



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
NAAS Rating (2026): 5.20
www.agronomyjournals.com
2026; 9(5): 753-757
Received: 16-03-2026
Accepted: 21-04-2026

Khuraijam Mahesh Meitei
PG Student, School of Agriculture,
Uttaranchal University, Dehradun,
Uttarakhand, India

Sunil Prakash
Assistant Professor, School of
Agriculture, Uttaranchal
University, Dehradun,
Uttarakhand, India

Dr. Sharad Pandey
Professor, School of Agriculture,
Uttaranchal University, Dehradun,
Uttarakhand, India

Effect of nano-fertilizer vs conventional fertilizer on growth and yield of Chickpea (*Cicer arietinum* L.)

Khuraijam Mahesh Meitei, Sunil Prakash and Sharad Pandey

DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i5j.5614>

Abstract

The present study entitled “Effect of Nano-Fertilizer vs Conventional Fertilizer on Growth and Yield of Chickpea (*Cicer arietinum* L.) under Doon Valley Conditions” was carried out at the Crop Research Centre, School of Agriculture, Uttaranchal University, Dehradun, Uttarakhand during rabi season 2025–26. The experimental design was Randomized Block Design (RBD) having seven treatments and three replications. Different combinations of recommended dose of fertilizers (RDF), nano urea, and zinc were tested and their effect on growth, yield, and quality parameters of chickpea was studied. It was found that the application of nano-fertilizer significantly increased plant growth, nodulation, plant yield traits, grain yield and protein content when compared with the conventional fertilizer treatment. T₅ (50% RDF + 1% Nano Urea) showed the tallest plant height, maximum number of branches, most dry matter accumulation, number of pods per plant, grain yield (12.23 q ha⁻¹), biological yield (80.16 q ha⁻¹), and protein content (6.42 mg/mL) among all treatments. Thus, 1% Nano Urea along with 50% RDF was found to be an efficient and sustainable nutrient management system for chickpea cultivation under Doon Valley conditions.

Keywords: Nano Urea, Conventional Fertilizer, Grain yield, Chickpea, Biological yield and Root Nodule

Introduction

Chickpea (*Cicer arietinum* L.) is one of the most important pulse crops belonging to the family Fabaceae and is widely cultivated in tropical and subtropical regions. It is an important source of protein, carbohydrates, vitamins, minerals, and dietary fibre, particularly for vegetarian populations. In India, chickpea plays a significant role in food security and soil fertility improvement due to its nitrogen-fixing ability through symbiosis with *Rhizobium* bacteria (Yewale *et al.*, 2025) ^[1]. India is one of the largest producers of chickpea, with major cultivation concentrated in states such as Madhya Pradesh ranked no one, Rajasthan, Maharashtra, and Uttar Pradesh second third and fourth respectively (Das *et al.*, 2025) ^[2]. Uttarakhand produce chickpea in shivalik foothills region, Dehradun Haridwar and Udhan Singh Nagar District. However, Chickpea productivity is often constrained by poor nutrient management, low fertilizer use efficiency, and micronutrient deficiencies. Excessive use of conventional fertilizers has led to nutrient losses, declining soil health, and environmental concerns (Sarika *et al.*, 2025) ^[3].

Application of nano-fertilizers has been reported to improve photosynthesis, root development, nodulation, protein synthesis, and grain yield in chickpea while reducing nutrient losses and environmental pollution (Sabaghnia *et al.*, 2023) ^[17]. Micronutrients like zinc also play an essential role in crop growth and productivity by regulating enzyme activity and chlorophyll formation (Dhaliwal *et al.*, 2021) ^[4]. This paper aimed to find out the effect of nano-fertilizer vs conventional fertilizer on growth and yield of chickpea under doon valley conditions.

