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Evaluate the performance of organic and inorganic fertilizers on growth and yield of chickpea (*Cicer arietinum* L.)

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Abstract
A field experiment was conducted at the Agriculture Research Farm, Bhagwant University, Ajmer, Rajasthan, India, during rabi seasons of 2020-21 and 2021-22. There were Ten treatments imposed in chickpea *viz*., T_1- Control, T_2- Farmers practice (50 kg DAP ha^{-1}), T_3- RDF, T_4- FYM @ 10 tha^{-1}, T-$_5$ Vermicompost @5 tha^{-1}, T_6- RDF + FYM @ 5 tha^{-1}, T_7- RDF + Vermicompost @ 5 tha^{-1}, T_8- 75% RDF + FYM@ 2.5 tha^{-1} + Vermicompost @ 1.0 tha^{-1}, T_9- 50% RDF + FYM@ 5 tha^{-1} + Vermicompost @ 2.5 tha^{-1}, T_{10}- 25% RDF + FYM @ 10 tha^{-1} + Vermicompost @ 5.0 tha^{-1}. These treatments were evaluated replicated Three times in randomized block design. Application of 75% RDF + FYM@ 2.5 tha^{-1} + Vermicompost @ 1.0 tha^{-1} (T_8) recorded significantly higher almost all the growth attributes *viz*., plant height, number of branches per plant, dry matter accumulation per plant, volume of nodules per plant, yield attributes and yield *viz*., number of pods per plant, seed index, seed yield per plant, seed yield, stover yield as well as available nutrient status in soil over the control and farmer's practice. The least vales were recorded under the control treatment where no fertilizer was used.

Keywords: Chickpea, RDF, organic, inorganic, yield, yield attributes

Introduction

Gram or Chickpea (*Cicer arietinum* Linnaeus), a member of family Fabaceae, is an ancient self-pollinated leguminous crop, diploid annual (2N=16 chromosomes) grown since 7000BC, in different area of the world but its cultivation is mainly concentrated in semi-arid environments. It is ranked 3rd after common bean (*Phaseolus vulgaris* L.) and pea (*Pisum sativum* L.) and known with different regional names like Dzelbana or Hamas (Arabic), Keker (Dutch), Bengal Gram (English), Cafe Franzais (Franch), Kichererbse (German), Garbanzo (Spanish), Cece, Ceci (Roman), Ovetichie harokh (Russian), Shimbra, (Ethiopia) Lablabi, (Turkey) and locally 'chana'.

Pulses as a candidate crop, contributes immensely towards doubling farmers' income through diminishing cost of production, scaling per unit productivity, efficient marketing networks and successful technology delivery mechanisms by giving emphasis sustainable intensification and crop diversification, climate resilient production technologies backed with strong research outputs in pulses can contribute towards doubling the farmers' income (Singh, 2018) [14].

Chickpea (*Cicer arietinum* L.) is an important pulse crop grown and consumed all over the world. It is a good source of vitamins such as riboflavin, niacin, thiamin, folate, a precursor, β-carotene and the protein quality is considered to be better than other pulses. Chickpea is rich in nutritionally important unsaturated fatty acids like linoleic and oleic acid.

In India, it is the premier food legume crop covering out 9.85 Mha area with a production of 11.08 Mt and productivity of 1142 kg ha^{-1} (DAC&FW. 2021) [5]. While in Rajsthan, chickpea is grown in an area of 10.76 million hectares producing 11.16 million tonnes with the productivity of 1037 kg/ha.

The basic concept of integrated nutrient management (INM) is the maintenance of soil fertility and supply plant nutrients to an optimum level for sustaining the desired crop productivity through optimization of benefits from all possible sources of plant nutrients in an integrated manner. Nitrogen, phosphorus and biofertilizers like rhizobium and phosphate solubilizing bacteria play a vital role in the nutrition of plants. In fact, these fertilizer nutrients are lacking mostly in the soils. Fertility analysis of Indian soils has indicated that the soils are deficient in micro-organisms and nutrients. Therefore, application of biofertilizers and inorganic fertilizers becomes essential to raise the crop yield.

