GESA
GLOCAL ENVIRONMENT & SOCIAL ASSOCIATION

International Journal of Biological Innovations
http://ijbi.org.in | http://www.gesa.org.in/journals.php
https://doi.org/10.46505/IJBI.2026.8208
IJBI 8(2): 216-221 **(2026)**
E-ISSN: 2582-1032

ENHANCING ROOT NODULES, SOIL PROPERTIES AND SEED YIELD OF ZERO TILL CHICKPEA (*CICER ARIETINUM* L.) THROUGH NUTRIENT MANAGEMENT AND FOLIAR SUPPLEMENTATION UNDER RAINFED CONDITIONS

Abhishek Raj Ranjan*, Narendra Singh, Dinesh Sah, Arun Kumar and Aniket H. Kalhapure

Department of Agronomy
Banda University of Agriculture and Technology (BUAT), Banda (U.P.), India

**Corresponding author*: abhishekrajranjan98@gmail.com

Article Info:
Research Article
Received
10.05.2026
Reviewed
15.07.2026
Accepted
14.08.2026

Abstract: The field experiments conducted at University Research Farm, BUAT, Banda during two years Rabi Seasons of 2023-24 and 2024-2025 evaluated zero-till chickpea (Jawahar Gram-36) under rainfed condition, using split plot design with three replications and 15 treatment combination comprising three nutrient management practices (100% RDF, 100% RDF + FYM @ 5 t/ha and 100% RDF + 2.5 t/ha) in main plot and five foliar supplementation (NPK (19:19:19), NPK (19:19:19) + vermiwash @ 10%, NPK (19:19:19) + cow urine @ 10%, NPK (19:19:19) + jeevamrutha @ 25% and vermiwash @ 10% + cow urine @ 10% + jeevamrutha @ 25%), all at PFI and PIS in sub plot. The result showed 100% RDF + vermicompost @ 2.5 t/ha promoted root nodules, dry weight of root nodules and grain yield. Among foliar supplementations, vermiwash @ 10% + cow urine @ 10% + jeevamrutha @ 25%at PFI and PIS had significantly improved root nodulation, dry weight of root nodules and grain yield of chickpea over rest treatments in both the years. Therefore, 100% RDF + vermicompost @ 2.5 t/ha and vermiwash @ 10% + cow urine @ 10% + jeevamrutha @ 25% statistically increased growth and yield in both the years of experimentation.

Keywords: Chickpea, Cow urine, Jeevamrutha, Nodulation, Soil properties, Vermicompost.

Cite this article as: Ranjan A.R., Singh N., Sah D., Kumar A. and Kalhapure A.H. (2026). Enhancing root nodules, soil properties and seed yield of zero till chickpea (*Cicer arietinum* L.) through nutrient management and foliar supplementation under rainfed conditions. *International Journal of Biological Innovations*. 8(2): 216-221. https://doi.org/10.46505/IJBI.2026.8208

INTRODUCTION

Pulses are an important group of staple crops next to cereals. They are also known as food legumes. Pulses are a substantial and inexpensive source of nutritional protein, particularly for vegetarians, who make up a large portion of human population. The pulses are grown in 28.73 million-hectare area with the production of 25.75 million tones, and productivity 896 kg ha-1 during 2024-25 in India. It is grown in more than 50 countries in the world and in India chickpea grown in an area of 9.98 m-ha with total production of 11.97 m-tonnes with productivity of 1199 kg/ha (Anonymous, 2022). Chickpea (*Cicer arietinum* L.) belongs to the tribe Cicereae, subfamily Papilionaceae of family Fabaceae.

It is known by its different names like 'Bengal gram' in English, 'Chana' in Hindi, 'Garbanzo' in Spanish and 'Chanaka' in Sanskrit and also regarded as 'King of pulses'. Chickpea (*Cicer arietinum* L.) originated in south-eastern turkey and derived from the 'Greek' word 'kikus' meaning force or strength.

