



Response of Vermicompost and Zinc Application on Yield and Nutrient Uptake by Gram (*Cicer arietinum*)

Kanika Dubey ^{a*}, Chandrakanta Jakhar ^a, Neelu Jain ^a
and Indra Raj Yadav ^b

^a Department of Agriculture, Faculty of Agriculture and Veterinary Science, Mewar University Gangrar, Chittorgarh Rajasthan-312901, India.

^b Department of Soil Science, Rajmata Vijayaraje Scindia Krishi Vishwavidyalaya, Gwalior-474002, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present study aimed to determine the response of vermicompost and Zinc Application on Yield and Nutrient uptake by Gram (*Cicer arietinum*). Vermicompost typically contains 0.40–0.75%, 0.13–0.22% P, and 0.6–1.2% N. The usage of synthetic fertilizers has been shown to have a negative influence on the environment, and their cost has been rising over time. Farmers are becoming more aware of the benefits of raising crops organically, which will save expenses and lessen adverse environmental effects. A field experiment was conducted at experimental farm, Department of Agronomy, Faculty of Agriculture and Veterinary Sciences, Mewar University Gangrar, Chittorgarh (Rajasthan) during Rabi season of 2023-24. The required quantities of fertilizers as per treatments were applied. The experiment was laid out in randomized block design with three replications

*Corresponding author: Email: dubeykanika6@gmail.com;

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consisting of ten treatments. The data recorded maximum yield parameter such as number of pods per plant (68.48), number of seed per pod (2.14), seed yield (2289.12 kg/ha), stover yield (2790.12 kg/ha), biological yield (5079.24 kg/ha) and NPK content in grain and straw (3.432; 0.822, 0.395; 0.165 and 0.712; 1.452%) and uptake (78.56; 22.93, 9.04; 4.60 and 16.30; 40.51 kg/ha), respectively with T₁₀-Vermicompost (4.5 tons ha⁻¹) + Zn (5.0 kg ha⁻¹). The minimum yield, nutrient content and uptake obtained with control treatment. Therefore, conclude be application of Vermicompost (4.5 tons ha⁻¹) + Zn (5.0 kg ha⁻¹) are indigenous sources of enhance productivity and nutrient uptake by chickpea.

Keywords: Vermicompost; zinc; productivity; gram; uptake.

1. INTRODUCTION

“Since pulses are the main source of protein in our nation, pulse crops are especially important to the vegetarian community. The world's biggest producer and consumer of pulses is India. Among all grain legumes, gram comes in third place worldwide. India is the largest chickpea producer as well as consumer in the world and ranks first in terms of area (10.56 million hectare) and production (11.23 million tonnes) with productivity of 1063 kg ha⁻¹ in Madhya Pradesh it is cultivated on an area of 3.59 million hectare with production of 4.59 million tonnes and productivity of 1278 kg ha⁻¹” [1].

“Vermicompost has a higher N, P, and K content than typical heap manure, making it an excellent alternative to commercial fertilizers” [2]. “Vermicompost typically contains 0.40–0.75%, 0.13–0.22% P, and 0.6–1.2% N. The usage of synthetic fertilizers has been shown to have a negative influence on the environment, and their cost has been rising over time. Farmers are becoming more aware of the benefits of raising crops organically, which will save expenses and lessen adverse environmental effects” [3]. Furthermore, organic farming will lessen the additional environmental contamination that results from the source-side manufacturing of these synthetic fertilizers. Vermicompost is a fully stabilized organic soil amendment with a low C:N ratio that is created through the mesophilic breakdown of organic materials by earthworms and microorganisms [4].

Zinc (Zn) plays a variety of roles in cellular functions and is a micronutrient that is vital to plants and other living things. A zinc deficit is characterized by inadequate zinc availability for ideal growth, which can cause a precipitous drop in crop output and quality. The ratio of grain yield or above-ground dry matter yield to the total amount of zinc absorbed in both zinc-sufficient and zinc-deficient environments is known as zinc efficiency [5].

