Vol. 1. 2012. p. 320-321.
12. Indian Council of Agricultural Research. New Delhi.
13. Rana M, Pathania P, Khaswan SL. Effect of biofertilizers and phosphorus on productivity and nutrient uptake of soybean (*Glycine max* L.). Ann Agric Res. 2013;34 (3):245-247.
14. Sharma S, Dubey YP, Kaistha BP, Verma TS. Effect of *Rhizobium* inoculation and phosphorus level on symbiotic parameters, growth and yield of French bean (*Phaseolus vulgaris* L.) in north-western acid alfisol. Legume Res. 1998;28:103-106.