Nutrient management particularly in rainfed areas is a major constraint which limits the productivity of chickpeas. The integrated nutrient application is crucial for maintaining higher crop productivity, sustainability of soil health and environmental quality. Organic sources such as FYM (farm yard manure) contains 0.5-1.5% nitrogen, 0.4-0.8% phosphorous and 0.5-1.9% potassium and vermicompost 1.6% nitrogen, 0.54% phosphorus and 0.80% potassium are widely known for improving the physical, chemical and biological qualities of soil. These organic sources include balanced nutrients as well as the ability to release fixed nutrients that crops require. Foliar application can be targeted to particularly stage of crop development to achieve specific objective and is an excellent way to fine tune a high fertility programme.

Now days, specialty fertilizers are introduced for plant nutrition through fertigation and foliar application. Specialty fertilizers are the fertigation, which are water soluble and specific/special for that crop. The legumes are normally heavy feeder of phosphorus. Phosphatic fertilization of gram promotes root growth, nodulation and enhances yield. It imparts hardiness of shoots, improves grain quality, regulates the photosynthesis and governs other physio-biochemical processes besides helping root enlargement nodule production and increasing nitrogen fixation. Therefore, the use of organic manures like FYM, vermicompost and liquid organic fertilizers like vermiwash, cow urine and jeevamrutha etc. as foliar supplementation along with inorganic fertilizers as basal dressing included in this investigation increases the quality and fertility of the soil and ultimately doubles the crop yield.

MATERIALS AND METHODS

The field experiments were conducted at the University Research Farm, BUAT, Banda during two years *Rabi* seasons of 2023-24 and 2024-2025. The experiment was laid out in Split Plot Design with three replications. The experiment was conducted with 15 treatment combination comprising three nutrient management practices namely, 100% RDF, 100% RDF + FYM @ 5 t/ha and 100% RDF + 2.5 t/ha in main plot and five foliar supplementation viz; NPK (19:19:19) at PFI & PIS, NPK (19:19:19) + vermiwash @ 10% at PFI and PIS, NPK (19:19:19) + cow urine @ 10% at PFI and PIS, NPK (19:19:19) + jeevamrutha @ 25% at PFI and PIS and vermiwash @ 10% + cow urine @ 10% + jeevamrutha @ 25% in sub plot. The chickpea variety JG-36 (Jawahar Gram-36) was used for field experiment during the exploration.

The experimental site is situated between latitude 25°31'00" and 28°7'00" North and longitudes 80°20'00" and 41°9'00" East and having an altitude of 119 m above sea level. It comes under Agro-climatic zone - VIII (Central Plateau and Hills Region) of Uttar Pradesh. The summer season, usually starts in March and lasts till June, brings hot waves and winds to this area. November marks the start of the *Rabi* season, which lasts until early February. The area has a wide range of temperature ranging from 5°C up to 48°C. Generally, rainfall in this region is received between the months of June and September with an average annual rainfall of 850 mm in this region. Soil plays a vital role in the producing of optimum growth, development and yield of the particular crop which helps in producing of higher yield. The experimental crop sown on 04 November, 2023 and 28 October, 2024 as per treatment under zero till chickpea and the row-to-row spacing of crop was 30 cm × 10 cm. Harvesting of crop in all plot was done at maturity on 05 April, 2024 and 20 March, 2025 with handle sickles by manual labour.

RESULTS AND DISCUSSION

Root parameters

The root parameters of chickpea *viz.*, root nodules per plant and dry weight of root nodules per plant has been presented in Table 1. The number of root nodules per plant of zero till chickpea was influenced significantly with nutrient management practices with 100% RDF + vermicompost @ 2.5 t/ha during both the years of exploration. The higher number of nodules per plant was 34.53 and 35.13 were observed during 2023-24 and 2024-25 respectively over remaining of the treatment. The dry weight of root nodules per plant of zero till chickpea was influenced significantly with nutrient management practices during both the years of exploration. The nutrient management with 100 % RDF + vermicompost (2.5 t/ha) was highly significant over rest of the treatments. The higher produce dry weight of root nodules per plant 338.45 and 344.26 were observed during 2023-24 and 2024-25 over 100 % RDF + FYM (5 t/ha) and 100% RDF, respectively.