Materials and Methods

The experiment was conducted during the rabi season of 2025–26 at the Crop Research Centre, School of Agriculture, Uttaranchal University, Prem Nagar, Dehradun, Uttarakhand. The experimental site was situated in the foothills of the Himalayas and experiences a humid subtropical climate with moderate winter temperatures and substantial monsoon rainfall. During

Corresponding Author:
Khuraijam Mahesh Meitei
PG Student, School of Agriculture,
Uttaranchal University, Dehradun,
Uttarakhand, India

the crop growth period, the maximum temperature ranged from 20.6 °C to 34.2 °C, while the minimum temperature varied from 3.0 °C to 12.6 °C. Relative humidity remained comparatively high throughout the season, providing favourable conditions for chickpea cultivation (Jackson, 1967) [6].

The soil of the experimental field was sandy loam in texture with moderate fertility status. The soil analysis revealed a pH of 5.62, electrical conductivity of 0.75 dSm⁻¹, and organic carbon content of 1.30%. Available nitrogen, phosphorus, and potassium were recorded as 100.90 kg ha⁻¹, 17.70 kg ha⁻¹, and 57.60 kg ha⁻¹, respectively. Soil texture was determined by the International Pipette Method as described by (C.S. Piper, 1966) [10], while organic carbon was estimated by the (Walkley and Black 1934) [12] method. Available nitrogen, phosphorus, and potassium were estimated using the methods described by (Subbiah and Asija 1956, Olsen *et al.* 1954, and Jackson 1967) [11, 8, 6], respectively.

The experiment was laid out in a Randomized Block Design (RBD) with seven treatments and three replications, making a total of twenty-one plots. Each net plot measured 2 m × 3 m (6 m²), while the gross experimental area covered 250 m². Chickpea variety “Desi Chana,” locally collected, was used as the test crop. Seeds were sown by line sowing at a spacing of 15 cm between rows and 5 cm between plants with a sowing depth of 3–5 cm.

The treatments consisted of different combinations of recommended dose of fertilizers (RDF), nano urea, and zinc. The treatments included: T₁ (100% RDF), T₂ (75% RDF + 1% Nano Urea), T₃ (75% RDF + 1% Nano Urea + Zn), T₄ (50% RDF + 2% Nano Urea), T₅ (50% RDF + 1% Nano Urea), T₆ (50% RDF + 2% Nano Urea + Zn), and T₇ (50% RDF + 1% Nano Urea + Zn). Foliar application of nano-fertilizer and zinc was carried out according to treatment specifications during crop growth.

Observations on growth and yield parameters were recorded from five randomly selected plants in each plot. Plant height, number of branches, dry matter accumulation and number of root nodules, were measured at different growth stages. Yield attributes such as number of pods per plant, number of seeds per pod, grain weight/plant and 100-grain weight were recorded at harvest. Grain yield, biological yield, harvest index, and protein content were also estimated. Biological yield was calculated as the sum of grain yield and straw yield as suggested by (Abdalla *et al.* 2015) [5]. Harvest index was computed according to the formula proposed by (Nichiporovich 1967) [7].

The experimental data collected during the investigation were statistically analysed using analysis of variance (ANOVA) appropriate for Randomized Block Design following the procedure described by (Panse and Sukhatme 1989) [9]. The significance of treatment effects was tested at 5% probability level, and critical difference (CD) values were calculated wherever the treatment effects were found significant.

Results and Discussion

The present investigation revealed significant variations among different nutrient management treatments with respect to growth and developmental parameters of chickpea under Doon Valley conditions. The application of nano-fertilizer in combination with reduced levels of recommended dose of fertilizers (RDF) positively influenced vegetative growth, nodulation, and dry matter accumulation of chickpea crop. Similar findings were also reported by Sabaghnia *et al.* (2023) [17], who observed that nano-fertilizer application enhanced crop growth and nutrient uptake in pulse crops under semi-arid conditions.