2. MATERIALS AND METHODS

A field experiment was conducted during Rabi season of 2022-23 at experimental farm, Department of Agronomy, Faculty of Agriculture and Veterinary Sciences, Mewar University Gangrar, Chittorgarh (Rajasthan). Soil of the experimental field was sandy loam in texture, saline in reaction with a pH value of 7.6, poor in organic carbon (0.16%), deficient in available zinc (0.48 ppm) and iron (1.2 ppm) low in available nitrogen (176 kg/ha) and phosphorus (20.2 kg/ha) but medium in available potassium (320 kg/ha). The experiment was laid out in randomized block design with three replications consisting of ten treatments viz. T₁-Control, T₂-Vermicompost (1.5 tons ha⁻¹) + 0.5 % Zn foliar spray at 30 DAS, T₃-Vermicompost (1.5 tons ha⁻¹) + Zn (2.5 kg ha⁻¹), T₄-Vermicompost (1.5 tons ha⁻¹) + Zn (5.0 kg ha⁻¹), T₅-Vermicompost (3.0 tons ha⁻¹) + 0.5 % Zn foliar spray at 30 DAS, T₆-Vermicompost (3.0 tons ha⁻¹) + Zn (2.5 kg ha⁻¹), T₇-Vermicompost (3.0 tons ha⁻¹) + Zn (5.0 kg ha⁻¹), T₈-Vermicompost (4.5 tons ha⁻¹) + 0.5 % Zn foliar spray at 30 DAS, T₉-Vermicompost (4.5 tons ha⁻¹) + Zn (2.5 kg ha⁻¹) and T₁₀-Vermicompost (4.5 tons ha⁻¹) + Zn (5.0 kg ha⁻¹). The required quantities of fertilizers as per treatments were applied. The doses of NPK were applied in the form of urea, diammonium phosphate, murate of potash respectively. The half dose of nitrogen gives basal dose and remain two split doses after irrigation and full dose of phosphorus and potassium at basal dose. Vermicompost apply in field at field preparation before sowing.

3. RESULTS AND DISCUSSION

The data presented in Table 1 and Fig. 1 has showed the variation in the yield attributes with application of vermicompost and zinc found significantly to the treatments. The data presented in Table 1 that the highest number of pods/plant was recorded with treatment T₁₀-

Table 1. Effect of vermicompost and zinc application on yield attributes and yield of gram

Treatments	Number of pods/plant at harvest	Number of seeds/pod at harvest	Seed yield (kg/ha)	Straw yield (kg/ha)	Biological yield (kg/ha)
T ₁	32.55	1.62	1232.02	1830.25	3062.27
T ₂	42.65	1.72	1632.45	2128.25	3760.7
T ₃	45.98	1.78	1685.36	2198.66	3884.02
T ₄	46.25	1.84	1745.78	2235.45	3981.23
T ₅	50.32	1.88	1832.65	2342.58	4175.23
T ₆	54.12	1.95	1868.44	2385.47	4253.91
T ₇	56.45	2.00	1965.25	2460.77	4426.02
T ₈	60.45	2.05	2078.58	2530.58	4612.16
T ₉	65.12	2.08	2085.36	2602.47	4687.83
T ₁₀	68.48	2.14	2289.12	2790.12	5079.24
S. Em. (±)	3.24	0.03	70.25	88.45	155.85
C.D. at 5%	9.75	0.09	210.92	264.25	468.05

Table 2. Effect of vermicompost and zinc application on nutrient content and uptake by gram

Treatments	Nitrogen content (%)		Phosphorus content (%)		Potassium content (%)		Nitrogen uptake (kg/ha)		Phosphorus uptake (kg/ha)		Potassium uptake (kg/ha)	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
T ₁	3.075	0.670	0.345	0.151	0.612	1.142	37.88	12.26	4.25	2.76	7.54	20.90
T ₂	3.125	0.762	0.355	0.153	0.635	1.255	51.01	16.22	5.80	3.26	10.37	26.71
T ₃	3.138	0.785	0.362	0.155	0.642	1.275	52.89	17.26	6.10	3.41	10.82	28.03
T ₄	3.145	0.788	0.365	0.155	0.652	1.285	54.90	17.62	6.37	3.46	11.38	28.73
T ₅	3.245	0.793	0.372	0.157	0.662	1.305	59.47	18.58	6.82	3.68	12.13	30.57
T ₆	3.285	0.798	0.378	0.158	0.668	1.345	61.38	19.04	7.06	3.77	12.48	32.08
T ₇	3.302	0.802	0.382	0.158	0.678	1.374	64.89	19.74	7.51	3.89	13.32	33.81
T ₈	3.375	0.810	0.385	0.160	0.685	1.402	70.15	20.50	8.00	4.05	14.24	35.48
T ₉	3.415	0.815	0.389	0.162	0.695	1.425	71.22	21.21	8.11	4.22	14.49	37.09
T ₁₀	3.432	0.822	0.395	0.165	0.712	1.452	78.56	22.93	9.04	4.60	16.30	40.51
S. Em. (±)	0.012	0.005	0.004	0.002	0.009	0.017	2.75	0.83	0.35	0.22	0.72	1.78
C.D. at 5%	0.036	0.015	0.012	0.006	0.027	0.051	8.28	2.50	1.04	0.65	2.18	5.30

