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Impact of Integrated Nutrient Management on Yield and Nutritional Value of Chickpea (Cicerarietinum L.)

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ABSTRACT
Through a significant focus on nitrogen utilization, pulses, a crucial source of dietary protein, exhibit remarkable potential for soil enrichment and restoration. In India, across an expanse of 23 million hectares, the production of approximately 14.4 million tons of pulse grains is achieved chickpea cultivation and examined nine different treatment combinations on farmer fields.The primary objective was to assess the impact of Integrated Fertilizer Management (IFM) on chickpea yield and overall soil health. The results indicated substantial variations in yield among the different treatments. Notably, treatments that incorporated intensive interventions exhibited significantly higher chickpea yields. Specifically, Treatment 1 (T1) resulted in the highest grain yield (16.96 quintals/ha), while Treatment 7 (T7) yielded the most straw (32.93 quintals/ha). There was a noticeable overall increase in both grain and straw yields post-treatment application. In terms of soil pH, Treatment 2 (T2) had the least impact compared to other treatments. Post-harvest, the average pH was recorded at 7.78, signifying a relatively insignificant change from the initial pH value of 7.81. This suggests that the soil maintained a relatively stable pH level throughout the experimental period. Both soil organic carbon (OC) and electrical conductivity (EC) were influenced by the applied treatments. While the primary OC in Integrated Nutrient Management (INM) strategies remained relatively stable, there was a significant shift in OC levels at the harvest stage. This could suggest that despite variations during the crop cycle, the overall OC content of the soil was maintained in INM-treated plots.
Following grain harvest, there were notable discrepancies in nitrogen content among the treatments. Treatment 1 (T1) exhibited a significantly higher nitrogen fixation of approximately 3.4% (7%), as opposed to the control treatment with a nitrogen content of only 3.13%. Phosphorus content in the grain samples varied within a range of 0.375% to 0.422% across the Integrated Plant Nutrient Systems (IPNS) treatments. While Treatment 9 (T9) grain displayed a higher potassium (K) content compared to Treatment 2 (T2) grain, Treatment 1 (T1) grain contained the highest concentration of phosphorus. Additionally, all treated plots demonstrated a considerable increase in sulfur content, aligning with traditional agricultural practices. Treatment 8 (T8) had the highest sulfur concentration, surpassing the control by 34.29%. Notably, straw exhibited abundant nitrogen content, with Treatment 7 (T7) displaying the highest accumulation at 7.7 kg/ha. Covering an area of approximately 23 million hectares, India produces about 14.4 million tons of pulse grains. Among pulse crops, chickpea (Cicerarietinum L.) stands out due to its high protein content and adaptability as a food grain. Chickpeas are cultivated on 7.1 million hectares, constituting 30.9% of the total area and contributing to 39.9% of total pulse production. With a yield of 26.6 lakh tons/ha and an average productivity of 931 kg/ha, Madhya Pradesh emerges as the leading chickpea producer in the country, cultivating over 28.62 lakh hectares.
The significant increase in agricultural productivity owes much to the adoption of synthetic fertilizers and high-yielding crop varieties. However, an overreliance on synthetic fertilizers, coupled with neglect of organic matter, has led to long-term issues including deficiencies in secondary and micronutrients. These deficiencies have consequently impacted crop efficiency, soil health, and the symbiotic relationships between plants and soil microorganisms, such as root nodulation and mycorrhizal associations.

Keywords: Chickpea, integrated nutrient management, yield, INM

I. INTRODUCTION

Chickpea is scientifically known as(Cicerarietinum L.), is a versatile and nutritious legume that has been cultivated for thousands of years. It holds a prominent place in various cuisines around the world and is cherished for its taste, texture and health benefits. Chickpeas belong to the Fabaceae family and are commonly referred to as Garbanzo beans in some regions.

Pulses are important source of dietary protein and have unique property of maintaining and restoring soil fertility through biological nitrogen fixation by virtue of their deep root system and leaf fall. India grows nearly 23 million hectare, pulse crops and produces nearly 14.4 million tonnes of pulse grains. Originating in the Mediterranean and middle Eastern regions, Chickpeas have a rich history dating back to ancient civilizations. Chickpeas are edible seeds and have high nutritional value and vital contribution to global food security, also played a significant role in the diets of ancient cultures. However, foliar applications of nutrients to chickpea plants can have a significant impact on their growth, development and overall health.