Among all the treatments, treatment T₅ (50% RDF + 1% Nano-Urea) consistently recorded superior performance in almost all growth parameters. Plant height increased progressively with crop age under all treatment; however, T₅ exhibited the maximum plant height at all growth stages, recording 18.35 cm at 30 DAS, 27.22 cm at 60 DAS, and 47.10 cm at 90 DAS. The enhanced plant height under T₅ might be attributed to improved nitrogen availability and efficient nutrient absorption through foliar application of nano urea, with promoted vigorous vegetative growth and cell elongation. Similar results were reported by (Verma *et al.*, 2009) [18], who stated that nano-based nutrient application significantly improved plant growth and biomass accumulation in legumes. In contrast, the lowest plant height was observed under (T₄ (50% RDF + 2% Nano Urea), indicating that higher concentration of nano urea was comparatively less effective.

The same trend was seen in number of branches of plants. Treatment T₅ had the maximum number of branches at 30, 60 and 90 DAS with 3.54, 7.70 and 8.38 branches/plant, respectively. The stimulating effect of nano-fertilizer on branching can be attributed to the better photosynthetic activity and better delivery of nutrients within the plant system. The results are in line with (Meena *et al.*, 2021) [14], who noted that the use of integrated nutrient management using nano-fertilizers resulted in higher vegetative growth and branching of chickpea.

Table 2: Effect of Different Treatment on Plant height and Number of Branches/plants

T. No.	Treatment	Plant height (cm)			No. of branches per plant		
		30DAS	60DAS	90DAS	30DAS	60DAS	90DAS
T ₁	100%RDF	17.8	25.28	43.29	2.21	6.17	6.43
T ₂	75% RDF + 1% Nano Urea	18.18	25.27	42.73	2.62	6.1	6.81
T ₃	75% RDF + 1% Nano Urea + Zn	16.83	26.09	43.52	2.51	5.78	7.28
T ₄	50% RDF +2% Nano Urea	17.15	23.54	42.18	2.16	6.14	6.02
T ₅	50% RDF + 1% Nano Urea	18.35	27.22	47.18	3.54	7.7	8.38
T ₆	50% RDF + 2% Nano Urea+ Zn	17.95	25.52	45.04	2.55	6.04	7.1
T ₇	50% RDF + 1% Nano Urea + Zn	17.96	25.19	45.16	2.24	5.72	6.69
C.D (P at 5%)		N/A	0.948	2.357	0.337	0.857	0.374
S. E (m) ±		0.486	0.304	0.757	0.108	0.275	0.12
S.E (d) ±		0.688	0.43	1.07	0.153	0.389	0.17
C.V		4.754	2.071	2.981	7.353	7.624	2.984

Dry weight per plant of chickpea was significantly influenced by different nutrient management treatments. Among all treatments, T₅ (50% RDF + 1% Nano Urea) recorded the highest dry weight per plant (82.05 g), whereas the lowest value was observed in T₁ (100% RDF) with (55.02 g). The increase in dry weight under T₅ may be attributed to improved nutrient availability, enhanced nutrient use efficiency, and better photosynthetic activity resulting from nano urea application. Similar findings were reported by (Raliya *et al.* 2018 and Meena *et al.* 2021) ^[15, 14], who observed increased biomass accumulation under nano-

fertilizer treatments.

Root nodulation was also markedly influenced by the treatments. Treatment T₅ produced the maximum number of root nodules per plant (18.66), Rhizobial activity promotion in the root zone and favourable nutrient availability may be the cause of enhanced nodulation under nano urea treatment. Similar findings were reported by (Dhoke *et al.* 2013) ^[13], who observed enhanced nodulation and nutrient uptake in legumes treated with nano-fertilizers.