Rhizobium has an enormous potential to fix atmospheric nitrogen. Phosphate solubilizing bacteria (PSB) solubilize the unavailable bound phosphates of the soil and make them available to plants which increase overall plant growth resulting in 10 to 15% increase in yield.

Materials and Methods

The present field investigation entitled *"*Evaluate the performance of organic and inorganic fertilizers on growth and yield of chickpea (*Cicer arietinum* L.).*"* was conducted during *Rabi* season 2020-21 and 2021-22 at Agriculture research farm of Bhagwant University, Ajmer, Rajasthan. The experimental site falls under subtropical region in Rajasthan and situated at 24.40-26.470 N latitude and 82.120-83.980 E longitude at an altitude of 113 meters from, mean sea level. The total rainfall during course of experimentation was 17.5 and 9.8 mm in 2020-21 and 2021-22 respectively. The winter months are cold and occasionally frost occurs during this period. The maximum Temperature 39.6 was recorded in 18^{th} meteorological week during 2020-21 and 39.2 °C in 16^{th} meteorological week during 2021-22.

The soil of experimental field was Sandy loam in texture and low in organic carbon (0.37%) and available nitrogen (228.20 kg/ha), medium in available phosphorus (13.07 kg/ha), Medium in available potassium (173.76 kg/ha) and slightly alkaline in reaction (pH 8.23). There were Ten treatments imposed in chickpea *viz*., T_1- Control, T_2- Farmers practice (50 kg DAP ha^{-1}), T_3- RDF, T_4- FYM @ 10 tha^{-1}, T-$_5$ Vermicompost @5 tha^{-1}, T_6- RDF + FYM @ 5 tha^{-1}, T_7- RDF + Vermicompost @ 5 tha^{-1}, T_8- 75% RDF + FYM @ 2.5 tha^{-1} + Vermicompost @ 1.0 tha^{-1}, T_9- 50% RDF + FYM @ 5 tha^{-1} + Vermicompost @ 2.5 tha^{-1}, T_{10}- 25% RDF + FYM @ 10 tha^{-1} + Vermicompost @ 5.0 tha^{-1}. These treatments were evaluated replicated Three times in randomized block design. Recommended dose of fertilizer (RDF) for Rabi chickpea is 20 N + 40 P_2O_5 + 00 K_2O kg/ha.

Results and Discussion

A perusal of data (Table 1) showed that plant stand per meter square of chickpea recorded at 15 DAS did not influence significantly due to varying various levels of organic and inorganic sources of nutrients.

It is clear from the data showed that the plant population was recorded highest under the treatment T_8 (75% RDF + FYM@ 2.5 tha^{-1} + Vermicompost @ 1.0 tha^{-1}) followed by T_3 (RDF 20 kg N + 60 kg P_2O_5 + 20 kg K_2O ha^{-1}) i.e. 325.38, 322.66 m^{-2}, and 327.3, 320.3 during both the years respectively. The lowest plant population was observed in control treatment (295.01 m^{-2} and 292.6 m^2). This is in agreement with the findings reported earlier by Jat *et al.* (2012) [7], Tripathi *et al.* (2013) [19], Singh *et al.* (2012) [13] and Singh *et al.* (2017) [15].

The data presented in (Table 2) showed that integrated sources of nutrients had no significant effect on plant height at 20 DAS, while 40, 60 DAS and at harvest, different levels of organic and inorganic sources of nutrients increased the plant height significantly over control. A significant increase in plant height at harvest was observed with the treatment 75% RDF + FYM@ 2.5 tha^{-1} + Vermicompost @ 1.0 tha^{-1} (T_8) 35.0 cm and 35.15 cm as compared to all other treatments during both the year respectively. The application of RDF, 50% RDF + FYM @ 5 tha^{-1} + Vermicompost @ 2.5 tha^{-1} and 25% RDF + FYM @ 10 t ha^{-1} + Vermicompost @ 5.0 tha^{-1} was also significantly superior over rest of the treatments. The lowest plant height was recorded in control treatment (28.87 cm and 29.25 cm) at harvest during both the years. These results are in close agreement with the findings of Asewar *et al.* (2003) [3], Rudesh *et al.* (2005), Alam *et al.* (2009) [1], and Mohod *et al.* (2010) [10].