It is one of the oldest cultivated crops, with origins in the Middle East. Chickpea is widely grown and consumed around the world due to its high nutritional value and versatility in various culinary applications. Chickpea seeds are a rich source of protein, dietary fiber, vitamins (such as B vitamins and folate), and minerals (iron, magnesium, potassium, and zinc). They are a staple in many traditional cuisines and are used to make dishes like hummus, soups, curries, and salads.

Integrated Nutrient Management (INM) refers to the practice of combining various sources of nutrients, such as organic and inorganic fertilizers, along with proper cultural practices to optimize nutrient availability to crops while maintaining soil health and sustainability. INM aims to enhance crop productivity, reduce nutrient imbalances, and minimize environmental impacts. INM involves the judicious use of both organic and inorganic fertilizers, considering the crop's nutrient requirements and the specific characteristics of the soil. Here are some components of integrated nutrient management in chickpea cultivation. Before implementing any nutrient management strategy, it's essential to conduct soil tests to determine the soil's nutrient status. This helps in identifying nutrient deficiencies and guiding the appropriate nutrient application.

Incorporating organic matter into the soil through practices like crop residue incorporation, green manuring, and composting can improve soil structure, water-holding capacity, and nutrient availability. Based on soil test results and crop nutrient requirements, balanced application of inorganic fertilizers (nitrogen, phosphorus, and potassium) can be carried out. However, excessive use should be avoided to prevent nutrient imbalances and environmental pollution. Adequate micro-nutrients like zinc, boron, and iron are crucial for chickpea growth. INM should consider these micronutrients, especially in areas where their deficiency is common. Beneficial microorganisms like rhizobium bacteria that form symbiotic relationships with chickpea plants can enhance nitrogen fixation. This reduces the reliance on synthetic nitrogen fertilizers. Integrating chickpea into a well-planned crop rotation can help break pest and disease cycles, improve soil health, and optimize nutrient utilization. Implementing conservation practices like minimum tillage and mulching can help retain soil moisture, reduce erosion, and maintain nutrient availability. Regular monitoring of crop growth and nutrient levels is essential to make timely adjustments in nutrient management practices based on observed results.

Integrated nutrient management in chickpea cultivation aims to optimize yield, improve soil health, and minimize the environmental impact of nutrient application. It's a holistic approach that takes into account both the crop's nutritional needs and the long-term sustainability of farming systems. Integrated nutrient supply, use or management systems involve efficient and judicious supply of all the major components of plant nutrients sources. Chemical fertilizers in conjunction with animal manures, compost, FYM, legume in cropping systems, biofertilizers, crop residues or waste recycle and other locally available nutrient sources are used for sustaining soil fertility, health and productivity. Integrated supply and use of plant nutrients from chemical fertilizers and organic manures produce higher crop yield than their individual application (Aeswar et al., 2003). A significant improvement in yield and biological nitrogen fixation due to Rhizobium inoculation has been reported in chickpea (Khurana and Dudeja, 1981).

The introduction of efficient phosphate solubilizers (Bacillus megaterium, Pseudomonas striata and Bacillus polymyxa) in the rhizosphere of crops and soils has reported to increase the availability of P from insoluble sources. (Gosh, 1998).

Vermicompost is a good source of plant nutrients having both major as well as micronutrients. Since the information on the effect of Rhizobium and phosphate solublizing microbial inoculants and vermicompost in conjunction with chemical fertilizers is very meager.

II. MATERIALS AND METHODS

The experiment was conducted in Village Gangrar of Chittorgarh District of Rajasthan in Mewar University Agriculture Farm.The soil of the experimental field was black in texture, poor in fertility in respect of available nitrogen and organic carbon and medium in respect of available phosphorus and available potassium. Soil was slightly alkaline in reaction (pH 7.70).

Details of treatment:

Treatments	**Description**
T1	Control
T2	100% RDF (Irrigated)(20:60:20)
T3	75%RDF + FYM 3 t/ha
T4	75% RDF + Vermicompost 1.5 t/ha
T5	75% RDF + FYM 2.5 t/ha + PSB
T6	50% RDF + Vermicompost 1.5 t/ha + PSB
T7	75% RDF + Vermicompost (2 t/ha) +PSB
T8	75% RDF + Vermicompost (1.5 t/ha) + Rhizobium
T9	50% RDF + FYM 2.5 t/ha + Rhizobium

ExperimentalDetail	
1. ExperimentalDesign	Randomized Block Design
2. No. of treatment combinations	9
3. No.ofreplications	Three
4. Total no.plots	27
5. Grossplotsize	$3.5m \times 2.5m^2$
6. Net plotsize	$3 \times 2m^2$
7. Spacing	30cm×10cm
8. Crop	Chickpea
9. Variety	RSG-963
10. Season	*Rabi*-2022-23