Contrary to other growth parameters, significantly higher values of root parameters *viz.*, root nodules per plant and dry weight of root nodules per plant of the zero till chickpea was observed with 100% RDF + vermicompost @ 2.5 t/ha under rainfed conditions. This may be explained by the greater benefits observed at most growth stages when RDF and vermicompost are applied together as opposed to only RDF. Vermicompost improves soil structure, increases moisture retention, boosts microbial activity, and offers a gradual and consistent delivery of organic nutrients. Its humic compounds and enzymes

enhance the easily accessible nutrients from inorganic fertilizers, improving nodulation, root development, and overall plant growth. Better nodulation supports symbiotic N-fixation reducing reliance on inorganic N while boosting overall growth. The improvement in nodulation with nutrient management practices were also observed by Siag and Yadav (2004), Patil *et al.* (2012), Tank *et al.* (2023) and Chaithra *et al.* (2024).

The response of foliar supplementation with vermiwash @ 10% + cow urine @ 10% + jeevamrutha @ 25% at PFI and PIS on nodule per plant and dry weight of root nodules per plant of zero till chickpea was more significant of 34.76 and 35.07 and 340.61 and 343.69 over rest of the treatments during both the years of field experimentations. The root parameters *viz.*, number of nodules per plant and dry weight of nodules per plant of zero till chickpea under rainfed conditions were observed by foliar supplementation of vermiwash @ 10% + cow urine 10% + jeevamrutha @ 25% at PFI and PIS which significantly enhanced the nodules per plant and dry weight of nodules per plant in both the years of study.

However, closely related studies on these organic liquid formulations as foliar spray provide relevant insights into their likely impacts on chickpea root parameters, particularly nodule number and nodule dry weight. Vermiwash was effective, no direct root or nodule data was reported but the strong positive effects on total dry matter and yield suggest improved nutrient uptake and photosynthetic efficiency, which typically correlate with better root development and nodulation in legumes. Jeevamrutha and cow urine gave the highest overall growth, biomass, and grain yield. Sridhara *et al.* (2023) also noticed vermiwash @ 10% supplies readily available macro and micro nutrients, plant growth hormones, enzymes, and beneficial microbes that directly stimulate root elongation and branching. Cow urine @ 10% provides ammonical nitrogen, minerals, and uric acid that enhance early vegetative growth and microbial activity in the rhizosphere and Jeevamrutha @ 25% is a microbial-rich bio-stimulant that boosts soil and root zone biological activity, improving N-fixation and nodule formation. The improvement in nodulation by Parimala *et al.* (2013) and number of nodules and nodule weight per plant by Dewangan *et al.* (2017) and Singh *et al.* (2022) were also observed with inorganic and organic combination sprays.

Table 1: Effect of nutrient management practices and foliar supplementation on root nodules per plant and dry weight of root nodules of zero till chickpea during 2023-24 and 2024-25.

Characters	Mean squares			
	No. of root nodules/plant		Dry weight of root nodules	
	60 days after sowing		60 days after sowing	
	2023	2024	2023	2024
Nutrient management				
100% RDF	30.47	31.22	298.65	305.91
100% RDF + FYM (5t/ha.)	32.36	32.99	317.19	323.32
100% RDF + Vermicompost (2.5t/ha.)	34.53	35.13	338.45	344.26
Sem ±	0.440	0.448	4.309	4.383
CD @ 5%	1.775	1.805	17.373	17.672
Foliar supplementation				
NPK (19:19:19) at PFI and PIS	30.15	30.68	295.72	300.71
NPK (19:19:19) + Vermiwash @ 10% at PFI and PIS	32.55	33.17	307.57	316.61
NPK (19:19:19) + Cow urine @ 10% at PFI and PIS	31.39	32.31	318.94	325.05
NPK (19:19:19) + Jeevamrutha @ 25% at PFI and PIS	33.44	34.33	327.65	336.43
Vermiwash 10% + Cow urine 10% + Jeevamrutha @ 25% at PFI and PIS	34.76	35.07	340.61	343.69
Sem±	0.700	0.715	6.858	7.005
CD @ 5%	2.054	2.098	20.137	20.568
Interaction (N×F)	**N.S.**	**N.S.**	**N.S.**	**N.S.**

