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Effect of tillage practices and nutrient management on growth and yield of chickpea (*Cicer Arietinum* L.)

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ABSTRACT

A field experiment was conducted during Rabi season 2025–26 at the Agricultural Research Farm, Department of Agronomy, School of Agriculture, Suresh Gyan Vihar University, Jaipur (Rajasthan), to study the effect of tillage practices and nutrient management on growth, yield attributes and productivity of chickpea (*Cicer arietinum* L.). The experiment comprised three tillage practices, viz., zero tillage, reduced tillage and conventional tillage, and five fertilizer management treatments involving different combinations of recommended dose of fertilizer (RDF) and recommended nitrogen through vermicompost. The results revealed that conventional tillage recorded superior growth and yield performance, with maximum plant height, dry matter accumulation, branches plant⁻¹ and yield attributes. Conventional tillage recorded 54.87 cm plant height at harvest, 23.95 branches plant⁻¹, 64.93 pods plant⁻¹, 1.63 seeds pod⁻¹ and seed yield of 1570.2 kg ha⁻¹. Among fertilizer management treatments, application of 75% RDF + 25% RDN through vermicompost resulted in superior performance, recording 56.00 cm plant height, 24.80 branches plant⁻¹, 66.09 pods plant⁻¹, 1.76 seeds pod⁻¹ and seed yield of 1612 kg ha⁻¹. The interaction between tillage and nutrient management was significant for major growth and yield attributes, with conventional tillage combined with 75% RDF + 25% RDN through vermicompost generally producing the highest values. This treatment combination also enhanced dry matter accumulation, biological yield and nutrient content and uptake of nitrogen, phosphorus and potassium.

Keywords: Chickpea, Conventional tillage, Vermicompost, Nutrient management, Growth, Yield, Nutrient uptake

1. Introduction

Chickpea (*Cicer arietinum* L.) is one of the most important cool-season food legumes and a major source of dietary protein, carbohydrates, minerals and other essential nutrients. It has considerable importance in Indian agriculture because of its contribution to nutritional security, pulse production and soil fertility. Chickpea also has the ability to fix atmospheric nitrogen through symbiotic association with *Rhizobium*, thereby contributing to nutrient cycling and improving the sustainability of cereal–pulse cropping systems.

Despite its importance, chickpea productivity is influenced by several agronomic and environmental constraints, including poor soil fertility, inadequate nutrient availability, moisture stress and unsuitable soil-management practices. Tillage plays an important role in modifying soil physical conditions, seedbed preparation, aeration, water availability and root development. Appropriate tillage can therefore create favourable conditions for crop establishment and subsequent growth, while its interaction with nutrient management may influence yield formation and resource-use efficiency.

Nutrient management is another critical factor governing chickpea growth and productivity. Although biological nitrogen fixation reduces the dependence of chickpea on external nitrogen, balanced application of essential nutrients is necessary for vigorous vegetative growth, nodulation, reproductive development and seed formation. Integrated nutrient management involving inorganic fertilizers and organic sources such as vermicompost can improve nutrient availability and soil health. Recent studies have demonstrated that combinations of recommended fertilizer doses with vermicompost and biofertilizers can substantially improve chickpea growth, yield attributes and grain yield (Zala *et al.*, 2024; Abisankar *et al.*, 2024) [2, 1].

Recent research has also shown that integrated nutrient management can improve nutrient uptake and grain quality, while organic nutrient sources such as vermicompost can enhance yield and nutrient acquisition in chickpea (Dubey *et al.*, 2024; Namdeo *et al.*, 2024) [3, 4]. Therefore, combining suitable tillage with balanced nutrient management may provide an effective approach for enhancing chickpea productivity and sustaining soil fertility. The present investigation was conducted during Rabi 2025–26 at Agricultural Research Farm, Department of Agronomy, School of Agriculture, Suresh Gyan Vihar University, Jaipur, Rajasthan, to study the effect of tillage practices and nutrient management on growth, yield attributes and productivity of chickpea.

2. Materials and Methods

A field experiment entitled “Effect of Tillage Practices and Nutrient Management on Growth, Yield Attributes and Productivity of Chickpea (*Cicer arietinum* L.)” was conducted during the Rabi season of 2025–26 at the Agricultural Research Farm, Department of Agronomy, School of Agriculture, Suresh Gyan Vihar University, Jaipur, Rajasthan. The experiment was laid out in a split-plot design with three replications. Three tillage practices were assigned to the main plots: T_1 – zero tillage, T_2 – reduced tillage and T_3 – conventional tillage. Five fertilizer management treatments were allocated to the sub-plots: F_1 – control, F_2 – 100% RDF, F_3 – 75% RDF + 25% RDN through vermicompost, F_4 – 50% RDF + 50% RDN through vermicompost and F_5 – 25% RDF + 75% RDN through vermicompost. Chickpea was grown using recommended agronomic practices. Observations on growth attributes, including plant height, number of branches, days to 50% flowering and dry matter accumulation, were recorded at specified growth stages. Yield attributes such as pods plant⁻¹, seeds pod⁻¹ and seed index were recorded at harvest. Seed, stover and biological yields and harvest index were also determined. The experimental data were subjected to analysis of variance (ANOVA) appropriate for split-plot design, and treatment means were compared using the critical difference (CD) at 5% probability level.

