

International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
IJABR 2026; SP-10(3): 81-84
www.biochemjournal.com
Received: 08-12-2025
Accepted: 10-01-2026

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Effect of natural farming components on yield of chickpea (*Cicer arietinum* L.) and physico-chemical properties of soil under Bundelkhand region

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DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i3Sb.7816>

Abstract

A field experiment was carried out during 2023-24 and 2024-25 to assess the effect of natural farming components (NFC) on the yield and yield attributes and soil physico-chemical properties of chickpea cultivation. The study comprised twelve treatments, including different natural farming components and organic mulching treatments arranged in a randomized block design. The research findings indicated that the application NFC significantly enhanced yield attributes and yield particularly the flower initiation, number of pods per plant, grain yields, seed index, organic carbon and available nutrients except soil pH. The result also revealed that the highest grain yield was recorded in T₁₂ (16.51 and 16.5 q/ha), followed by T₉ (14.33 and 14.36 q/ha) and T₈ (14.16 and 14.19 q/ha) however, the no-mulching (T₁₁) treatment recorded lowest grain yield (12.78 and 12.81 q/ha) in both experimental years. In addition, NFC and organic residue mulching improved soil organic carbon and increased the availability of essential nutrients. Overall, the results suggest that integrating NFC act as a sustainable and effective approach to enhancing chickpea yield as well as improving soil health and long-term agricultural sustainability.

Keywords: Organic mulching, natural farming, grain yield, soil fertility and soil health

Introduction

Cicer arietinum (chickpea) is one of the most significant rabi pulse crops globally, predominantly cultivated in South Asia and Sub-Saharan Africa ^[1, 17]. India ranks as the leading producer of chickpea, contributing about 65.2% of the total cultivated area and 65.4% of global production ^[2]. Unlike major cereals such as wheat and rice, legume cultivation in India is largely undertaken by small and marginal farmers who possess limited resources ^[3]; notably, 43.6% of chickpea growers fall under the smallholder category ^[4].

Conventional agricultural practices often depend on the use of costly agrochemicals, whereas natural farming depend on naturally derived inputs of plant and animal origin, including cow dung, urine, and crop residues. This waste-to-wealth approach helps lower production costs and enhances resource recycling. Moreover, earlier findings have indicated that organically managed soils can suppress plant and animal pathogens ^[5]. Thus, promoting awareness of natural farming among resource-poor farmers could offer a low-input, economically viable alternative. The increasing human population is exerting rising pressure on vigorous natural resources, including soil, water, and biodiversity and this stress is expected to intensify further in the coming years. In addition, climate change is compelling a transformation of conventional agricultural systems. Therefore, organic farming has gained prominence as an essential approach to ensure the production of safe and nutritious food while promoting long-term agricultural sustainability ^[6, 7, 17].

The natural farming is a natural way of farming without any capital investment. It basically soles use of rich natural resources which ancient agriculture fully relied. Expenditure on purchased inputs is completely excluded in this system. If some cost is incurred by any chance, it is compensated by the profitable production. In the present context of sharp increase of production cost and stagnation in production rate coupled with environmental footprints associated with chemical fertilizers/pesticides. Natural farming is gaining momentum as it rejuvenates soil health for sustainable crop production through diversification, microbial activities, nutrient recycling, beneficial biological interactions.

Besides, in rain fed areas where green revolution holds less significance, Zero Budget Natural Farming can be a promising option under uncertainty of weather. It is an extreme form of low external input sustainable agriculture, where all the inputs are locally available and output one farming system is mostly used as input in other farming system. In this context, a comparative evaluation of conventional and natural farming systems was conducted using chickpea as the test crop. The study aimed to assess natural farming systems in terms of soil health, grain yield, and agronomic performance within the distinctive agro-ecological conditions of the rainfed regions of Bundelkhand region of India.