Table 3: Effect of Different Treatment on Dry Weight/plant(g) and Number of Root Nodules/Plants

T. No.	Treatment	Dry matter accumulation/plant (g)	No. of root nodules per plants
T ₁	100%RDF	55.02	15.66
T ₂	75% RDF + 1% Nano Urea	60.04	16
T ₃	75% RDF + 1% Nano Urea + Zn	59.1	15.66
T ₄	50% RDF +2% Nano Urea	63.03	15
T ₅	50% RDF + 1% Nano Urea	82.05	18.66
T ₆	50% RDF + 2% Nano Urea+ Zn	62.68	15
T ₇	50% RDF + 1% Nano Urea + Zn	60.05	16
C.D (P at 5%)		14.44	N/A
S.E (m) ±		4.635	0.882
S.E (d) ±		6.555	1.247
C.V%		12.714	9.547

The number of pods per plant was significantly influenced by nano-fertilizer application. Among all treatments, T₅ (1% Nano urea + 50% RDF) recorded the highest number of pods per plant (22.8), whereas the lowest value (14.8) was observed in T₁. The increase in pod formation may be due to improved nutrient availability and enhanced nitrogen metabolism. Similar findings were reported by (Kumar *et al.* 2015) ^[21].

Nano-fertilizer application had a significant effect on number of seeds/pods. The highest number of seeds/pods (3) was found in treatment T₅ (50% RDF + 1% Nano Urea) and the lowest (1) was obtained in T₆. The better nutrient availability and translocation of photosynthates under nano urea application may have contributed to improve the seed development and grain filling. (Sabaghnia and Janmohammadi 2015 and Morovat *et al.*, 2019) ^[24, 23] similarly reported the same results.

The maximum 100-grain weight (19.66 g) was recorded in treatment T₅ (50%RDF + 1% Nano Urea) and Minimum value (17.66 g) was recorded in T₄. The improved availability of

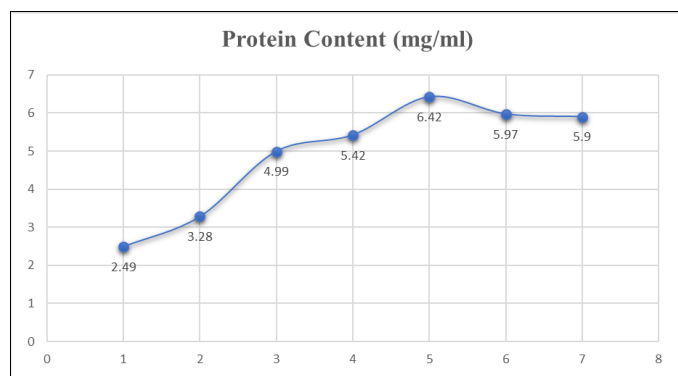
nutrients and translocation of photosynthates under application of nano-urea might have enhanced seed development and grain filling. Similar findings were reported by (Moradtalab *et al.*, 2018 and Pawar *et al.*, 2024) ^[26, 25].

T₅ (50% RDF + 1% Nano Urea) had the highest protein content (6.42 mg/mL), whereas the lowest protein was found in T₁ (100% RDF) with a value of (2.49 mg/mL). The greater protein content of the nano urea treatments may be attributed to greater availability of Nitrogen, and increased protein synthesis. The same has been reported by (Yadav R.S. *et al.* 2017 and Raliya *et al.* 2018) ^[22, 15].

Treatment T₅ recorded the highest grain yield (12.23 q ha⁻¹), biomass yield (80.16 q ha⁻¹) and harvest index (15.25%), whereas the lowest values were observed in T₄. The increase in yield may be due to enhanced nutrient use efficiency and improved plant growth under nano-urea application. Similar findings were reported by (Kumar *et al.* 2021 and Khandare *et al.* 2024) ^[20, 19].

