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EVALUATION OF NUTRIENT MANAGEMENT PRACTICES AND FOLIAR SUPPLEMENTATION FOR ENHANCING GROWTH-DEPENDENT ATTRIBUTES, YIELD PARAMETERS AND YIELD OF CHICKPEA (*Cicer arietinum* L.) UNDER RAINFED SITUATIONS

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ABSTRACT

The research trials were conducted at the University Research Farm, BUAT, and 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 in 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 & PIS, NPK (19:19:19) + Cow urine @ 10% at PFI & PIS, NPK (19:19:19) + Jeevamrutha @ 25% at PFI & PIS and Vermiwash @ 10% + Cow urine @ 10% + Jeevamrutha @ 25% in sub plot. The result revealed that the nutrient management practices of 100% RDF + Vermicompost @ 2.5 t/ha was promoted the growth and yield attributes, biological yield, grain yield and straw yield of Jawahar Gram-36 variety of zero-till chickpea under rainfed conditions except only plant population. The applied foliar application of Vermiwash @ 10% + Cow Urine @ 10% + Jeevamrutha @ 25% at PFI & PIS were significantly enhanced the all growth and yield attributes and yields during two years' study except only plant population. Therefore, the nutrient management with 100% RDF + Vermicompost @ 2.5 t/ha with foliar supplementation of Vermiwash @ 10% + Cow Urine @ 10% + Jeevamrutha @ 25% were significantly increased in the above observations in both the years of experimentation.

Keywords **:** Nutrient management practices, foliar supplementation, zero till chickpea.

Introduction

Chickpea (*Cicer arietinum* L.) is a major pulse crop in rainfed regions, contributing to protein security, soil nitrogen fixation and sustainable cropping systems like pearl millets-chickpea. It is often grown on conserved soil moisture in the *Rabi* season under rainfed conditions, where terminal drought, low soil organic matter and nutrient deficiencies, limit productivity. 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, 2026). Conventional tillage degrades soil structure, increases erosion and reduces moisture retention while zero tillage or conservation agriculture conserves soil moisture, enhances nutrient efficiency improves microbial activity and boosts resilience to moisture stress. Nutrient management and foliar supplementation like NPK, micronutrient, nano

fertilizers, bio-fertilizers address these constraints. Foliar sprays enable rapid uptake during critical stages viz. flowering, pod filling etc. when soil moisture limits root absorption, improving growth, yield, nutrient content and stress tolerance without heavy reliance on soil application. Foliar fertilization also known as foliar feeding, encourages the source of nutrients, growth regulators, stimulants as well as other useful substances in form of liquid to plants through aerial parts of the plants, such as leaves, stems and other parts of the plants, in order to achieve greater production, quality, resistance to pests, increased abiotic stress tolerance specially in rainfed condition and also to help the plants retrieve from transplant stress, hail damage or the effects of other weather extremes. An earthworm excretory product and mucous secretion together with micronutrients extracted from soil organic molecules are gathered in this substance. Sinha *et al.* (2025) revealed that integrated nutrient management practices improved nutrient availability and maintained soil health demonstrated the highest nutrient retention with nitrogen, phosphorus and potassium levels at harvest.Therefore, combined organic, inorganic and liquid organic fertilizers including FYM, Vermicompost, Vermiwash, Cow urine and Jeevamrutha with varying properties of recommended dose of fertilizers. Soil properties pH, EC, organic carbon and primary nutrients (NPK) were assessed at different growth stages. Finally resulted by INM practices improved nutrient availability and maintained soil health.

Materials and Methods

The research trial was conducted at the University Research Farm, BUAT, and 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 in 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 & PIS, NPK (19:19:19) + Cow urine @ 10% at PFI & PIS, NPK (19:19:19) + Jeevamrutha @ 25% at PFI & 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 both the years. 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. This region falls under Agro-climatic zone - V I I I (Central Plateaus & Hills Region) of Uttar Pradesh.This region experience shot waves or hot winds in summers as on which starts from November to April. Rabi season arrives in the month of November and last early February with minimum temperature of 5° Cand maximum temperature of 48°C during summer season. Generally, rainfall in this region is received between the months of June to September with 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 is helps in producing of higher yield. The experimental crop was 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 04 April, 2024 and 20 March, 2025 with handle sickles by manual labour when they attain their full maturity.

