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Impact of organic and inorganic fertilizer integration on chickpea (*Cicer arietinum* L.) yield and soil health

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Abstract
The research titled "Impact of Organic and Inorganic Fertilizer Integration on Chickpea (*Cicer arietinum* L.) Yield and Soil Health" was carried out at the Agricultural Research Farm, Faculty of Agricultural Sciences and Allied Industries, Rama University, Mandhana, Kanpur Nagar, Uttar Pradesh. The chickpea variety Digvijay, also known as Phule G-9425-5, was utilized for the study. Ten treatments, including a control, were applied. The findings indicated that the highest plant population per square meter (31.67) was observed in treatment T_{10}, which consisted of 50% Recommended Dose of Fertilizer (RDF) + Vermicompost (2.5 t/ha) + Rhizobium + Phosphate Solubilizing Bacteria (PSB). Similarly, treatment T_{10} recorded the highest plant population (24.33) and the greatest plant heights (15.90 cm, 33.07 cm, and 41.07 cm) at 30, 60, and 90 days after sowing (DAS), respectively. Additionally, the maximum number of pods per plant (55) and the highest grain yield (18.77 quintals per hectare) were achieved with treatment T_{10} (50% RDF + Vermicompost (2.5 t/ha) + Rhizobium + PSB).

Keywords: Chickpea, *Cicer arietinum*, organic fertilizer, inorganic fertilizer, vermicompost

Introduction
Pulses are a vital nutritional resource for billions globally, providing essential proteins and other nutrients. The terms "legumes" and "pulses" are often used interchangeably, though not all legumes qualify as pulses. Beyond their role as a primary protein source for many, pulses enhance soil health and combat climate change through their nitrogen-fixing capabilities. In India, key pulses include Bengal Gram (Desi Chickpea), Pigeon Peas (Arhar/Toor), Green Beans (Moong), Chickpeas (Kabuli Chana), Black Matpe (Urad), Red Kidney Beans (Rajma), Black Eyed Peas (Lobiya), Lentils (Masoor), and White Peas (Matar). Historically, pulses have been a cornerstone of Indian agriculture and diets, often dubbed "the poor man's meat" due to their affordability as a protein source (Mohanty and Satyasai, 2015) [1].

In 2024-25, chickpea (*Cicer arietinum*), a globally important legume, was cultivated on 14.56 million hectares worldwide, yielding 16.22 million tonnes with an average productivity of 1,252 kg/ha. This data is according to FAOSTAT. India dominates, contributing 70% of global chickpea production and occupying 71% of the cultivated area. Other major producers include Australia (12.35%), Myanmar (3.25%), and Ethiopia (2.92%). India's chickpea production surged from 3.85 million tonnes in 2001 to 11.23 million tonnes in 2017, with cultivated area expanding from 5.18 million to 10.56 million hectares, and yields rising from 744 kg/ha to 1,063 kg/ha. Madhya Pradesh leads in India, accounting for 34% of the area and 40% of production (Annual Report 2017-18, Pulses Development Authority). Despite past stagnant yields, India's chickpea imports dropped significantly in 2017-18 (0.590 million tonnes) to supplement domestic supply, with imports primarily from Canada, Australia, Iran, Myanmar, Tanzania, Pakistan, Turkey, and France. India also ranks as the third-largest chickpea exporter, shipping 0.212 million tonnes to countries like the US, UK, Saudi Arabia, UAE, Sri Lanka, and Malaysia (FAO, 2019). This study examines global and national trends in chickpea production, value, and trade, focusing on area, yield, and productivity.

Pulses are integral to Indian diets, with chickpeas offering 20-25% protein compared to 8-15% in cereals. Chickpeas are rich in protein, carbohydrates, and minerals, providing 358 calories per

100 grams (Panda, 2006) [2]. Chickpea flour, derived from grinding, is a staple in Indian vegetarian cuisine and confectionery. Tender leaves serve as vegetables, while dried plant parts are used as livestock feed. A leaf exudate, “amb,” containing medicinal oxalic and malic acids, is used to treat intestinal issues, stomach pain, and blood purification. However, chickpea yields in Maharashtra remain low due to limited soil moisture during the rabi season, short winters, and inadequate agricultural practices compared to northern states. Factors such as agronomic, socioeconomic, and environmental constraints contribute to low productivity. The introduction of high-yielding varieties responsive to irrigation and fertilizers necessitates testing with varied field layouts and fertilizer levels. Research indicates that ridge-and-furrow systems outperform flatbed planting for pulses and oilseeds under irrigation, enhancing growth and productivity due to improved soil moisture and aeration (More, 1979) [3]. Growing chickpeas on 90 cm-wide ridges and furrows, based on soil test values, boosts productivity under irrigated conditions (Shinde *et al*., 2000) [4]. Ridge-and-furrow systems significantly improve plant height, branching, dry matter accumulation, pod numbers, and seed weight compared to flatbeds (Jadhav and Pawar, 1999; Karande, 2001; Dhage, 2004) [7, 5, 6].