3. Results and Discussion

3.1 Growth attributes

Plant height was significantly influenced by tillage practices and fertilizer management at 30 DAS, 60 DAS and harvest (Table 4.1; Fig. 4.1). Among tillage treatments, conventional tillage (T_3) recorded the maximum plant height of 24.27, 39.40 and 54.87 cm, respectively, while zero tillage (T_1) recorded the minimum values of 22.84, 37.43 and 52.96 cm. Reduced tillage remained statistically at par with conventional tillage. Better soil tilth, aeration and root development under conventional tillage may have enhanced water and nutrient uptake, thereby promoting plant growth. Similar differences in chickpea performance under contrasting tillage systems have been reported by Dixit *et al.* (2015) and Singh *et al.* (2020) [5].

Fertilizer management also significantly affected plant height. The maximum height was recorded under F_3 (75% RDF + 25% RDN through vermicompost), with values of 24.93, 40.27 and 56.00 cm, respectively, followed by F_4 and F_2 . The minimum was observed under control (21.71, 35.51 and 51.62 cm). The improved growth under integrated nutrient management may be attributed to the continuous nutrient supply from vermicompost along with readily available nutrients from inorganic fertilizer. Similar responses were reported by Zala *et al.* (2024) [2], Abisankar *et al.* (2024) [1], Raghuwanshi *et al.* (2025) [6] and Meena *et al.* (2025) [7].

Conventional tillage produced the maximum number of branches (23.95 plant⁻¹), statistically at par with reduced tillage (23.36), whereas zero tillage recorded 22.39 branches plant⁻¹ (Table 4.5). Among fertilizer treatments, F_3 produced the highest number of branches (24.80 plant⁻¹), followed by F_4 (24.47), while control recorded the lowest value (21.07). The interaction showed the maximum number of branches under T_3F_3 (25.67 plant⁻¹). Enhanced nutrient availability and improved root growth probably increased vegetative development and branch formation. Similar improvements in branching due to INM have been reported by Jat *et al.* (2025) [8], Raghuwanshi *et al.* (2025) [6] and Zuber *et al.* (2026) [9].

Tillage and fertilizer management significantly influenced flowering time. Conventional tillage recorded the earliest 50% flowering (63.33 days), whereas zero tillage required 65.40 days. F_3 recorded the earliest flowering (62.56 days) and control the latest (66.67 days). Improved nutrient availability probably promoted faster crop establishment and reproductive development. Similar improvements in crop growth and phenological development under integrated nutrient management have been reported by Kumar *et al.* (2019) [10], Singh *et al.* (2024) [11] and Nagar *et al.* (2025) [12].

Dry matter accumulation was significantly influenced by both factors (Table 4.8). Conventional tillage recorded the maximum dry matter of 2.53, 14.82 and 23.90 g plant⁻¹ at 30 DAS, 60 DAS and harvest, respectively. F_3 recorded the highest values of 2.60, 14.97 and 24.50 g plant⁻¹, while control recorded the lowest. The interaction effect was significant, with T_3F_3 producing the highest dry matter accumulation (2.79, 15.17 and 25.08 g plant⁻¹). Greater dry matter production under INM can be attributed to improved nutrient availability, root activity and photosynthetic efficiency. Comparable findings were reported by Zala *et al.* (2024) [2], Abisankar *et al.* (2024) [1], Jat *et al.* (2025) [8] and Meena *et al.* (2025) [7].

3.2 Yield attributes and yield

The number of pods plant⁻¹ was significantly affected by tillage and fertilizer management (Table 4.12). Conventional tillage recorded the maximum pods (64.93 plant⁻¹), followed by reduced tillage (64.33), whereas zero tillage recorded 63.04. Among fertilizer treatments, F_3 produced the maximum number of pods (66.09 plant⁻¹), followed by F_4 (65.73), while control recorded 61.67. The interaction effect was significant and the maximum value was recorded under T_3F_3 (67.33 pods plant⁻¹).