Materials and Methods

The present investigation was carried out at Department of Agronomy, Institute of Agricultural Sciences, Bundelkhand University, Jhansi (U.P.) during two concentric *rabi* season 2023-24 and 2024-25 under typical rainfed agro-climatic conditions. The field experiments were carried out with twelve treatments and five replications laid out in Randomized Block Design (RBD). The experimental site is situated in the semi-arid condition, at 25°27'31" N latitude and 78°34'47" E longitude and 258 m above mean sea level (MSL). The experiment comprised of 12 treatments viz., T₁-Leaves of *Madhuca indica*, T₂-Leaves of *Dalbergia sisso*, T₃-Leaves of *Azadirchta indica*, T₄-Leaves of *Lantana camera*, T₅-Leaves of *Duranta erecta*, T₆-Leaves of *Cynodon dactylon*, T₇-Leaves of *Cyperus rotundus*, T₈-Leaves of *Saccharum officinarum*, T₉-Leaves of pulse straw, T₁₀-Adequate control, T₁₁-No Mulching and T₁₂-FYM Impact. The Chickpea JG-16 variety was sown in month of October during both cropping sessions. Prior to sowing, composite soil samples (0-15 cm depth) were collected and analyzed for initial physico-chemical properties following standard analytical procedures. The crop from each net plot area was harvested separately, sun-dried, and threshed manually. Grain yield was recorded and converted into kg ha⁻¹ after adjusting seed moisture.

The representative soil samples were collected from experimental plots at 0-15 cm depth using a soil auger after the harvesting of crop within the treatments in month of April 2024 and 2025. The composite soil samples were air dried in a shed house and grained with wooden mortal and pestal and passed through a 2 mm sieve for laboratory analysis. The soil samples were analyzed for standard laboratory protocols. The recorded data were statistically analyzed using analysis of variance (ANOVA) appropriate for Randomized Block Design as described by [8]. Treatment means were compared using the Critical Difference (CD) test at 5% level of significance.

Results and Discussion

Chickpea yield (q/ha)

Results revealed that the mean data of chickpea yield was significantly influenced by different NFC, as depicted in the table 1. The significant variation among treatments was observed during both years of the study, indicating the strong impact of NFC on chickpea yield. Among all

treatments, T₁₂ recorded the highest grain yield followed by T₉, T₈, and T₃. However, the lowest grain yields were observed under T₆ and T₇. The crop residue mulches reduce evaporation losses and maintain favourable soil temperature, thereby minimizing moisture stress during critical growth stages. Enhanced nutrient mineralization and improved root growth under mulched conditions further supported higher yield formation. Similar increases in chickpea yield under residue mulching have been reported by [9, 10], who attributed yield improvement to better soil hydrothermal regimes. Chen *et al.* (2018) [11] and Li *et al.* (2018) [12, 17] also reported enhanced crop productivity due to improved soil biological activity and nutrient cycling under organic mulches. Larkin (2020) [13] emphasized that organic amendments improve soil health and long-term productivity, whereas [14] and Zhou *et al.* (2022) [15] documented higher yields under residue-based sustainable farming systems.

Table 1: Effect of natural farming components (NFC) on yield of chickpea under Bundelkhand region

Treatments Detail	Chickpea Yields (q/ha)	
	2023-24	2024-25
T ₁ -Leaves of <i>Madhuca indica</i>	14.03	14.07
T ₂ -Leaves of <i>Dalbergia sisso</i>	14.29	14.32
T ₃ -Leaves of <i>Azadirchta indica</i>	14.31	14.35
T ₄ -Leaves of <i>Lantana camera</i>	13.59	13.62
T ₅ -Leaves of <i>Duranta erecta</i>	13.40	13.43
T ₆ -Leaves of <i>Cynodon dactylon</i>	12.08	12.11
T ₇ -Leaves of <i>Cyperus rotundus</i>	12.01	12.39
T ₈ -Leaves of Sugar cane	14.16	14.20
T ₉ -Leaves of pulse straw	14.34	14.37
T ₁₀ -Adequate control	13.02	13.05
T ₁₁ -No Mulching	12.78	12.82
T ₁₂ -FYM Impact	16.51	16.54
CD (5%)	10.17	17.30
SE(m)	3.56	6.05

Soil reaction (pH) and Electrical conductivity (dS/m)