Materials and Methods

The present study entiT_1ed “Impact of Organic and Inorganic Fertilizer Integration on Chickpea (*Cicer arietinum* L.) Yield and Soil Health” was carried0ut at Agriculture Research Farm, Faculty of Agriculture Sciences and Allied Industries, Rama University, Kanpur during the Rabi season of 2023-24. The pr0perties are measured at different time period at field and laboratory of Rama University. The pr0cedure of material used, experimental procedures and methodology ad0pted are described in this chapter.

Growth parameters

Plant population

Following complete seed emergence, a 10-cm plant-to-plant spacing was maintained. Forty-five days later, the number of plants in each square meter is counted.

Plant height

Five plants had been selected rand0mly from every plot, tagged c0mpletely and used for dimension of plant height. Top of essential shoot i.e., from the floor surface to base of abs0lutely extended leaf became measured by way of meter scale in centimetre. Common plant height at 30, 60, 90 DAS and at harvest degree changed into worked out.

Plant leaves

Five plants had been selected randomly from every plot, tagged c0mpletely and used for counting of plant leaves. Common leaves at 30, 60, 90 DAS and at harvest degree changed into worked out.

Number of branches per plant

The five plants randomly selected and tagged completely in each plot for height determine were used to recorded the number of branches per plant at 30, 60 and 90 DAS, their average was worked out.

Leaf Area Index (LAI)

Leaf area index is the ratio of leaf area to the gr0undarea per plant. Leaf area index was worked out at various stages of plant growth by using the formula

$$LAI = \text{Leaf area per plant } (m^2)/\text{Land area per plant}(m^2)$$

Yield attributes and yield

Number of pods per plants

The randomly selected plants used for recording the height branches and for counting the full range of pods at harvest and their common turned into worked out to d0cument quantity of pods per plant.

Test weight

One thousand seeds were randomly assigned to a sample that was randomly extracted from the fallen and purified product of each piece and its recorded test weight.

Grains yield (qha^{-1})

The overall biomass of each plot become threshed and cleaned, the seeds obtained had been weighed and transformed into quintal per hectare.

Results and Finding

Number of Plant per meter square

The information on the number of plants per meter square was shown in Table 1 at 15 DAS and after harvest. The number of plants per meter square was significantly impacted by various integrated fertilizer management systems. The greatest number of plants per meter square (31.67) was found in treatment T_{10} (50% RDF + Vermicompost (2.5 t/ha) + Rhizobium + PSB), which was substantially different from all other treatments for 15 DAS and comparable to treatment T_9 (75% RDF + Vermicompost (2 t/ha) + Rhizobium + PSB). Treatment T_9 (75% RDF + Vermicompost (2 t/ha) + Rhizobium + PSB) and treatment T_8 (50% RDF + Vermicompost (2.5 t/ha) + PSB) were shown to be significantly equivalent, with 31.33 and 30.67 plants per meter square, respectively. The least plant population per meter (27.67) square was found in Treatment T_1 (Control). At harvest, the largest plant population (24.33) was found in treatment T_{10} (50 percent RDF + Vermicompost (2 t/ha) + Rhizobium + PSB), which was found to be significantly comparable to treatment T_9 (75% RDF + Vermicompost (2 t/ha) + Rhizobium + PSB), which had a plant population of 23.67 per meter square. Apart from that, it was demonstrated that the two therapies were very different from one another.

Plant height (cm)

The plant height data for the crop's 30, 60, and 90 DAS are displayed in 1. The data revealed that treatment T_{10} (50 percent RDF + Vermicompost (2.5 t/ha) + Rhizobium + PSB) produced the highest plant heights (15.90, 33.07, and 41.07 cm) during all growth phases (30, 60, and 90 DAS). The plant height at 30 DAS for the 30 and 90DAS periods was found to be significantly similar, with the exception of the 60DAS period. However, it was discovered that treatment T_{10} (50 percent RDF + Vermicompost (2.5 t/ha) + Rhizobium + PSB) was statistically different from all other treatments during the 60DAS period. At 30, 60, and 90 DAS, the lowest plant heights (14.53, 24.93, and 33.60 cm) were recorded for treatment T_1 (control).