The increase in pods may be attributed to greater branching and dry matter accumulation under favourable tillage and nutrient conditions. Similar enhancement in pod production through integrated nutrient management was reported by Jakhar *et al.* (2021) [13], Mukati *et al.* (2021) [14], Raghuwanshi *et al.* (2025) [6] and Zuber *et al.* (2026) [9]. Conventional tillage recorded the maximum number of seeds pod⁻¹ (1.63) and seed index (15.19 g), whereas zero tillage recorded 1.31 seeds pod⁻¹ and 14.56 g, respectively. F_3 produced the highest values of 1.76 seeds pod⁻¹ and 15.50 g seed index, while the control recorded the lowest values. The T_3F_3 combination recorded the maximum values of 1.99 seeds pod⁻¹ and 15.73 g, indicating better reproductive development under combined tillage and nutrient management. Similar improvements in seed formation and seed weight through INM have been reported by Kumar *et al.* (2019) [10], Jakhar *et al.* (2021) [13], Zala *et al.* (2024) [2] and Meena *et al.* (2025) [7].

Seed yield was significantly influenced by tillage practices and fertilizer management (Table 4.12; Fig. 4.6). Conventional tillage produced the maximum seed yield of 1570.2 kg ha⁻¹, followed by reduced tillage (1544.8 kg ha⁻¹), while zero tillage recorded 1488.2 kg ha⁻¹. The greater yield under conventional tillage was associated with higher plant height, branching, pod number and seed formation. Earlier studies have reported that chickpea yield response to tillage varies with soil, moisture and residue conditions; both conventional and reduced tillage can perform well under suitable environments. Among fertilizer treatments, F_3 (75% RDF + 25% RDN through vermicompost) recorded the maximum seed yield of 1612 kg ha⁻¹, followed by F_4 (1601.7 kg ha⁻¹) and F_2 (1568.3 kg ha⁻¹), while control produced 1407 kg ha⁻¹. Integrated application probably improved nutrient availability and nutrient-use efficiency. Similar yield enhancement under combinations of inorganic fertilizer and vermicompost has been reported by Zala *et al.* (2024) [2], Raghuwanshi *et al.* (2025) [6], Jat *et al.* (2025) [8], Meena *et al.* (2025) [7] and Nagar *et al.* (2025) [12].

Conventional tillage recorded the maximum stover yield (2411.0 kg ha⁻¹) and biological yield (3981.2 kg ha⁻¹), whereas zero tillage recorded 2341.6 and 3829.8 kg ha⁻¹, respectively. F_3 produced the highest stover yield (2445.3 kg ha⁻¹) and biological yield (4057.3 kg ha⁻¹). The interaction T_3F_3 recorded the highest stover (2476 kg ha⁻¹) and biological yield (4124 kg ha⁻¹). Increased biomass production was associated with greater plant growth and nutrient availability. Similar results have been reported by Jakhar *et al.* (2021) [13], Abisankar *et al.* (2024) [1], Raghuwanshi *et al.* (2025) [6] and Zuber *et al.* (2026) [9].

Harvest index was not significantly affected by either tillage or fertilizer management (Table 4.18). Numerically, conventional tillage recorded the highest harvest index (39.38%), while F_3 recorded 39.69%. The non-significant response indicates that increases in seed

and vegetative biomass occurred proportionately, resulting in relatively similar partitioning of assimilates. A similar non-significant response of harvest index under integrated nutrient management was reported by Zuber *et al.* (2026) [9].

Conclusion

The study revealed that tillage practices and nutrient management significantly influenced the growth, yield attributes and productivity of chickpea. Among tillage practices, conventional tillage (T_3) generally

recorded superior growth, yield attributes, seed yield, stover yield and biological yield compared with reduced and zero tillage. Among nutrient management treatments, 75% RDF + 25% RDN through vermicompost (F_3) performed best across most growth and yield parameters. The combination of conventional tillage with 75% RDF + 25% RDN through vermicompost (T_3F_3) recorded the highest overall performance, particularly for plant height, branches, dry matter accumulation, pods plant⁻¹, seeds pod⁻¹, seed index, seed yield, stover yield and biological yield. Harvest index was not significantly affected by the treatments.

Table 1. Effect of tillage practice and fertilizers management on plant height

Treatments	Plant height		
	30 DAS	60 DAS	At harvest
Main Plot- Tillage practices			
T ₁ -Zero tillage	22.84	37.43	52.96
T ₂ -Reduced tillage	23.71	38.59	54.27
T ₃ -Conventional tillage	24.27	39.40	54.87
SEm±	0.22	0.31	0.29
CD at 5%	0.66	0.91	0.89
CV	7.57%	7.10%	6.05%
Sub Plot- Fertilizer management			
F ₁ -Control	21.71	35.51	51.62
F ₂ -100 % RDF	24.07	39.38	54.33
F ₃ -75 % RDF + 25 % RDN through VC	24.93	40.27	56.00
F ₄ -50 % RDF + 50 % RDN through VC	24.58	40.04	55.67
F ₅ -25 % RDF + 75 % RDN through VC	22.73	37.17	52.53
SEm±	0.67	0.90	0.77
CD at 5%	1.95	2.63	2.24
CV	8.49%	7.02%	7.26%