Soil parameter and yield

The data related to soil pH, soil EC, organic carbon and yield after crop harvest was demonstrated in Table 2. The findings clearly demonstrated that practices of nutrient management were not showing any significant influence on soil pH, soil EC and organic carbon at harvesting stage during both the years of study. However, the maximum soil pH and EC were recorded with 100% RDF nutrient management over 100% RDF + FYM @ 5 t/ha and 100% RDF + vermicompost @ 2.5 t/ha and the maximum organic carbon (%) was recorded in 100% RDF + vermicompost @ 2.5 t/ha nutrient management over 100% RDF + FYM @ 5 t/ha and 100% RDF during both the years. The grain yield was significantly increased at 100% RDF + vermicompost @ 2.5 t/ha which was more than 100% RDF and 100% RDF + FYM (5 t/ha) treatment at par in both the year of study, respectively. The relevant data recorded on soil parameters *viz.,* soil pH, soil EC and organic carbon (%) were recorded at after harvesting of zero till chickpea under rainfed conditions.

The findings clearly demonstrated that practices of nutrient management did not show any significant influence on above all observation during both the years. The maximum soil pH and EC were recorded with 100% RDF nutrient management followed by 100% RDF + FYM @ 5 t/ha and 100% RDF + vermicompost @ 2.5 t/ha during both the years. Whereas, the maximum organic carbon, was just reverse noted with 100% RDF + vermicompost @ 2.5 t/ha over 100% RDF and 100 % RDF + FYM @ 5 t/ha during both the years of experiment. Soil pH act as the biggest master key in soil, soil EC is a good indicator of nutrient availability in soil and organic carbon is called the life force of the soil along with nutrient supply. The vermicompost and FYM increase the organic matter in the soil, which slightly reduces soil pH and soil EC, which allows plant roots to spread more easily, improving water and air exchange. However, without compost and vermin compost, organic matter in the soil is depleted, resulting in an increase in soil pH and deterioration of soil structure. Oyege and Bhaskar (2023) also reported similar kind of findings.

Table 2: Effect of nutrient management practices and foliar supplementation on soil pH and soil EC (ds/m), organic carbon (%) and seed yield (q/ha) of zero till chickpea during 2023-24 and 2024-25.

Characters	Soil pH		Soil EC		Organic Carbon		Seed yield	
	2023	2024	2023	2024	2023	2024	2023	2024
Nutrient management								
100% RDF	7.81	7.80	0.62	0.61	0.39	0.40	13.38	13.81
100% RDF+FYM (5t/ha.)	7.80	7.79	0.61	0.60	0.40	0.40	15.51	15.93
100% RDF+Vermi (2.5t/ha.)	7.79	7.78	0.60	0.58	0.41	0.42	18.57	18.97
Sem±	0.106	0.105	0.008	0.008	0.006	0.005	0.224	0.232
CD @ 5%	N/A	N/A	N/A	N/A	N/A	N/A	0.902	0.934
Foliar supplementation								
NPK (19:19:19) at PFI and PIS	7.81	7.80	0.61	0.60	0.39	0.39	13.22	13.77
NPK (19:19:19)+Vermiwash @10 % at PFI and PIS	7.80	7.79	0.61	0.60	0.39	0.39	14.41	14.49
NPK (19:19:19) +Cow urine @ 10% at PFI and PIS	7.80	7.79	0.60	0.59	0.40	0.41	16.22	16.80
NPK (19:19:19)+Jeevamrutha @ 25% at PFI and PIS	7.79	7.78	0.60	0.59	0.40	0.41	17.23	17.51
Vermiwash @ 10%+ Cow urine @ 10% + Jeevamrutha @25% at PFI and PIS	7.78	7.77	0.59	0.58	0.41	0.41	18.01	18.60
Sem±	0.165	0.165	0.013	0.012	0.009	0.009	0.380	0.361
CD @ 5%	N/A	N/A	N/A	N/A	N/A	N/A	**1.117**	**1.059**
Interaction (N×F)	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**