Table 4: Effect of different treatment on grain yield and yield attributes

T. No.	Treatment	Grain yield (q/ha)	Biomass yield (q/ha)	Harvest index (%)	Grain weight/plant	100 grain/weight	Pods/plants	Seeds/pods
T ₁	100%RDF	7.01	49.31	14.21	43.59	18.33	12.4	1.33
T ₂	75% RDF + 1% Nano Urea	6.23	51.14	12.18	41.8	18.66	15.28	1.33
T ₃	75% RDF + 1% Nano Urea + Zn	7.13	53.33	13.36	40.62	18.66	14.17	1.33
T ₄	50% RDF +2% Nano Urea	1.48	18.63	7.94	38.56	17.66	14.62	1.33
T ₅	50% RDF + 1% Nano Urea	12.23	80.16	15.25	56.77	19.66	20.78	3
T ₆	50% RDF + 2% Nano Urea+ Zn	5.5	53.01	10.37	53.56	18.33	14.29	1
T ₇	50% RDF + 1% Nano Urea + Zn	6.63	58.69	11.29	48.32	18.33	17.18	1.66
C.D (P at 5%)		0.101	0.124	0.090	8.796	0.921	3.123	0.817
S.E(m)		0.032	0.04	0.029	2.823	0.295	1.002	0.262
S.E (d)		0.046	0.056	0.041	3.993	0.418	1.417	0.371
C.V%		0.846	0.132	0.413	10.591	2.763	11.175	28.907



Conclusion

The present investigation clearly demonstrated that the application of nano-fertilizer significantly influenced the growth, yield, and yield-attributing characters of chickpea under Doon Valley conditions. Among the different nutrient management treatments, treatment T₅ (50% RDF + 1% Nano Urea) proved to be the most effective and consistently superior in improving plant growth, nodulation, dry matter accumulation, protein content and yield parameters. The treatment recorded maximum plant height, number of branches per plant, dry matter accumulation, root nodules, pods per plant, seeds per pod, 100-grain weight, grain weight/plant, grain yield, protein content, biomass yield, and harvest index compared to other treatments.

Better performance of T₅ could be due to better nutrient availability, nutrient use efficiency and better physiological and metabolic activities resulting from the application of nano urea. Moreover, the study found that the application of nano-fertilizer along with lower RDF can be effective in improving crop productivity and lowering the reliance on conventional fertilizers. On the contrary, higher concentration of nano urea (as seen in T₄) was comparatively less effective suggesting that optimum concentration of nano-fertilizer is crucial for better crop performance. Hence, it can be concluded that 1% foliar application of Nano Urea and 50% RDF is an appropriate and effective nutrient management practice in Doon Vally condition for chickpea crop. The method has the potential to increase growth and yield and provides an alternative method to minimize the overuse of chemical fertilizers and increase nutrient use efficiency in pulse production system in a sustainable way.