Number of Plant branches

Table 2 shows the information about the number of plant branches for the crop's 30, 60, and 90 DAS. At every stage of chickpea growth, the number of branches per plant progressively rises under all treatments. Due to various integrated management practices, the data revealed that the range of branches per plant was 2.17 to 2.83, 7.8 to 9.9, and 16.2 to 28.1. At all growth phases (30, 60, and 90 DAS), the data showed the highest number of plant branches (2.83, 9.9, and 28.1), respectively, recorded with treatment T_{10} (50 percent RDF + Vermicompost (2.5 t/ha) + Rhizobium + PSB). The plant height at 30 DAS was found to be statistically different at 30 and 90 DAS, but significantly similar for the 60 DAS period. For the 30DAS and 90DAS periods, however, treatment T_{10} (50 percent RDF + Vermicompost (2.5 t/ha) + Rhizobium + PSB) was found to be statistically distinct from all other treatments. Treatment T_2 (100% RDF (18 N+46 P_2O_5 +20 S Kg/ha)) with 98 branches was statistically equivalent to treatment T_{10} for 60 DAS. For treatment T_1 (control), the lowest plant height (2.1, 7.8, 16.2) was measured at 30, 60, and 90 DAS.

Table 1: Effect of INM on pods/plant, grain yield (q/ha), test weight (g) of chickpea

Treatment	Description	Pods/plant	Grain Yield (q/ha)	Test Weight (g)
T_1	Control (No Nutrient Application)	40	9.57	180.6
T_2	100% RDF (18 N +46 P_2O_5 +20 S Kg/ha)	52	17.60	194.2
T_3	75% RDF	49	15.20	184.8
T_4	50% RDF	44	11.40	182.7
T_5	75% RDF + Vermicompost (2 t/ha)	45	12.30	181.4
T_6	50% RDF + Vermicompost (2.5 t/ha)	48	14.80	187.8
T_7	75% RDF + Vermicompost (2 t/ha) + PSB	49	15.60	189.2
T_8	50% RDF+Vermicompost (2.5 t/ha) + PSB	50.3	16.30	192.7
T_9	75% RDF + Vermicompost (2 t/ha) + Rhizobium + PSB	52	17.17	194.8
T_{10}	50% RDF + Vermicompost (2.5 t/ha) +Rhizobium + PSB	55	18.77	195.0
	CD(0.05)	1.054	0.569	1.103
	CV	1.269	2.232	0.341
	SE.m	0.354	0.192	0.371

Table 2: Effect of INM gross cultivation, gross return, net return

Treatment	Description	Cost of cultivation	Gross return	Net return	B:C
T_1	Control (No Nutrient Application)	37409	51037	13628	0.36
T_2	100% RDF (18 N +46 P_2O_5 +20 S Kg/ha)	39932	96140	56304	1.41
T_3	75% RDF	37330	77070	42660	1.14
T_4	50% RDF	37329	76672	42552	1.14
T_5	75% RDF + Vermicompost (2 t/ha)	38861	78552	43652	1.12
T_6	50% RDF + Vermicompost (2.5 t/ha)	39450	83600	44245	1.12
T_7	75% RDF + Vermicompost (2 t/ha) + PSB	39601	88118	48613	1.23
T_8	50% RDF + Vermicompost (2.5 t/ha) + PSB	39741	95352	54460	1.37
T_9	75% RDF + Vermicompost (2 t/ha) + Rhizobium + PSB	40821	97180	56415	1.38
T_{10}	50% RDF + Vermicompost (2.5 t/ha) + Rhizobium + PSB	43334	107203	63869	1.47

References

1. Mohanty S, Satyasai KJ. Feeling the pulse, Indian pulses sector. NABARD Rural pulse. 2015 Jul;10:1-4.
2. Panda UC, Sundaray SK, Rath P, Nayak BB, Bhatta D. Application of factor and cluster analysis for characterization of river and estuarine water systems-a case study: Mahanadi River (India). Journal of hydrology. 2006 Dec 15;331(3-4):434-445.
3. Moré JJ, Sorensen DC. On the use of directions of negative curvature in a modified Newton method. Mathematical Programming. 1979 Dec;16(1):1-20.
4. Shinde U, Inouye M. Intramolecular chaperones: polypeptide extensions that modulate protein folding. InSeminars in cell & developmental biology 2000 Feb 1 (Vol. 11, No. 1, p. 35-44). Academic Press.
5. Singhapakdi A, Karande K, Rao CP, Vitell SJ. How important are ethics and social responsibility?-A multinational study of marketing professionals. European Journal of Marketing. 2001 Feb 1;35(1/2):133-53.
6. Dhage BC. On existence of extremal solutions of nonlinear functional integral equations in Banach algebras. International Journal of Stochastic Analysis. 2004;2004(3):271-282.
7. Eggleton CD, Pawar YP, Stebe KJ. Insoluble surfactants on a drop in an extensional flow: a generalization of the stagnated surface limit to deforming interfaces. Journal of Fluid Mechanics. 1999 Apr;385:79-99.