Results and Discussions

Growth attributes

The growth parameters of chickpea viz., plant population, plant height, branches per plant and dry matter accumulation has been presented in Table 1. The effect of nutrient management was significantly not count in respect to plant population at 100% RDF + Vermicompost @ 2.5 t/ha (11.54 and 11.56) over 100% RDF (11.46 and 11.48) and 100% RDF + FYM @ 5 t/ha (11.49 and 11.52) results in higher plant population per unit area, in both the year of 2023-24 and 2024-25, respectively. The plant height was significantly increased in nutrient management of 100 % RDF + Vermicompost (2.5 t/ha) over rest of treatments at harvesting time; There plant height at maturity between 100% RDF + FYM @ 5 t/ha and 100% RDF + 2.5 t/ha were found equal during both the years. The treatment of 100 % RDF + Vermicompost (2.5 t/ha) increased significantly the number of branches per plant over 100% RDF and 100% RDF + FYM (5 t/ha), respectively in both the years with percentage increments of 12.10 & 8.71 at maturity time during both the years, respectively. The dry matter accumulation showed significant variation due to nutrient managementin both the years. However, the trend showed nutrient management in 100% RDF + Vermicompost (2.5 t/ha) more than other nutrient management with percentage increments over 100 % RDF of 7.92 and 100 % RDF + FYM @ 5.0 t/ha of 1.43 of zero till chickpea on the mean basis of the data, respectively. Nutrient management with 100% RDF + Vermicompost @ 2.5 t/ha had significantly effect on growth parameters of zero till chickpea under rainfed conditions viz., plant height, number of branches per

plant and dry matter accumulation were also better with above treatments compared to rest treatment except plant population during both the years. This integrated approach provides a balanced supply of macro and micronutrients, improves soil microbial activity, enhances nutrient uptake and availability via Vermicompost's humic substances and enzymes and promotes better growth parameters. Taller plants due to improved N and P availability from Vermicompost, supporting better cell elongation and photosynthesis. More produce branching, leading to greater canopy development and higher photosynthetic surface area. Higher biomass production effect enhanced nutrient assimilation, root development and overall vigor. It often matched or approached top integrated nutrient management treatments. The result in respect of plant height, branches per plant and dry matter accumulation of chickpea is the conformity with the findings of Namvar *et al.* (2011), Patil *et al.* (2012), Singh *et al.* (2021) and Chaithra *et al.* (2024).

Among the foliar supplementation the plant population of vermiwash @ 10% + cow urine @ 10% + Jeevamrutha @ 25% at PFI and PIS (11.55 and 11.57) recorded statistically at par results over NPK (19:19:19) at PFI and PIS (11.46 and 11.48), NPK (19:19:19) + Vermiwash @ 10% at PFI and PIS (11.48 and 11.50), NPK (19:19:19) + cow urine @ 10% PFI and PIS (11.51 and 11.53) and NPK (19:19:19) + Jeevamrutha @ 25 % at PFI and PIS (11.53 and 11.55) during both the year, respectively. Foliar supplementation produced marked variation on plant height when it increased significantly was also not observed at Vermiwash @ 10% + cow urine @ 10 % + Jeevamrutha @ 25% at PFI and PIS as compared to other rest treatments in both the years. When, plant height between foliar supplementation of NPK (19:19:19) + Jeevamrutha @ 25% and Vermiwash @ 10% + Cow urine @ 10% + Jeevamrutha @ 25% was at par in both the years, respectively. The foliar supplementation at increasing exerted a positive effect on production of branches per plant into Vermiwash @ 10% + Cow urine @ 10% + Jeevamrutha @ 25% compared to NPK (19:19:19) at PFI & PIS of foliar supplementation during both the years of study. Whereas, among the rest treatment with foliar supplementation was recorded in both the years, respectively. The dry matter accumulation was significantly more with Vermiwash @ 10% + Cow urine @ 10% + Jeevamrutha @ 25% @ PFI and PIS over remaining treatments of foliar supplementation in both the year of experimentation. Different foliar supplementation with Vermiwash @ 10% + Cow urine @ 10% + Jeevamrutha @ 25% at PFI and PIS had significant effect on growth parameters of zero till chickpea under rainfed conditions viz., plant height, number of branches per plant and dry matter accumulation were also significantly higher with above treatments when compared to rest of the treatments. These liquid organic manures supply macro and micro-nutrients, beneficial microbes, and growth-promoting substances like hormones, enzymes, vitamins, humic acid, and anti-microbial compounds that enhance foliar nutrient uptake, photosynthesis, cell division, and overall vegetative vigour when spread on leaves. Using these organics improves growth attributes through better nutrient supply, photosynthetic efficiency, and translocation. Using Vermiwash, Cow urine, and Jeevamrutha as foliar spray reliably enhances chickpea growth parameters like dry matter, biomass, height, branching, and spread with the greatest benefits from two applications at PFI and PIS. Similar results were found by Sridhara *et al.* (2022), Patil *et al.* (2022) and Zala *et al.* (2024).