References

- Yewale SV, Ugale NS, Danawale NJ, Ghodke SK, Patil MR, Bodake PS. Response of foliar spray of nano DAP and nutrients on growth, yield and quality of chickpea (*Cicer arietinum* L.). International Journal of Research in Agronomy. 2025;8(1S):306-310. doi:10.33545/2618060X.2025.v8.i1Se.2422.
- Das A, Deka N, Munshi SA, Barman B, Mondal I, Hemanth DB. Economic impact of biotech and nanotech approaches in chickpea (*Cicer arietinum* L.) cultivation. Indian Journal of Agricultural Research. 2025;59(9):1481-1487. doi:10.18805/IJARE.A-6313.
- Sarika K, Ramesh G, Srinivasulu K, Latha M. Effect of nano DAP on growth, yield attributes and yield of chickpea (*Cicer kabulium*). International Journal of Research in Agronomy. 2025;8(4):20-25. doi:10.33545/2618060X.2025.v8.i4a.2734.
- Dhaliwal SS, Sharma V, Shukla AK, Verma V, Sandhu PS, Irmak S. Zinc biofortification in chickpea (*Cicer arietinum* L.) through agronomic approaches. Agronomy for Sustainable Development. 2021;41(5):1-17. doi:10.1007/s13593-021-00708-1.
- Abdalla MM, El-Sayed SA, Ahmed MA. Studies on biological yield and productivity of chickpea under different nutrient management practices. Journal of Agricultural Science. 2015;7(4):112-118.
- Jackson ML. Soil chemical analysis. New Delhi: Prentice Hall of India Pvt. Ltd.; 1967.
- Nichiporovich AA. Photosynthesis and theory of obtaining high crop yields. USSR: Academy of Sciences; 1967.
- Olsen SR, Cole CV, Watanabe FS, Dean LA. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. USDA Circular No. 939. Washington, DC: USDA; 1954.
- Panse VG, Sukhatme PV. Statistical methods for agricultural workers. New Delhi: Indian Council of Agricultural Research; 1989.
- Piper CS. Soil and plant analysis. Bombay: Hans Publishers; 1966.
- Subbiah BV, Asija GL. A rapid procedure for the estimation of available nitrogen in soils. Current Science. 1956;25:259-260.
- 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;37:29-38.
- Dhoke SK, Mahajan P, Kamble R, Khanna A. Effect of nanoparticles suspension on the growth of mung (*Vigna radiata*) seedlings by foliar spray method. Nanotechnology Development. 2013;3(1):1-5.
- Meena DS, Ram B, Meena VS, Verma JP. Integrated nutrient management using nano-fertilizers in pulse crops: a sustainable approach for improving productivity. Legume Research. 2021;44(6):695-701.
- Raliya R, Saharan V, Dimkpa C, Biswas P. Nano-fertilizer for precision and sustainable agriculture: current state and future perspectives. Journal of Agricultural and Food Chemistry. 2018;66(26):6487-6503.
- Sabaghnia N, Janmohammadi M, Seifollahpour B. Effect of nano-fertilizers on growth and yield performance of chickpea under water stress conditions. Agricultural Water Management. 2023;278:108154.
- Sabaghnia N, Janmohammadi M. Influence of some nano-fertilizers on chickpeas under three irrigation strategies. FAO AGRIS. 2023.
- Verma A, Kumar R, Yadav DD. Effect of foliar nutrition on growth and productivity of chickpea. Indian Journal of Agronomy. 2009;54(2):215-218.
- Khandare VP, Patil DV, Shinde PB, Jadhav SR. Effect of foliar application of nano urea, nano DAP and growth regulator on growth, yield and quality of chickpea (*Cicer arietinum* L.) under Inceptisol. International Journal of Research in Agronomy. 2024;7(12):318-323.
- Kumar Y, Singh A, Kumar R, Meena RK. Effect of nano-urea on growth, yield attributes and yield of pulse crops. International Journal of Plant & Soil Science. 2021;33(18):20-25.
- Kumar P, Burman U, Santra P. Effect of nano-zinc oxide on nitrogenase activity in legumes: an interplay of concentration and exposure time. International Nano Letters. 2015;5(4):191-198. doi:10.1007/s40089-015-0155-6.
- Yadav RS, Kumar R, Singh B. Effect of nitrogen management on growth, yield and quality of chickpea.

- Journal of Food Legumes. 2017;30(1):45-48.
23. Morovat J, Pasari B, Rokhzadi A. Effect of Pluramin and iron and zinc nano-fertilizer on rainfed chickpea (*Cicer arietinum* L.) at on-farm conditions. Journal of Central European Agriculture. 2019;20(2):647-656. doi:10.5513/JCEA01/20.2.2145.
24. Sabaghnia N, Janmohammadi M. Analysis of the impact of nano-zinc, nano-iron, and nano-manganese fertilizers on chickpea under rain-fed conditions. Annales Universitatis Mariae Curie-Sklodowska, Sectio C – Biologia. 2015;70(2):43-53.
25. Pawar GS, Pawar AV, Thanekar DD, Rodge SM. Response of nano fertilizers of zinc and ferrous on growth and yield attributes of chickpea (*Cicer arietinum* L.). International Journal of Advanced Biochemistry Research. 2024;8(5):290-293. doi:10.33545/26174693.2024.v8.i5d.1085.
26. Moradtalab N, Ghorbani A, Koocheki A, Asadi GA. Nano-scale zinc oxide effects on growth, seed yield and phosphorus use efficiency in chickpea (*Cicer arietinum* L.). Journal of Plant Nutrition. 2018;41(4):484-496. doi:10.1080/01904167.2017.1384011.