ExperimentalLayout

Main Irrigation Channel				
R-I	**Sub-Irrigation channel**	**R-II**	**Sub-Irrigation channel**	**R-III**
T1		T2		T2
T2		T5		T5

T3		T9		T8
T4		T7		T4
T5		T1		T9
T6		T3		T6
T7		T2		T3
T8		T6		T7
T9		T8		T1

Agronomic practice and Management

In this Unique experiment, a tractor was initially employed to create a well prepared seed bed. Stubble picking and harrowing was done to maintain the soil tilthupto fine condition. The fertilizers were then carefully measured even across designated area following given instructions. On October 28, 2022, the planting phase commenced, where 80 kg per hectare of specially treated RSG-963 chickpea seeds were sown.

III. RESULTS AND DISCUSSION

The research was done under the Chittorgarh town under Gangrar village in a University field, a research was done by using twelve remarkable treatment mixes, comparative medications were used in the assessment of

Table 1.Mean plant height (cm) as influenced periodically by INM treatments

		Mean plant height (cm)			
Treatments		30 DAS	60 DAS	90 DAS	At harvest
T1	Control	18.84	28.46	39.08	42.56
T2	100% RDF (Irrigated)(20:60:20)	19.24	37.24	48.11	52.67
T3	75%RDF + FYM 3 t/ha	19.14	39.16	50.71	54.29
T4	75% RDF + VC 1.5 t/ha	18.76	36.04	47.32	51.6
T5	75% RDF + FYM 2.5 t/ha + PSB	19.38	38.76	50.22	54.45
T6	50% RDF + VC 1.5 t/ha + PSB	18.74	37.48	46.84	51.68
T7	75% RDF + VC (2 t/ha) +PSB	20.08	40.16	52.44	56.88
T8	75% RDF + VC (1.5 t/ha) + Rhizobium	19.24	38.48	48.11	52.24
T9	50% RDF + FYM 2.5 t/ha + Rhizobium	19.58	39.16	49.84	53.46
	SE(m) ±	0.14	1.17	1.27	1.33
	CD at 5%	NS	NS	NS	NS
	CV	2.24	9.42	7.95	7.62

4.1 Mean relative growth rate (g g-1 day-1 plant-1) of chickpea as influenced by various INM treatments

		Mean relative growth (g g^{-1} $day^{-1)}$			
Treatment		30 DAS	30-60 DAS	60-90 DAS	90- Harvest
T1	Control	0.031	0.239	0.147	0.052
T2	100% RDF (Irrigated)(20:60:20)	0.032	0.277	0.168	0.058
T3	75%RDF + FYM 3 t/ha	0.030	0.278	0.188	0.069
T4	75% RDF + VC 1.5 t/ha	0.032	0.268	0.165	0.056
T5	75% RDF + FYM 2.5 t/ha + PSB	0.031	0.267	0.172	0.059
T6	50% RDF + VC 1.5 t/ha + PSB	0.035	0.269	0.174	0.059
T7	75% RDF + VC (2 t/ha) +PSB	0.038	0.326	0.19	0.07
T8	75% RDF + VC (1.5 t/ha) +	0.033	0.269	0.184	0.068

	Rhizobium				
T9	50% RDF + FYM 2.5 t/ha + Rhizobium	0.034	0.268	0.182	0.066
	SE(m) ±	0.03	0.01	0.009	0.002
	CD at 5%	NS	NS	NS	NS
	G.M.	0.032	0.277	0.167	0.057
	CV	7.52	8.31	7.76	10.45

4.1 Mean number of pods plant-1, weight of pods plant- 1 (g), grain yield plant-1 (g) and 100 seed weight (g) as influenced by various INM treatments

Treatment		No. of pods plant-1	Weight of pods plant-1 (g)	Grain yield plant-1 (g)	100 seed weight (g
T1	Control	61.89	20.78	19.04	26.78
T2	100% RDF (Irrigated)(20:60:20)	69.06	25.88	24.2	28.2
T3	75%RDF + FYM 3 t/ha	73.56	28.23	26.87	29.49
T4	75% RDF + VC 1.5 t/ha	67.31	25.03	23.23	27.46
T5	75% RDF + FYM 2.5 t/ha + PSB	68.54	26.22	23.8	28.2
T6	50% RDF + VC 1.5 t/ha + PSB	70.26	27.32	25.12	28.42
T7	75% RDF + VC (2 t/ha) +PSB	74.36	28.34	28.14	30.36
T8	75% RDF + VC (1.5 t/ha) + Rhizobium	72.18	28.19	27.94	29.12
T9	50% RDF + FYM 2.5 t/ha + Rhizobium	73.13	28.23	28.02	29.64
	SE(m) ±	1.3	0.82	0.99	2.76
	CD at 5%	NS	NS	NS	NS
	CV%	5.58	9.3	11.2	3.7