The results presented in the table 2 show that the influence of different NFC on soil reaction (soil pH) and electrical conductivity during the cropping seasons of 2023-24 and 2024-25. Statistical analysis indicated that the differences among treatments were non-significant (NS) effect for both soil pH and EC. However, slight variations were observed among treatments. Results also revealed that the maximum soil pH (7.50) was recorded under T₈ (sugarcane leaves) and T₉ (pulse straw), while the minimum pH value (6.90) was observed under T₁₀ (adequate control). Results of EC was safer in limits or not change in the application of NFC during the both experimental years. The NFC increase microbial activity and soil organic carbon, which help stabilize soil reaction and prevent large fluctuations in soil pH. Similar findings were reported by Kumar *et al.* (2018) [9] and Sun *et al.* (2021) [14], who observed that the application of organic residues and mulches-maintained soil pH within a narrow range while improving soil fertility. Similarly, Agrawal *et al.* (2022) [16] reported that organic mulching practices generally cause minimal changes in soil pH due to slow mineralization of organic materials and improved soil buffering capacity.

Table 2: Effect of NFC on soil pH and electrical conductivity of chickpea under Bundelkhand region

Treatments Detail	Soil pH		Electrical Conductivity (dS/m)	
	2023-24	2024-25	2023-24	2024-25
T ₁ -Leaves of <i>Madhuca indica</i>	7.10	7.20	0.23	0.34
T ₂ -Leaves of <i>Dalbergia sisso</i>	7.20	7.40	0.24	0.36
T ₃ -Leaves of <i>Azadirchta indica</i>	7.20	7.30	0.25	0.33
T ₄ -Leaves of <i>Lantana camera</i>	7.40	7.40	0.33	0.32
T ₅ -Leaves of <i>Duranta erecta</i>	7.40	7.40	0.31	0.31
T ₆ -Leaves of <i>Cynodon dactylon</i>	7.30	7.20	0.26	0.33
T ₇ -Leaves of <i>Cyperus rotundus</i>	7.30	7.40	0.34	0.23
T ₈ -Leaves of Sugar cane	7.20	7.50	0.21	0.31
T ₉ -Leaves of pulse straw	6.90	7.50	0.23	0.33
T ₁₀ -Adequate control	7.20	6.90	0.35	0.32
T ₁₁ -No Mulching	6.90	7.30	0.23	0.24
T ₁₂ -FYM Impact	7.20	7.40	0.33	0.35
CD (5%)	NS	NS	NS	NS
SE(m)	0.02	0.01	0.04	0.03

Soil organic carbon (%)

The results indicated that the application of different NFC influenced the soil organic carbon (SOC) content under chickpea cultivation during both experimental years (Table 3). The SOC content ranged from 0.37 to 0.48% in 2023-24 and 0.41 to 0.49% in 2024-25. During the first year, the highest SOC content (0.48%) was recorded under T₉ (pulse straw mulch), followed by T₁ (*Madhuca indica* leaves) and T₁₂ (FYM impact) with 0.44%, whereas the lowest value (0.37%) was observed under T₁₁ (no mulching). In the second year, a slight increase in SOC was observed across most treatments, where the maximum SOC (0.49%) was recorded under T₁ (*Madhuca indica* leaves), T₉ (pulse straw) and T₁₂ (FYM impact), while the lowest value (0.41%) was recorded under T₁₀ (adequate control) and T₁₁ (no

mulching). The results evidently indicated that treatments involving organic residue mulching and farmyard manure contributed to relatively higher soil organic carbon compared to control treatments. This improvement in SOC may be attributed to the continuous addition and decomposition of organic residues which enhance soil organic matter content and microbial activity. Similar results were reported by Kumar *et al.* (2018) ^[9] and Sun *et al.* (2021) ^[14] who observed that the application of organic residues and mulches significantly improves soil organic carbon and overall soil fertility. Likewise, Zhou *et al.* (2022) ^[15] reported that organic residue mulching plays an important role in enhancing soil carbon accumulation and maintaining soil health under sustainable agricultural systems.