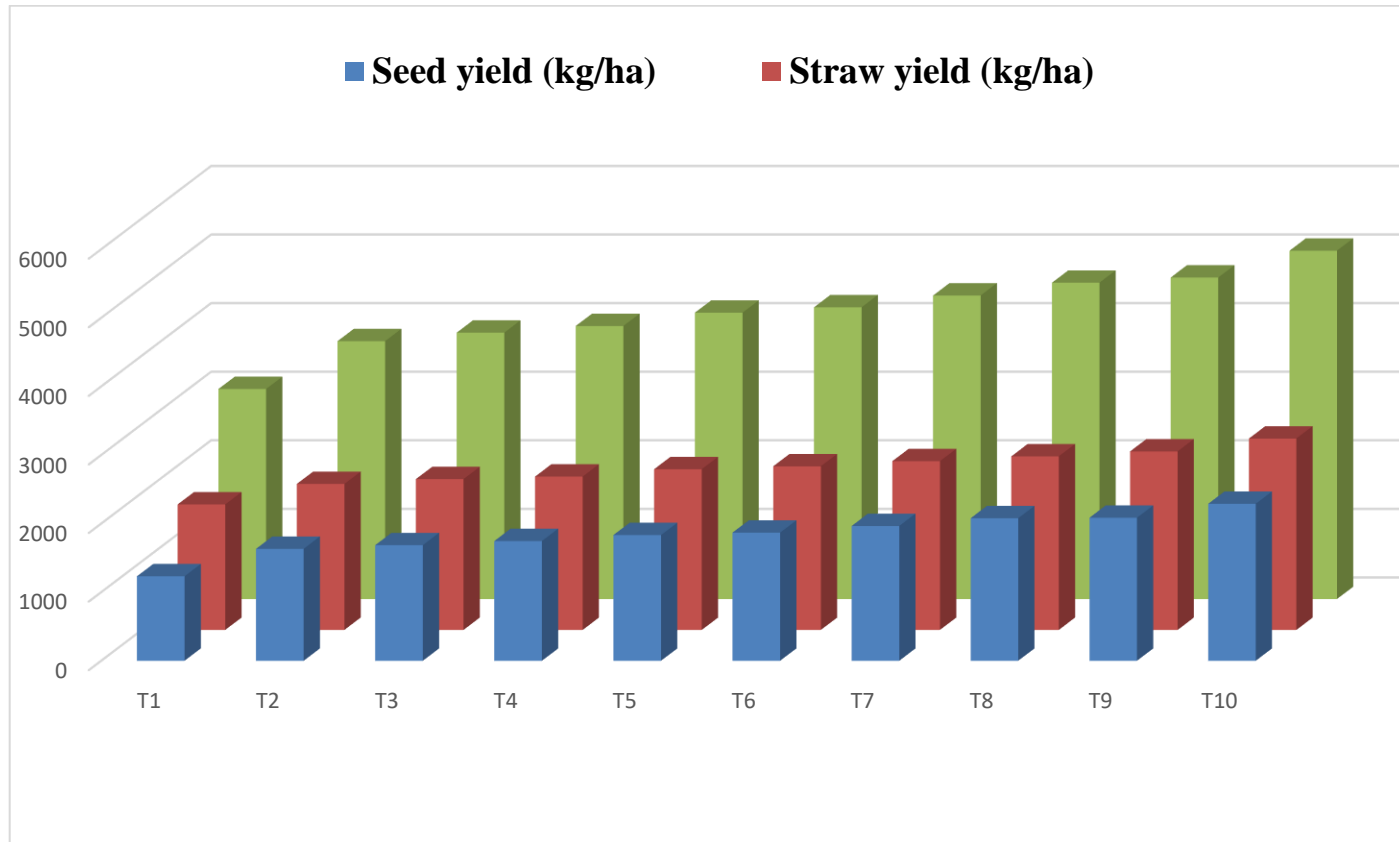


Fig. 1. Effect of vermicompost and zinc application on yield of gram

Vermicompost (4.5 tons ha⁻¹) + Zn (5.0 kg ha⁻¹) (68.48). The minimum number of pods/plant was recorded with control treatment (32.55). The data state that the highest number of seeds per pod was obtained with treatment T₁₀-Vermicompost (4.5 tons ha⁻¹) + Zn (5.0 kg ha⁻¹) (2.14). The minimum number of seeds per pod was recorded with control treatment (1.62). The data furnished that the maximum seed yield was recorded with treatment T₁₀-Vermicompost (4.5 tons ha⁻¹) + Zn (5.0 kg ha⁻¹) (2289.12 kg/ha). The minimum seed yield was recorded with control treatment (1232.02 kg/ha). The maximum straw yield was recorded with treatment T₁₀-Vermicompost (4.5 tons ha⁻¹) + Zn (5.0 kg ha⁻¹) (2790.12 kg/ha). The minimum straw yield was recorded with control treatment (1830.25 kg/ha). The maximum biological yield was recorded with treatment T₁₀-Vermicompost (4.5 tons ha⁻¹) + Zn (5.0 kg ha⁻¹) (5079.24 kg/ha). The minimum biological yield was recorded with control treatment (3062.27 kg/ha). These findings also supported by Jakhar [6], Fuller et al. [7], Dhyani et al. [3], Bameri et al. [8], Singh et al. [9] and Krishana et al. [10].