4.1 Mean number of branches plant-1 as influenced periodically by various treatments

		Mean No. of branches per plant			
Treatment		30 DAS	60 DAS	90 DAS	At harvest
T1	Control	3.41	6.58	8.31	8.42
T2	100% RDF (Irrigated)(20:60:20)	3.44	7.52	9.51	9.64
T3	75%RDF + FYM 3 t/ha	3.44	8.13	10.13	10.22
T4	75% RDF + VC 1.5 t/ha	3.42	7.15	9.27	9.38
T5	75% RDF + FYM 2.5 t/ha + PSB	3.48	7.9	10.23	10.32
T6	50% RDF + VC 1.5 t/ha + PSB	3.46	8.06	10.12	10.23
T7	75% RDF + VC (2 t/ha) +PSB	3.92	8.82	10.51	10.61
T8	75% RDF + VC (1.5 t/ha) + Rhizobium	3.42	7.84	9.88	10.00

T9	50% RDF + FYM 2.5 t/ha + Rhizobium	3.49	8.02	10.18	10.28
	SE(m) ±	0.05	0.21	0.22	0.22
	CV%	4.59	8.21	6.88	6.75

4.1 Effect of INM treatments on Biological yield and Harvest Index

	Yield q ha-1				**Harvest index (%)**
Treatment		**Grain**	**Straw**	**Biological**	
T1	Control	15.02	25.53	40.55	37.04
T2	100% RDF (Irrigated)(20:60:20)	17.33	29.46	46.79	37.03
T3	75%RDF + FYM 3 t/ha	19.23	36.54	55.77	34.48
T4	75% RDF + VC 1.5 t/ha	17.13	28.41	44.54	37.61
T5	75% RDF + FYM 2.5 t/ha + PSB	18.22	32.54	50.76	35.89
T6	50% RDF + VC 1.5 t/ha + PSB	19.34	36.85	56.19	34.41
T7	75% RDF + VC (2 t/ha) +PSB	20.87	38.54	59.41	35.12
T8	75% RDF + VC (1.5 t/ha) + Rhizobium	18.68	35.40	54.08	34.54
T9	50% RDF + FYM 2.5 t/ha + Rhizobium	19.53	36.12	55.65	35.09
	CV	9.28	13.55	12.23	3.05
	SE(m) ±	0.57	1.75	2.3	0.72
	CD at 5%	NS		NS	NS

4.1 Effect of various treatment of INM on the yield of chickpea grain and straw

Treatment	**Description**	Grain yield(q/ha)	Straw yield (q/ha)
T1	Control	15.34	21.92
T2	100% RDF (Irrigated)(20:60:20)	16.34	26.4
T3	75%RDF + FYM 3 t/ha	16.00	21.87
T4	75% RDF + VC 1.5 t/ha	18.42	28.66
T5	75% RDF + FYM 2.5 t/ha + PSB	15.43	25.82
T6	50% RDF + VC 1.5 t/ha + PSB	19.62	30.83
T7	75% RDF + VC (2 t/ha) +PSB	20.64	32.93
T8	75% RDF + VC (1.5 t/ha) + Rhizobium	18.33	31.22
T9	50% RDF + FYM 2.5 t/ha + Rhizobium	19.18	29.88
	CD (0.05)	3.97	6.26
	CV	11.10	14.42
	SE(m) ±	0.95	1.46

Effect of treatments on soil pH

Treatment	**Nutrient Management Practice**	**Initial Value**	**Post Harvest Value**
T1	Control	7.71	7.68
T2	100% RDF (Irrigated)(20:60:20)	7.82	7.83
T3	75%RDF + FYM 3 t/ha	7.85	8.03
T4	75% RDF + VC 1.5 t/ha	7.81	7.86
T5	75% RDF + FYM 2.5 t/ha + PSB	7.81	7.61
T6	50% RDF + VC 1.5 t/ha + PSB	7.83	7.64
T7	75% RDF + VC (2 t/ha) +PSB	7.84	7.78
T8	75% RDF + VC (1.5 t/ha) + Rhizobium	7.82	7.83
T9	50% RDF + FYM 2.5 t/ha + Rhizobium	7.78	7.82
	CD (0.05)	NS	NS
	CV	0.53	1.66
	S E.m	0.01	0.04