Table 1 : Effect of nutrient management and foliar supplementation on growth attributes at maturity of zero till chickpea during 2023-24 and 2024-25.

	Plant population		**Plant height**		**Number of branches**		**Dry matter accumulation**	
	2023	**2024**	**2023**	**2024**	**2023**	**2024**	**2023**	**2024**
Nutrient management								
100% RDF	11.47	11.51	50.31	51.22	16.01	16.04	41.23	41.34
100% RDF + FYM (5t/ha.)	11.49	11.52	52.25	53.22	16.51	16.54	43.66	44.19
100% RDF + Vermicompost (2.5t/ha.)	11.54	11.56	54.36	55.22	17.95	17.99	44.56	44.55
Sem ±	0.156	0.156	0.71	0.72	0.23	0.23	0.583	0.59
CD @ 5%	**N.S**	**N.S**	2.86	2.90	0.94	0.94	2.35	2.36
Foliar supplementation								
NPK (19:19:19) at PFI & PIS	11.46	11.48	48.86	49.97	15.73	15.76	40.58	40.77
NPK (19:19:19) + Vermiwash@ 10% at PFI & PIS	11.48	11.50	51.61	52.66	16.89	16.93	42.87	43.11
NPK (19:19:19) + Cow Urine @ 10% at PFI & PIS	11.51	11.53	52.28	53.39	17.01	17.05	42.97	43.24
NPK (19:19:19) + Jeevamrutha @ 25% at PFI &	11.53	11.55	53.83	54.99	17.18	17.22	44.57	44.66

PIS								
Vermiwash 10% + Cow Urine 10% + Jeevamrutha @ 25% at PFI & PIS	11.55	11.57	54.98	55.10	17.30	17.33	44.76	45.02
Sem ±	**0.24**	**0.25**	1.13	1.15	0.36	0.36	0.93	0.94
CD @ 5%	**N.S**	**N.S**	**3.31**	**3.37**	1.06	1.07	**2.73**	**2.74**
Interaction (N×F)	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**

Yield Attributes

The yield attributes of chickpea viz., pods per plant, seeds per pod, grain yield per plant and seed index has been presented in the Table 2. The nutrient management of 100% RDF + Vermicompost @ 2.5 t/ha produced significantly higher number of pods per plant than 100% RDF and at par of 100% RDF + FYM @ 5 t/ha nutrient management in both the years. The number of seeds per pod progressively increased with increase in nutrient management from 100% RDF to 100% RDF with FYM @ 5 t/ha and Vermicompost @ 2.5 t/ha and non-significantly the highest number of seeds per pod was noticed with 100% RDF + Vermicompost @ 2.5 t/ha than remaining treatments of nutrient management in both the year, respectively. The grain yield per plant at 100% RDF + Vermicompost (2.5 t/ha) nutrient management was significantly more than other treatment in both the years. The seed index (g) increased non-significantly among the treatments of nutrient management of 100% RDF + Vermicompost (2.5 t/ha) was found statistically better than all other treatments of nutrient management during 2023-24 and 2024-25.The different nutrient management of 100% RDF + Vermicompost @ 2.5 t/ha practices brought significantly effect on yield attributes of zero till chickpea during both the years of study but only the economically higher seed per pod, seed index of zero till chickpea were recorded under 100% RDF + Vermicompost @ 2.5 t/ha followed by 100% RDF + FYM @ 5t/ha and 100% RDF during both the year of experiment. Yield attributes improve statistically due to the synergistic effect recommended dose of fertilizer as 100% supplies readily available N and P for quick uptake, while Vermicompost provides slow-release nutrients as N, P, K and micro nutrients, growth promoting substances viz., humic acids enzymes, hormones and improves soil microbial activities, structures, water holding capacity and root nodulation. Better pods per plant, seeds per pod, seed filling heavier as well as finally grain yield, due to sustainable nutrient supply during reproductive stages. This practice is highly effective for higher and more sustainable zero till chickpea productivity, especially in nutrient depleted or low organic matter of soils., Drostkar *et al.* (2018), Tank *et al.*(2019) were also observed significantly improvement in recommended dose of fertilizer nutrient supply with Vermicompost under nutrient management practices.