Table 3: Effect of NFC on soil organic carbon content under Bundelkhand region

Treatments Detail	Organic Carbon (%)	
	2023-24	2024-25
T ₁ -Leaves of <i>Madhuca indica</i>	0.44	0.49
T ₂ -Leaves of <i>Dalbergia sisso</i>	0.42	0.47
T ₃ -Leaves of <i>Azadirchta indica</i>	0.42	0.47
T ₄ -Leaves of <i>Lantana camera</i>	0.43	0.48
T ₅ -Leaves of <i>Duranta erecta</i>	0.43	0.48
T ₆ -Leaves of <i>Cynodon dactylon</i>	0.38	0.42
T ₇ -Leaves of <i>Cyperus rotundus</i>	0.40	0.45
T ₈ -Leaves of Sugar cane	0.43	0.48
T ₉ -Leaves of pulse straw	0.48	0.49
T ₁₀ -Adequate control	0.39	0.41
T ₁₁ -No Mulching	0.37	0.41
T ₁₂ -FYM Impact	0.44	0.49
CD (5%)	0.18	0.04
SE(m)	0.01	0.02

Available nutrients status (kg/ha)

The results revealed that different NFC and organic mulching treatments influenced the availability of soil nitrogen (N), phosphorus (P), and potassium (K) under chickpea cultivation during the cropping seasons 2023-24 and 2024-25 (Table 4). The available nitrogen content ranged from 160.96 to 176.83 kg ha⁻¹ in 2023-24 and 161.69 to 192.30 kg ha⁻¹ in 2024-25, where the highest nitrogen was recorded under T₂ (*Dalbergia sissoo* leaves) during the first year and T₁₂ (FYM impact) during the second year, while the lowest value was observed under T₄ (*Lantana camara* leaves) in 2023-24 and T₁₁ (no mulching) in 2024-25. However, treatment effect was non-significant in the

first year but significant in the second year. Similarly, the available phosphorus content varied from 10.61 to 13.18 kg ha⁻¹ in 2023-24 and 11.83 to 16.55 kg ha⁻¹ in 2024-25, where the maximum phosphorus content was recorded under T₁₂ (FYM impact) in both years, whereas the minimum value was recorded under T₈ (sugarcane leaves) in the first year and T₁₀ (adequate control) in the second year, with significant differences during 2024-25. The available potassium content ranged from 241.37 to 298.15 kg ha⁻¹ in 2023-24 and 248.57 to 311.98 kg ha⁻¹ in 2024-25, where the highest potassium content was recorded under T₆ (*Cynodon dactylon* leaves) during the first year and T₁₂ (FYM impact) during the second year, while the lowest values were

observed under T₄ (Lantana camara leaves mulch) in 2023-24 and T₁₀ (adequate control) in 2024-25. However, differences among treatments were significant in both years. Overall, treatments involving organic residues and FYM under natural farming practices improved soil nutrient

availability, which may be attributed to the gradual decomposition of organic materials, enhanced microbial activity, and mineralization of nutrients that increase soil fertility and nutrient cycling^[9, 14, 15, 17].

Table 4: Effect of NFC on available nutrients in soils of Bundelkhand

Treatments Detail	Available Nitrogen (kg/ha)		Available Phosphorous (kg/ha)		Available Potassium (kg/ha)	
	2023-24	2024-25	2023-24	2024-25	2023-24	2024-25
T ₁ -Leaves of <i>Madhuca indica</i>	168.71	178.51	12.18	14.35	257.12	273.29
T ₂ -Leaves of <i>Dalbergia sisso</i>	176.83	186.63	12.01	14.58	249.21	266.40
T ₃ -Leaves of <i>Azadirchta indica</i>	176.67	186.47	11.54	14.11	242.88	260.06
T ₄ -Leaves of <i>Lantana camera</i>	160.96	178.76	11.71	12.68	241.37	258.56
T ₅ -Leaves of <i>Duranta erecta</i>	168.49	178.29	12.13	14.30	241.46	258.64
T ₆ -Leaves of <i>Cynodon dactylon</i>	170.03	179.83	11.25	13.42	298.15	305.34
T ₇ -Leaves of <i>Cyperus rotundus</i>	171.16	180.96	12.39	12.96	268.54	285.72
T ₈ -Leaves of Sugar cane	172.65	182.45	10.61	13.18	259.63	276.82
T ₉ -Leaves of pulse straw	162.61	188.41	12.38	15.35	268.52	285.70
T ₁₀ -Adequate control	166.50	166.30	11.26	11.83	273.38	248.57
T ₁₁ -No Mulching	167.89	161.69	12.13	14.30	268.45	285.63
T ₁₂ -FYM Impact	166.50	192.30	13.18	16.55	271.47	311.98
CD (5%)	NS	17.32	NS	2.01	28.20	31.44
SE(m)	4.01	6.06	0.72	0.70	9.86	10.99