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Effect of treatments on soil EC

Treatments	Nutrient Management Practice	Initial Value	Post Harvest value
T1	Control	7.71	0.15
T2	100% RDF (Irrigated)(20:60:20)	7.82	0.16
T3	75%RDF + FYM 3 t/ha	7.85	0.19
T4	75% RDF + VC 1.5 t/ha	7.81	0.17
T5	75% RDF + FYM 2.5 t/ha + PSB	7.81	0.18
T6	50% RDF + VC 1.5 t/ha + PSB	7.83	0.14
T7	75% RDF + VC (2 t/ha) +PSB	7.84	0.16
T8	75% RDF + VC (1.5 t/ha) + Rhizobium	7.75	0.16
T9	50% RDF + FYM 2.5 t/ha + Rhizobium	7.79	0.15
	CD (0.05)	NS	NS
	CV	0.58	9.64
	S E.m	0.02	0.01

Effect of treatments on soil Organic Carbon

Treatments	Nutrient Management Practice	Initial Value	Post Harvest value
T1	Control	0.64	0.63
T2	100% RDF (Irrigated)(20:60:20)	0.66	0.68
T3	75%RDF + FYM 3 t/ha	0.66	0.66
T4	75% RDF + VC 1.5 t/ha	0.66	0.67
T5	75% RDF + FYM 2.5 t/ha + PSB	0.65	0.65
T6	50% RDF + VC 1.5 t/ha + PSB	0.68	0.7
T7	75% RDF + VC (2 t/ha) +PSB	0.70	0.73
T8	75% RDF + VC (1.5 t/ha) + Rhizobium	0.69	0.71
T9	50% RDF + FYM 2.5 t/ha + Rhizobium	0.67	0.68
	CD (0.05)	3.16	4.95
	CV	2.88	4.57
	S E.m	0.01	0.01

Effect of treatments on the available soil nitrogen (kg/ha)

Treatments	Nutrient Management Practice	Initial Value	Post Harvest value
T1	Control	215.2	210.82
T2	100% RDF (Irrigated)(20:60:20)	219.6	220.37
T3	75%RDF + FYM 3 t/ha	218.3	212.37
T4	75% RDF + VC 1.5 t/ha	222.5	230.35
T5	75% RDF + FYM 2.5 t/ha + PSB	219.6	227.4

T6	50% RDF + VC 1.5 t/ha + PSB	224.34	230.32
T7	75% RDF + VC (2 t/ha) +PSB	225.45	232.3
T8	75% RDF + VC (1.5 t/ha) + Rhizobium	223.18	230.11
T9	50% RDF + FYM 2.5 t/ha + Rhizobium	220.88	227.88
	CD (0.05)	2.06	3.97
	CV	1.46	3.63
	S E.m	1.07	2.72

Effect of treatments on the available soil phosphorus kg/ha

Treatments	Nutrient Management Practice	Initial Value	Post Harvest Value
T1	Control	11.5	11.45
T2	100% RDF (Irrigated)(20:60:20)	12.3	12.85
T3	75%RDF + FYM 3 t/ha	12.1	12.2
T4	75% RDF + VC 1.5 t/ha	11.4	13.1
T5	75% RDF + FYM 2.5 t/ha + PSB	12.8	12.9
T6	50% RDF + VC 1.5 t/ha + PSB	12.4	13.72
T7	75% RDF + VC (2 t/ha) +PSB	13.02	14.7
T8	75% RDF + VC (1.5 t/ha) + Rhizobium	12.99	14.20
T9	50% RDF + FYM 2.5 t/ha + Rhizobium	13.00	13.89
	CD (0.05)	NS	NS
	CV	5.07	7.69
	S E.m	0.21	0.34

Effect of treatments on the available soil potassium

Treatments	**Nutrient Management Practice**	Initial Value	Post Harvest Value
T1	Control	370	375
T2	100% RDF (Irrigated)(20:60:20)	380	403
T3	75%RDF + FYM 3 t/ha	400	380
T4	75% RDF + VC 1.5 t/ha	375	398
T5	75% RDF + FYM 2.5 t/ha + PSB	389	390
T6	50% RDF + VC 1.5 t/ha + PSB	360	410
T7	75% RDF + VC (2 t/ha) +PSB	420	426
T8	75% RDF + VC (1.5 t/ha) + Rhizobium	400	408
T9	50% RDF + FYM 2.5 t/ha + Rhizobium	387	395
	CD (0.05)	NS	NS
	CV	4.7	4.78
	S E.m	6.06	6.32