The application of Vermiwash @ 10% + Cow urine @ 10% + Jeevamrutha @ 25% at PFI and PIS foliar supplementation produced significantly more number of pods per plant than only treatment of NPK (19:19:19) at PFI & PIS in both years of study. Among the foliar supplements with bio fertilizers used treatments were recorded pods per plant at par during both the years. The use of Vermiwash @ 100% + Cow urine @ 10% + Jeevamrutha @ 25% at PFI and PIS foliar supplementation was no significant recorded highest number of seed per pod over rest treatment in both the year, respectively. The response of foliar supplementation was noted that Vermiwash @ 10% + Cow urine @ 10% + Jeevamrutha @ 25% at PFI and PIS was found significant in respect of yield per plant (g) in both the years of study. The foliar supplementation of Vermiwash @ 10% + Cow urine @ 10% + Jeevamrutha @ 25% at PFI and PIS found non significantly higher on seed index (g) over rest of the treatments during both the years of experimentation. The result showed that the foliar supplementation of Vermiwash @ 10% + Cow urine @ 10% + Jeevamrutha @ 25% at PFI & PIS brought a significantly higher effect on yield attributes viz., pods per plant and grain yield per plant (g) followed by NPK (19:19:19) + Jeevamrutha @ 25%, NPK (19:19:19) + Cow urine @ 10%, NPK (19:19:19) + Vermiwash @ 10%, and NPK (19:19:19) at PFI & PIS during both the years of experimentation whereas, seeds per pod and seed index, which is non significantly higher produce during both the year as above treatments. This is due to improved nutrient availability, hormonal stimulation, microbial activity, and stress tolerance. This treatment proves to be an effective and sustainable approach for improving productivity in resource-constrained environments. The result in respect to number of pods per plant, number of seeds per pod, grain yield per plant (g), and seed index (g) were also observed by Pathak *et al.* (2012), Sridhara *et al.* (2022), and Zala *et al.* (2024).

Table 2 : Effect of nutrient management and foliar supplementation on yield attributes at maturity of zero till chickpea during 2023-24 and 2024-25.

	No. of pods/plant		No. of seeds/pod		Yield/plant (g)		Seed index (100 seed weight)	
	2023	**2024**	**2023**	**2024**	**2023**	**2024**	**2023**	**2024**
Nutrient management								
100% RDF	42.01	42.69	1.85	1.89	11.02	11.26	16.75	16.75
100% RDF + FYM (5t/ha.)	45.14	45.48	1.88	1.92	13.66	13.96	16.75	16.87
100% RDF + Vermicompost (2.5t/ha.)	46.24	46.42	1.91	1.95	14.16	14.46	16.95	17.00
Sem ±	0.61	0.61	0.025	0.026	0.18	0.19	0.227	0.228
CD @ 5%	2.44	2.48	**N.S**	**N.S**	0.73	0.75	**N.S**	**N.S**
Foliar supplementation								
NPK (19:19:19) at PFI & PIS	42.07	42.44	1.83	1.85	10.97	11.90	16.63	16.68
NPK (19:19:19) + Vermiwash@ 10% at PFI & PIS	43.23	43.95	1.88	1.91	12.57	13.42	16.80	16.86
NPK (19:19:19) + Cow Urine @ 10% at PFI & PIS	44.68	45.10	1.86	1.89	13.37	13.22	16.72	16.77
NPK (19:19:19) + Jeevamrutha @ 25% at PFI & PIS	45.80	45.55	1.90	1.94	13.81	13.71	16.91	16.98
Vermiwash 10% + Cow Urine 10% + Jeevamrutha @ 25% at PFI & PIS	46.53	47.26	1.92	1.97	14.02	13.88	17.00	17.10
Sem ±	0.96	0.96	0.040	0.041	0.29	0.29	0.357	0.358
CD @ 5%	2.81	2.83	**N.S**	N.S	0.84	0.85	**N.S**	**N.S**
Interaction (N×F)	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**