It is evident from the data given in Table 3 showed that dry matter accumulation g $plant^{-1}$ was influenced significantly by different integrated nutrient management practices at successive crop growth stages of chickpea. The dry matter accumulation g $plant^{-1}$ was found highest with the application of 75% RDF + FYM @ 2.5 tha^{-1} + Vermicompost @ 1.0 tha^{-1} (29.72 g and 30.12 g $plant^{-1}$) followed by RDF and RDF + Vermicompost @ 5 tha^{-1} i.e. (28.43. 28.94 g) and (27.51 g 27.85g), during both the years respectively. These treatments were also significantly superior over rest of the treatments and at par with each other. The lowest dry matter accumulation was observed in control treatment (16.51 g and 16.85 g $plant^{-1}$) during the study period. These results are in agreement with the findings of Singh *et al.* (2019) [16].

It is evident from the data given in Table 4 showed that Leaf area (dm² plant-^{1}) was influenced significantly by different integrated nutrient management practices at successive crop growth stages of chickpea. The Leaf area dm² $plant^{-1}$ at 60 DAS was found highest with the application of 75% RDF + FYM @ 2.5 tha^{-1} + Vermicompost @ 1.0 tha^{-1} (2.54 and 2.59 dm² $plant^{-1}$) followed by RDF + Vermicompost @5 tha-^{1} i.e. (2.48 and 2.51 dm² $plant^{-1}$) during both the years respectively. These treatments were also significantly superior over rest of the treatments. At 90 DAS, all the treatments (T_2 to T_{10}) either receiving Fertilizer/FYM/VC alone or in combination was recorded significantly higher leaf area per plant than absolute control (T_1). The lowest Leaf area (dm² plant-^{1}) was observed in control treatment 2.16 2.15 dm² $plant^{-1}$ at 60 DAS and 2.26 and 2.31 dm² $plant^{-1}$ at 80 DAS during the study period. These results are in close agreement with the findings of Asewar *et al.* (2003) [3], Rudesh *et al.* (2005), Alam *et al.* (2009) [1], and Mohod *et al.* (2010) [10].

The data pertaining to yield attributes *viz*., number of pod $plant^{-1}$, Number of seed $plant^{-1}$, 1000-seed weight (g) of chickpea under main effects of treatments recorded during 2021 and 2022 are given in Table 5. It is clear from the data indicated that number of pod $plant^{-1}$ was influenced significantly by integrated nutrient management practices of chickpea. The number of pod was produced maximum with the application of 75% RDF + FYM @ 2.5 tha^{-1} + Vermicompost @ 1.0 tha^{-1} as compared to all other treatments. The number of pod was also noticed higher with the RDF and 50% RDF + FYM @ 5 tha^{-1} + vermicompost @ 2.5 tha^{-1} i.e. (55.94 and 56.25) and (53.42 and 53.64) during both the years respectively, which was also significantly superior over rest of the treatments during the experimental period. The minimum number of pods was recorded in control treatment (41.38 and 41.42) during both the years. These results are in close conformity with Kumar and Kumar (2008) [21] Ali *et al.* (2010) [2] Poonia and Pithia (2014) [11] as well as Singh *et al.* (2017) [15].