The foliar supplementation of vermiwash @ 10% + cow urine @ 10% + jeevamrutha @ 25% at PFI and PIS on soil pH and soil EC were not found significantly demonstrated lowest over other used foliar supplementations and the maximum organic carbon was recorded in vermiwash @ 10% + cow urine @ 10% + jeevamrutha @ 25% during both the years of experimentation, respectively. The foliar supplements exerted a positively effect on grain yield at vermiwash @ 10% + cow urine @ 10% + jeevamrutha @ 25% at PFI and PIS over all rest treatments in both the years of study, with percentage increments of 36.33 and 35.08 over control treatment as foliar supplementation of NPK (19:19:19) at PFI and PIS in first year and second year, respectively. High organic matter into the soil decreases soil pH, EC, PD and BD on the application of vermiwash @ 10% + cow urine @ 10% + jeevamrutha @ 25% at PFI and PIS in zero till chickpea under rainfed condition during both the years respectively. These foliar organic supplements, especially jeevamrutha, cow urine and vermiwash improve soil biological health and crop nutrient efficiency in chickpea under rainfed conditions. They do not drastically alter soil pH, EC and organic carbon but support sustainable soil fertility indirectly through microbial stimulation. No adverse effects on soil were reported. The results are in conformity with the findings of Sridhara *et al.* (2023) and Sinha and Thakur (2025).

The significant differences in respect to yield (q/ha) were significantly observed of foliar supplementation. Though the trend showed that the yield of chickpea was statistically higher in vermiwash @ 10% + cow urine @ 10% + jeevamrutha @ 25% at PFI and PIS during 2023-24 and 2024-25 respectively; helps overcome nutrient fixation problems and ensures direct nutrient absorption through leaves. Foliar supplementation improves osmotic adjustment, root growth, water use efficiency and enhances the microbial activity, hormonal stimulation, improved physiological efficiency and better assimilate partitioning, which collectively contribute to higher productivity. These results are in agreement with the findings of Parimala *et al.* (2013), Tiwari and Kushwaha (2020), Jakhar *et al.* (2021), Parmar *et al.* (2022) and Zala *et al.* (2024).

CONCLUSIONS

Based on the above result, it can be concluded that the nutrient management of 100% RDF + vermicompost @ 2.5 t/ha with foliar supplementation of vermiwash @10% + cow urine @10% + jeevamrutha @ 25% at PFI and PIS is superior over the remaining nutrient management with foliar supplementation in respect to root nodulation per plant, dry weight of root nodules and grain yield of zero till chickpea under rainfed situation. Thus, 100% RDF + vermicompost @ 2.5 t/ha nutrient management practices with vermiwash @ 10% + cow urine @ 10% + jeevamrutha @ 25% at PFI and PIS may be recommended to realize higher root nodules per plant, dry weight of root nodules and grain yield of zero till chickpea in rainfed conditions.