Yields

The data pertaining to seed yield (q/ha), straw yield, biological yield and harvest index as influenced by nutrient management and applied foliar supplements are presented in Table 3. 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 in both the year of study, respectively. The same trend of straw and biological yield was significantly increased at 100% RDF + Vermicompost @ 2.5 t/ha which was higher than rest of the treatment. The minimum straw and biological yield recorded with 100% RDF in present study. Here the significant differences was not found observed among different treatments, through 100% RDF + Vermicompost @ 2.5 t/ha gave more harvest index than other treatments during both the years of experimentation. The different nutrient management of 100% RDF + Vermicompost @ 2.5 t/ha practices brought significantly effect on yields of zero till chickpea during both the years of study but only the economically higher harvest index of zero till chickpea were recorded under 100% RDF + Vermicompost @ 2.5 t/ha followed by 100% RDF + FYM @ 5t/ha and 100% RDF during both the year of experiment. Yield improve statistically due to the synergistic effect recommended dose of fertilizer as 100% supplies readily available N and P for quick uptake, while Vermicompost provides slow-release nutrients as N, P, K and micro nutrients, growth promoting substances viz, humic acids enzymes, hormones and improves soil microbial activities, structures, water holding capacity and root nodulation. Better pods per plant, seeds per pod, seed filling heavier as well as finally grain yield, due to sustainable nutrient supply during reproductive stages. This practice is highly effective for higher and more sustainable zero till chickpea productivity, especially in nutrient depleted or low organic matter of soils. Bayskar *et al.* (2021) and Chaithra *et al.* (2024) were also observed significantly improvement in recommended dose of fertilizer nutrient supply with Vermicompost under nutrient management practices.

The application of 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. The same trend of straw and biological yield to foliar supplementation was found significant effect during both the years of experimentation. Vermiwash @ 10% + Cow urine @ 10% + Jeevamrutha @ 25% at PFI and PIS was significantly more noted over rest of the treatments during both the years of experimentation. The significant differences in respect to yield parameters viz., seed yield (q/ha), straw yield (q/ha) and biological yield (q/ha) were significantly observed except harvest index among different treatments of foliar supplementation during both the years. Though the trend showed that the yield parameters in chickpea were statistically higher in Vermiwash @ 10% + Cow urine @ 10% + Jeevamrutha @ 25% at PFI & 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 also 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), Jakhar *et al.* (2021), Parmar *et al.* (2022) and Zela *et al.* (2024).

Table 3: Effect of nutrient management and foliar supplementation on yields viz. seed yield (q/ha), straw yield (q/ha), biological yield (q/ha) and harvest index (%) at maturity of zero till chickpea during 2023-24 and 2024-25.

	Seed yield		**Straw yield**		**Biological yield**		**Harvest index**	
	2023	**2024**	**2023**	**2024**	**2023**	**2024**	**2023**	**2024**
Nutrient management								
100% RDF	13.38	13.81	14.72	14.36	28.09	28.16	47.64	49.04
100% RDF + FYM (5t/ha.)	15.51	15.93	18.05	18.72	33.56	34.65	46.25	45.99
100% RDF + Vermicompost (2.5t/ha.)	18.57	18.97	20.52	21.22	39.09	40.18	47.53	47.23
Sem ±	0.224	0.232	0.250	0.258	0.474	0.489	0.642	0.642
CD @ 5%	0.902	0.934	1.007	1.041	1.909	1.971	N.S.	N.S.
Foliar supplementation								
NPK (19:19:19) at PFI & PIS	13.22	13.77	14.29	14.64	27.51	28.41	48.05	48.59
NPK (19:19:19) + Vermiwash@ 10% at PFI & PIS	14.41	14.49	16.58	16.83	30.99	31.32	46.51	46.37
NPK (19:19:19) + Cow Urine @ 10% at PFI & PIS	16.22	16.80	18.25	18.64	34.47	35.44	47.06	47.52
NPK (19:19:19) + Jeevamrutha @ 25% at PFI & PIS	17.23	17.51	19.46	19.84	36.68	37.35	46.97	46.99
Vermiwash 10% + Cow Urine 10% + Jeevamrutha @ 25% at PFI & PIS	18.01	18.60	20.24	20.54	39.25	39.14	47.10	47.63
Sem ±	0.380	0.361	0.400	**0.409**	0.752	0.770	0.997	0.999
CD @ 5%	**1.117**	**1.059**	**1.174**	**1.202**	**2.208**	**2.261**	**N.S.**	**N.S.**
Interaction (N×F)	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**

Conclusion

Looking into above discussion it is concluded that the practices of nutrient management with 100% RDF + Vermicompost a@ 2.5 t/ha and foliar supplementation with Vermiwash 10% + Cow Urine 10% + Jeevamrutha @ 25% at PFI & PIS was the best options for improving growth attributes vi., plant height, branches and dry matter accumulation, yield attributes viz., pods per plant and yield per plant and yields viz., grain, straw and biological yield in zero till chickpea under rainfed conditions.

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