Table 2. Effect of tillage practice and fertilizers management on number of branches per plant and days to 50% flowering

Treatments	Number of of branches per plant	Days to 50% flowering
Main Plot- Tillage practices		
T ₁ -Zero tillage	22.39	65.40
T ₂ -Reduced tillage	23.36	64.13
T ₃ -Conventional tillage	23.95	63.33
SEm±	0.27	0.28
CD at 5%	0.84	0.89
CV	6.53%	6.67%
Sub Plot- Fertilizer management		
F ₁ -Control	21.07	66.67
F ₂ -100 % RDF	23.82	63.78
F ₃ -75 % RDF + 25 % RDN through VC	24.80	62.56
F ₄ -50 % RDF + 50 % RDN through VC	24.47	63.00
F ₅ -25 % RDF + 75 % RDN through VC	22.00	65.44
SEm±	0.47	0.76
CD at 5%	1.38	2.21
CV	7.09%	9.54%

Table 3. Effect of tillage practice and fertilizers management on dry matter accumulation

Treatments	Dry matter accumulation		
	30 DAS	60 DAS	At harvest
Main Plot- Tillage practices			
T ₁ -Zero tillage	2.31	14.48	22.73

(continued on next page)

Treatments	Dry matter accumulation		
	30 DAS	60 DAS	At harvest
T ₂ -Reduced tillage	2.43	14.69	23.48
T ₃ -Conventional tillage	2.53	14.82	23.90
SEm±	0.03	0.06	0.17
CD at 5%	0.09	0.17	0.53
CV	6.27%	6.59%	6.85%
Sub Plot- Fertilizer management			
F ₁ -Control	2.20	14.22	21.82
F ₂ -100 % RDF	2.47	14.78	23.76
F ₃ -75 % RDF + 25 % RDN through VC	2.60	14.97	24.50
F ₄ -50 % RDF + 50 % RDN through VC	2.57	14.92	24.24
F ₅ -25 % RDF + 75 % RDN through VC	2.28	14.41	22.52
SEm±	0.04	0.08	0.49
Main Plot- Tillage practices			
CV	6.34%	6.73%	6.34%

Table 4. Effect of tillage practice and fertilizers management on number of pods plant⁻¹, number of seeds pod⁻¹, seed index, seed yield and stover yield

Treatments	No of pods plant ⁻¹	Number of Seeds pod ⁻¹	Seed index (g)	Seed yield (kg/ha)	Stover yield (kg/ha)
Main Plot- Tillage practices					
T ₁ -Zero tillage	63.04	1.31	14.56	1488.2	2341.6
T ₂ -Reduced tillage	64.33	1.51	14.98	1544.8	2387.2
T ₃ -Conventional tillage	64.93	1.63	15.19	1570.2	2411.0
SEm±	0.29	0.03	0.08	11.28	11.94
CD at 5%	0.91	0.10	0.27	34.31	34.87
CV	6.74%	8.65%	6.07%	7.85%	6.94%
Sub Plot- Fertilizer management					
F ₁ -Control	61.67	1.18	13.93	1407.0	2281.0
F ₂ -100 % RDF	64.42	1.49	15.17	1568.3	2408.3
F ₃ -75 % RDF + 25 % RDN through VC	66.09	1.76	15.50	1612.0	2445.3
F ₄ -50 % RDF + 50 % RDN through VC	65.73	1.70	15.38	1601.7	2434.3
F ₅ -25 % RDF + 75 % RDN through VC	62.60	1.28	14.58	1483.0	2331.7
SEm±	1.07	0.04	0.32	32.79	19.29
CD at 5%	3.12	0.13	0.93	95.71	56.32
CV	9.00%	8.92%	6.43%	8.41%	7.43%

Table 5. Effect of tillage practice and fertilizers management on biological yield and harvest index

Treatments	Biological yield (kg/ha)	Harvest index (%)
Main Plot- Tillage practices		
T ₁ -Zero tillage	3829.8	38.84
T ₂ -Reduced tillage	3932.0	39.24
T ₃ -Conventional tillage	3981.2	39.38
SEm±	13.26	0.26
CD at 5%	40.08	NS
CV	6.31%	
Sub Plot- Fertilizer management		
F ₁ -Control	3688.0	38.08
F ₂ -100 % RDF	3976.7	39.44
F ₃ -75 % RDF + 25 % RDN through VC	4057.3	39.69
F ₄ -50 % RDF + 50 % RDN through VC	4036.0	39.68
F ₅ -25 % RDF + 75 % RDN through VC	3813.7	38.88

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Treatments	Biological yield (kg/ha)	Harvest index (%)
SEm±	43.15	0.49
CD at 5%	125.95	NS
CV	7.31%	

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