REFERENCES

1. **Anonymous** (2022). Agricultural statistics at a glance. Government of India, Ministry of Agriculture & Farmers Welfare, Department of Agriculture & Farmers Welfare Economics & Statistics Division. www.agricoop.nic.in
2. **Chaithra G.M., Basavanneppa M.A., Rao S., Koppalkar B.G., Pralhad and Gaddi A.K.** (2024). Effect of different nutrient management practices on growth and yield of chickpea under foxtail millet- chickpea cropping system in integrated farming system under Tungbhadra project area of Karnataka, India. *Internation Journal of Research in Agronomy.* 7(3): 399-403. doi.org/10.33545/2618060X.2024.v7.i3f.470
3. **Dewangan S., Singh R.P., Singh M.K. and Singh S.** (2017). Effect of integrated nutrient management and drought mitigation practices on performance of rainfed chickpea (*Cicer arietinum* L.). *Indian Journal of Agriculture Sciences.* 87(3): 301-305. https://doi.org/10.56093/ijas.v87i3.68596
4. **Jakhar M., Sharma P.K., Mandeewal R.L., Choudhary R. and Lal B.** (2021). Effect of integrated nutrient management on yield and economics of chickpea (*Cicer arietinum* L.). *Annals of Agriculture Research, New Series*. 42: 54-58.
5. **Oyege I. and Bhaskar B.M.S.** (2023). Effect of vermicompost on soil and plant health and promoting sustainable agriculture. *Soil Systems.* 7(4): 101. https://doi.org/10.3390/soilsystems7040101
6. **Parimala K., Anitha G. and Reddy A.V.** (2013). Effect of nutrient sprays on yield and seedling quality parameters of chickpea (*Cicer arietinum* L.). *Plant Archives*. 13(2): 735-737.
7. **Parmar S.K., Virdia H.M. and Pankhaniya R.M.** (2022). Response of integrated nutrient management on growth and yield of chickpea (*Cicer arietinum* L.). *The Pharma Innovation Journal.* 11(7):2841-2843.
8. **Patil S.V., Halikatti S.I., Hiremath S.M., Babalad H.B., Sreenivasa M.N., Hebsur N.S. and Somanagouda G.** (2012). Effect of organics on

growth and yield of chickpea (*Cicer arietinum* L.) in vertisols. *Karnataka Journal of Agricultural Sciences*. 25(3): 326-331.

9. **Siag R.K. and Yadav B.S.** (2004). Effect of vermicompost and fertilizers on productivity of gram (*Cicer arietinum* L.) and soil fertility. *The Indian Journal of Agricultural Sciences*. 74(11): 613-615. https://www.researchgate.net/publication/289662075
10. **Sinha A. and Thakur S.** (2025). Integrated nutrient management for chickpea cultivation to improve soil fertility. *Journal of Advance Agricultural Research*. 1(1):.22-29. https://doi.org/10.65525/jaar.v1i1.5
11. **Singh V., Mishra A., Chaubey A.K., Panwar G.S., Sachan R., Pal R., Kumar D. and Tiwari A.** (2022). Effect of integrated nutrient management on performance of chickpea in Bundelkhand region of North India. *International Journal of Plant and Soil Science*. 34(23): 1115-1122. https://doi.org/10.9734/IJPSS/2022/v34i232524
12. **Sridhara M.R., Nandagavi R.A., Nooli S.S. and Biradar A.H.** (2023). Effect of liquid organic foliar spray on chickpea (*Cicer arietinum* L.) under rainfed condition. *International Journal of Environment and Climate Change*. 13 (7): 298-308. https://doi.org/10.9734/IJECC/2023/v13i71880
13. **Tank S., Bharose R., David A.A. and Reddy I.S.** (2023). Effect of integrated nutrient management on growth and yield attributes of chickpea (*Cicer arietinum* L.). *Ecology, Environment and Conservation*. 29: S208-S210. https://doi.org/10.53550/EEC.2023.v29i05s.036
14. **Tiwari R.K. and Kushwaha H.S.** (2020). Effect of foliar nutrition on productivity and profitability of Chickpea (*Cicer arietinum* L.) in Kymore plateau of Madhya Pradesh. *International Journal of Current Microbiology and Applied Sciences*. 9(9): 1333-1338. https://doi.org/10.20546/ijcmas.2020.909.169
15. **Zala D.A., Dadarwal R.S., Jat R.D., Prakash R. and Asif M.** (2024). Optimizing integrated nutrient management (INM) for enhanced growth and yield of Chickpea (*Cicer arietinum* L.) under irrigated conditions. *Journal of Experimental Agriculture International*. 46(12): 872-881. https://doi.org/10.9734/jeai/2024/v46i123196