The data presented in Table 2 has showed the variation in the nutrient content with application of vermicompost and zinc found significantly to the treatments. The data revealed that the maximum nitrogen content in grain was recorded with treatment T₁₀-Vermicompost (4.5 tons ha⁻¹) + Zn (5.0 kg ha⁻¹) (3.432%). The minimum nitrogen content in grain was recorded with control treatment (3.075%). The maximum nitrogen content in straw was recorded with treatment T₁₀-Vermicompost (4.5 tons ha⁻¹) + Zn (5.0 kg ha⁻¹) (0.822%). The minimum nitrogen content in straw was recorded with control treatment (0.670%). The maximum phosphorous content in grain was recorded with treatment T₁₀-Vermicompost (4.5 tons ha⁻¹) + Zn (5.0 kg ha⁻¹) (0.395%). The minimum phosphorus content in grain was recorded with control treatment (0.345%). The maximum phosphorus content in straw was recorded with treatment T₁₀-Vermicompost (4.5 tons ha⁻¹) + Zn (5.0 kg ha⁻¹) (0.165%). The minimum phosphorus content in straw was recorded with control treatment (0.151%). The maximum potassium content in grain was recorded with treatment T₁₀-Vermicompost (4.5 tons ha⁻¹) + Zn (5.0 kg ha⁻¹) (0.712%). The minimum potassium content in grain was recorded with control treatment (0.612%). The maximum potassium content in straw was recorded with treatment T₁₀-Vermicompost (4.5 tons ha⁻¹) + Zn (5.0 kg ha⁻¹)

(1.452%). The minimum potassium content in straw was recorded with control treatment (1.142%). Similar result also reported by Ramesh et al. [11], Shivran et al. [12], Mohammadi et al. [13], Barlas et al. [14] and Joshi et al. [15].

The data presented in Table 2 has showed the variation in the nutrient uptake with application of vermicompost and zinc found significantly to the treatments. The maximum nitrogen uptake in grain was recorded with treatment T₁₀-Vermicompost (4.5 tons ha⁻¹) + Zn (5.0 kg ha⁻¹) (78.56 kg/ha). The minimum nitrogen uptake in grain was recorded with control treatment (37.87 kg/ha). The maximum nitrogen uptake in straw was recorded with treatment T₁₀-Vermicompost (4.5 tons ha⁻¹) + Zn (5.0 kg ha⁻¹) (22.93 kg/ha). The minimum nitrogen uptake in straw was recorded with control treatment (12.26 kg/ha). The maximum phosphorous uptake in grain was recorded with treatment T₁₀-Vermicompost (4.5 tons ha⁻¹) + Zn (5.0 kg ha⁻¹) (9.04 kg/ha). The minimum phosphorus uptake in grain was recorded with control treatment (4.25 kg/ha). The maximum phosphorus uptake in straw was recorded with treatment T₁₀-Vermicompost (4.5 tons ha⁻¹) + Zn (5.0 kg ha⁻¹) (4.60 kg/ha). The minimum phosphorus uptake in straw was recorded with control treatment (2.76 kg/ha). The maximum potassium uptake in grain was recorded with treatment T₁₀-Vermicompost (4.5 tons ha⁻¹) + Zn (5.0 kg ha⁻¹) (16.30 kg/ha). The minimum potassium uptake in grain was recorded with control treatment (7.54 kg/ha). The maximum potassium uptake in straw was recorded with treatment T₁₀-Vermicompost (4.5 tons ha⁻¹) + Zn (5.0 kg ha⁻¹) (40.51 kg/ha). The minimum potassium uptake in straw was recorded with control treatment (20.90 kg/ha). Similar concluded by Shivay et al. [16] Tripathi et al. [17], Kansotia et al. [18], Samant [19] and Meena et al. [20].

4. CONCLUSION

On the basis of experimental result of the present investigation conducted application of Vermicompost (4.5 tons ha⁻¹) + Zn (5.0 kg ha⁻¹) showed significant effect with respect to yield, nutrient content and uptake as compared to control. Therefore, conclude be application of Vermicompost (4.5 tons ha⁻¹) + Zn (5.0 kg ha⁻¹) are indigenous sources of enhance productivity and nutrient uptake by chickpea.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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