Effect of treatments on the nutrient content in grain

Effect of different treatments on the uptake of nutrient N, P, K and S in grain

Treatment code	Treatment	N	P	K	S
T1	Control	38.62	4.62	9.88	3.46
T2	100% RDF (Irrigated)(20:60:20)	48	5.86	12.13	4.31
T3	75%RDF + FYM 3 t/ha	54.05	6.66	14.06	5.59
T4	75% RDF + VC 1.5 t/ha	60.6	7.55	7.55	6.3
T5	75% RDF + FYM 2.5 t/ha + PSB	49.83	6.29	13.3	5.26
T6	50% RDF + VC 1.5 t/ha + PSB	65.72	8.12	8.12	7.08
T7	75% RDF + VC (2 t/ha) +PSB	74.74	9.06	10.06	8.1
T8	75% RDF + VC (1.5 t/ha) + Rhizobium	70.85	7.89	8.25	6.45
T9	50% RDF + FYM 2.5 t/ha + Rhizobium	72.58	7.55	10.15	7.88
	Mean	55.85	6.88	10.73	5.73
	SE-m±	1.3	0.87	1.18	0.51
	CD at 5%	2.77	1 .83	2.48	1 .35

Effect of various treatments on Protein Content chickpea grain

Treatment code	**Treatments**	**Protein content in Grain (%)**
T1	Control	19.69
T2	100% RDF (Irrigated)(20:60:20)	23.71
T3	75%RDF + FYM 3 t/ha	21.42
T4	75% RDF + VC 1.5 t/ha	21.67
T5	75% RDF + FYM 2.5 t/ha + PSB	21.79
T6	50% RDF + VC 1.5 t/ha + PSB	23.96
T7	75% RDF + VC (2 t/ha) +PSB	24.15
T8	75% RDF + VC (1.5 t/ha) + Rhizobium	20.51
T9	50% RDF + FYM 2.5 t/ha + Rhizobium	21.56
	SEm+	3.92
	Cd (P = 0.05)	19.69
	CV (%)	23.71

IV. CONCLUSION

The growth yield and quality parameters were recorded to evaluate the treatment effect on the available nutrient status determined at initial and after harvest of crop, pH, OC, EC, NPK and S wererecorded for interpretation of the effect of treatment schedule on the frame objectives.

Though there was no significant difference in the initial and after harvest samples but observed. However, the EC was higher recorded due to treatment having 0.19 dSm-1 with T5 (75% RDF + FYM 2.5t/ha + PSB @ 4 kg ha-1).

The maximum OC 0.73% was recorded after the harvest of the crop. The highest content of N, P, K and S was found to be significant due to the treatment T7 (75% RDF + Vermicompost @ 3.5 t/ha + PSB @ 4 kg ha-I) having recorded 3.47, 0.42 and 0.88 per cent N, P and K in grain and 0.52, 0.166 and 1.0 per cent N, P and K in straw respectively. Similarly the uptake of N and P by grain was 74.74 and 9.06 kg/ha respectively due to treatment T7 while 14.06 kg/ha K was recorded in grain due to treatment T3 (75% RDF + FYM 3 @ t ha^{-1}) while the N, P and K uptake (50% RDF + VC @ 2 t ha-I+ PSB) while the N, P and K uptake in straw as found to be maximum due to treatment T7 having 17.1 1, 5.46 and 39.92 kg $ha^{-1}$of N, P and K respectively. The protein content in chickpea grain was also found to be maximum (22.68%) due to the T7 treatment.The grain and straw yield was also influenced significantly due to T7 treatment yielding highest of 21.54 and 32.95 q ha^{-1}, respectively.

Conclusively it can be stated that the results due to various organic and inorganic treatments reveals that the yield of chickpea grain is highly influenced by RDF alone and its integration with organic sources. Significantly over control the 75% RDF incorporated with vermicompost and PSB has resulted maximum yield.

Credit authorship contribution statement

Ishfaq Ahmad Rather, Gautam Singh Dhaked: Conceptualization, Methodology, Data Curation, Writing Original draft.

Gautam Singh Dhaked; Review and Supervision.

Declaration of Competing Interest

The authors declare no conflict of interest.

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