It is perusal from the data given in Table 5 revealed that number of seed $plant^{-1}$ was influenced significantly by various nutrient management practices of chickpea. The number of seed $plant^{-1}$ was observed significantly highest with the application of 75% RDF + FYM @ 2.5 tha^{-1} + Vermicompost @ 1.0 tha^{-1} (16.40 and 16.56) followed by RDF (14.13 and 14.26) which was also significantly superior over control and significantly at par with each other during both the years respectively. The least number of seed plant^{-1} was in control treatment (12.47 and 12.58). These results are in close conformity with Kumar and Kumar (2008) Ali *et al.* (2010) [2] Poonia and Pithia (2014) [11] as well as Singh *et al.* (2017) [15].

It is evident from the data given in Table 5 showed that 100 seed weight (g) was marked with significant variation due to different integrated nutrient management practices of chickpea during the observation. Similarly, Application of 75% RDF + FYM@ 2.5 tha^{-1} + Vermicompost @ 1.0 tha^{-1} (14.45g and 14.52g) was recorded significantly highest 100-seed weight over control treatment (9.97g and 10.12g) during both the years. The application of RDF and 50% RDF + FYM@ 5 tha^{-1} + Vermicompost @ 2.5 tha^{-1} was also observed higher 100-seed weight over rest of the treatments and significantly at par with T_8 (75% RDF + FYM @ 2.5 tha^{-1} + Vermicompost @ 1.0 tha^{-1}) treatment. These results are in close conformity with Kumar and Kumar (2008) [21] Ali *et al.* (2010) [21] Poonia and Pithia (2014) [11] as well as Singh *et al.* (2017) [15].

It is evident from the data given in Table 6 revealed that seed yield was influenced significantly by various nutrient management practices of chickpea. The seed yield was recorded maximum with the application of 75% RDF + FYM @ 2.5 tha^{-1} + Vermicompost @ 1.0 tha^{-1} (20.67 q ha^{-1} and 20.81 q ha^{-1}) as compared to control plot (11.92 q ha^{-1} and 12.10 q ha^{-1}) during both the years respectively. Application of RDF and 50% RDF + FYM @ 5 tha^{-1} + Vermicompost @ 2.5 tha^{-1} was also significantly superior over rest of the treatment in respect of seed yield and significantly at par with T_8. The results corroborated the findings of Asewar *et al.* (2003) [3], Tigga *et al.* (2004) [22], Wandkhekar *et al.* (2005), Billore *et al.* (2009) [23] and Thenua *et al.* (2010) [24].

Effect of integrated nutrient management on straw yield was found significant and the maximum straw and biological yield was obtained in 75% RDF + FYM @ 2.5 tha^{-1} + Vermicompost @ 1.0 tha^{-1} during both the year, respectively. The results are in close agreement with the findings of Tomar and Khajanji (2009) [18], Chaturvedi *et al.* (2010) [4], Gajbhiye *et al.* (2011) [6] and Koushal and Singh (2011) [8].

Integrated nutrient management did not influence the harvest index. The maximum harvest index was recorded with the application of 75% RDF + FYM @ 2.5 tha^{-1} + vermicompost @ 1.0 tha^{-1} it may be due to better availability of nutrients in the soil and source – sink relationship, resulting in higher production of photosynthates and increased translocation to reproductive parts and increase the yield thus resulting higher harvest index. The results are in close agreement with the findings of Tomar and Khajanji (2009) [18], Chaturvedi *et al.* (2010) [4], Gajbhiye *et al.* (2011) [6] and Koushal and Singh (2011) [11].

It is perusal from the data given in Table 7 showed that cost of cultivation was higher under the treatment T_{10} (Rs 28257.00 and 28564.00 ha^{-1}) which received 25% RDF + FYM@ 10 tha^{-1} + Vermicompost @ 5.0 tha^{-1} doses followed by T_7 (Rs 24606.00 and 24853.00 ha^{-1}) and T_9 (Rs 24456.00 and 24754.00 ha^{-1}), respectively during the observation period. The lowest cost of cultivation was noticed in control (Rs 19307.00 and 19850.00 ha^{-1}) treatment during both the years, respectively. These results are in conformity with those observed by Kumar *et al.* (2014) [9] and Singh *et al.* (2019) [16].