References

- Thudi M, Upadhyaya HD, Rathore A, Gaur PM, Krishnamurthy L, Roorkiwal M, *et al.* Genetic dissection of drought and heat tolerance in chickpea (*Cicer arietinum* L.) through genome-wide and candidate gene-based association mapping approaches. *PLoS One*. 2017;12(4):e0175609.
- Dixit GP. Chickpea production and productivity in India: Status and future prospects. *Indian J Agric Sci*. 2021;91(7):973-982.
- Akpo E, Crane TA, Vissoh PV, Tossou RC, Kossou DK. Co-production of knowledge in agricultural research for development: Lessons from sustainable soil fertility management practices. *Agric Syst*. 2021;188:103037.
- Food and Agriculture Organization. FAOSTAT statistical database. Rome: Food and Agriculture Organization of the United Nations; 2018.
- Suyal DC, Singh R, Chaudhary A, Kumar S, Goel R. Role of soil microbial communities in improving soil fertility and sustainable crop production. *Front Microbiol*. 2021;12:636732.
- Christel W, Bruun S, Magid J, Jensen LS, de Neergaard A. Crop residue management and organic amendments influence soil organic matter dynamics and nutrient availability in agricultural soils. *Agric Ecosyst Environ*. 2021;315:107447.
- Montgomery DR, Bickel A. What your food ate: How to heal our land and reclaim our health. New York: W W Norton & Company; 2021.
- Gomez KA, Gomez AA. Statistical procedures for agricultural research. 2nd ed. New York: John Wiley & Sons; 1984.
- Kumar V, Sharma P, Yadav S. Effect of crop residue management on soil health, nutrient availability and crop productivity. *Int J Curr Microbiol Appl Sci*. 2018;7(3):1421-1428.
- Jain N, Bhatia A, Pathak H, Jain V. Mitigation of greenhouse gas emission and improvement of soil health through residue management in agricultural systems. *Agric Ecosyst Environ*. 2017;236:1-12.
- Chen H, Li X, Hu F, Shi W. Soil microbial biomass and activity in response to crop residue management and organic amendments in agricultural soils. *Appl Soil Ecol*. 2018;130:79-87.
- Li Y, Chen D, Zhang W, Edis R. Crop residue management and its effects on soil organic carbon and nutrient availability in agricultural soils. *Soil Tillage Res*. 2018;176:66-75.
- Larkin RP. Soil health paradigms and implications for disease management. *Annu Rev Phytopathol*. 2020;58:199-221.
- Sun J, Liu Y, Zhang Z, Wang X. Effects of organic mulching on soil physical and chemical properties and crop productivity in agricultural ecosystems. *Soil Tillage Res*. 2021;210:104999.
- Zhou X, Li Y, Zhang J, Wang G. Organic residue mulching improves soil fertility, nutrient dynamics and crop productivity in sustainable agricultural systems. *Agric Ecosyst Environ*. 2022;328:107856.
- Agrawal S, Singh R, Kumar A, Sharma P. Impact of organic residue mulching on soil fertility, microbial activity and crop productivity under sustainable farming systems. *J Soil Sci Plant Nutr*. 2022;22:3120-3132.
- Singh P, Suyal DC, Kumar S, Singh DK, Goel R. Long-term organic farming impact on soil nutrient status and grain yield at the foothill of Himalayas. *Front Environ Sci*. 2024;12:1378926.