It is clear from the data given in Table 7 was indicate that gross return in respect of chickpea crop was recorded maximum Rs (123112.00 and 123751 ha^{-1}) with the application of 75% RDF + FYM @ 2.5 tha-1 + Vermicompost @ 1.0 tha-^{1} (T_8) followed by T_6 and T_7, respectively during the both the year respectively. The least value of gross return was recorded with control plot (Rs 71491.00 and 71751.00 ha^{-1}) during both the years, respectively. These results are in conformity with those observed by Kumar *et al.* (2014) [9] and Singh *et al.* (2019) [16].

It is evident from the data showed that highest net return was found with the application of 75% RDF + FYM@ 2.5 tha^{-1} + Vermicompost @ 1.0 tha^{-1} (T_8) Rs 100506.00 and 101214.00 ha^{-1} as compared to control treatment (Rs 52184.00.00 and 52658.00 ha^{-1}). The treatment T_3 (Rs 93779.00 and 94120.00 ha^{-1}) and T_7 (Rs 89776.00 and 90215.00 ha^{-1}) was also recorded higher as compared to other treatments during both the years, respectively. These results are in conformity with those observed by Kumar *et al.* (2014) [9] and Singh *et al.* (2019) [16].

It is clear from the data given in Table 7 showed that B:C ratio was higher (4.45 and 4.44) with the application of 75% RDF + FYM@ 2.5 tha^{-1} + Vermicompost @ 1.0 tha^{-1} followed by T_3 which received 100% RDF alone (4.44 and 4.43) as compared to treatment T_6 (RDF + Vermicompost @5 tha-^{1}) i.e., 3.86 and 3.82 followed with application of RDF + Vermicompost @ 5 tha^{-1} (3.65 and 3.63) during both the years, respectively. Similar results were also reported by Kumar *et al.* (2017) [15], Kumar *et al.* (2015) [25], Singh *et al.* (2017) [15] and Kumar *et al.* (2018) [26].

Table 1: Effect of integrated nutrient management on plant population (m^{-2}) of chickpea

Treatment Combinations		Plant population m^{-2} 2020	2021
		15 DAS	
T_1	Control	295.01	292.6
T_2	Farmers practice (50 kg DAP ha^{-1})	301.71	302.7
T_3	RDF	322.66	320.3
T_4	FYM @ 10 tha^{-1}	312.38	310.4
T_5	Vermicompost @5 tha^{-1}	309.12	307.8
T_6	RDF + FYM @ 5 tha^{-1}	320.3	321.8
T_7	RDF + Vermicompost @5 tha^{-1}	322.1	324.8
T_8	75% RDF + FYM@ 2.5 tha^{-1} + Vermicompost @ 1.0 tha^{-1}	325.38	327.3
T_9	50% RDF + FYM@ 5 tha^{-1} + Vermicompost @ 2.5 tha^{-1}	321.15	323.04
T_{10}	25% RDF + FYM@ 10 tha^{-1} + Vermicompost @ 5.0 tha^{-1}	316.39	317.4
	SE m ±	7.16	7.46
	CD @ $_{5\%}$	NS	NS

Table 2: Effect of integrated nutrient management on plant height (cm) of chickpea

Treatment Combinations		Plant height (cm)							
		2020	2021	2020	2021	2020	2021	2020	2021
		30 DAS		60 DAS		90 DAS		At harvest	
T_1	Control	18.20	18.0	24.40	24.82	26.93	27.12	28.87	29.25
T_2	Farmer's practice (50 kg DAP ha^{-1})	18.53	18.46	24.27	24.75	27.00	27.24	29.73	30.24
T_3	RDF	20.20	21.20	26.73	27.21	29.40	29.86	34.53	34.95
T_4	FYM @ 10 tha^{-1}	19.33	19.01	25.27	25.49	28.47	28.49	31.93	32.24
T_5	Vermicompost @5 tha^{-1}	18.80	18.73	24.80	25.12	27.13	27.81	31.40	31.86
T_6	RDF + FYM @ 5 tha^{-1}	19.20	19.84	20.23	20.82	28.10	28.65	32.12	33.28
T_7	RDF + Vermicompost @5 tha^{-1}	18.90	19.10	19.45	19.85	27.92	28.31	32.81	33.14
T_8	75% RDF + FYM@ 2.5 tha^{-1} + Vermicompost @ 1.0 tha^{-1}	20.80	21.20	28.07	28.90	29.60	30.75	35.00	35.15
T_9	50% RDF + FYM@ 5 tha^{-1} + Vermicompost @ 2.5 tha^{-1}	19.87	20.12	26.47	27.10	29.20	29.87	33.80	34.21
T_{10}	25% RDF + FYM@ 10 tha^{-1} + Vermicompost @ 5.0 tha^{-1}	19.80	19.98	26.33	27.54	28.60	28.30	32.80	32.95
	SE m ±	0.75	0.82	0.70	1.12	0.63	0.84	1.17	1.26
	CD @ 5%	NS	2.30	2.13	3.13	1.90	2.35	3.56	3.62

Table 3: Effect of integrated nutrient management on dry matter accumulation g plant^{-1} of chickpea

Treatment Combinations		Dry matter accumulation g plant^{-1}							
		2020	2021	2020	2021	2020	2021	2020	2021
		30 DAS		60 DAS		90 DAS		At harvest	
T_1	Control	3.27	3.41	9.04	9.15	13.40	13.59	16.51	16.85
T_2	Farmer's practice (50 kg DAP ha^{-1})	3.65	3.71	10.77	10.89	15.72	15.85	18.62	18.92
T_3	RDF	5.45	3554	16.24	16.43	24.07	24.56	28.43	28.94
T_4	FYM @ 10 tha^{-1}	4.75	484	12.63	12.86	17.47	18.41	20.54	20.85
T_5	Vermicompost @5 tha^{-1}	4.39	4.45	11.90	12.23	16.95	17.84	19.57	19.87
T_6	RDF + FYM @ 5 tha^{-1}	4.65	4.86	12.10	12.25	19.84	20.24	27.12	27.59
T_7	RDF + Vermicompost @5 tha^{-1}	4.78	4.96	12.23	12.45	20.10	20.58	27.51	27.85
T_8	75% RDF + FYM@ 2.5 tha^{-1} + Vermicompost @ 1.0 tha^{-1}	5.93	6.12	16.51	16.75	25.64	26.12	29.72	30.12
T_9	50% RDF + FYM@ 5 tha^{-1} + Vermicompost @ 2.5 tha^{-1}	5.27	5.31	13.58	13.84	20.47	20.89	26.53	26.75
T_{10}	25% RDF + FYM@ 10 tha^{-1} + Vermicompost @ 5.0 tha^{-1}	4.73	4.86	13.19	13.51	18.75	19.12	25.28	25.65
	SE m ±	0.18	0.21	0.95	1.06	1.42	1.58	1.25	1.46
	CD @ 5%	0.55	0.65	2.90	3.56	4.31	4.84	3.78	4.39

Table 4: Effect of integrated nutrient management on Leaf area (dm² plant^{-1}) of chickpea 2020 and 2021

Tr. No.	Treatments imposed to sesame crop	Leaf area (dm² plant^{-1}) 2020			Leaf area (dm² plant^{-1}) 2021		
		30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
T_1	Control	2.00	2.16	2.26	2.03	2.15	2.31
T_2	Farmer's practice (50 kg DAP ha^{-1})	2.10	2.30	2.50	2.11	2.31	2.56
T_3	RDF	2.12	2.34	2.53	2.13	2.36	2.58
T_4	FYM @ 10 tha^{-1}	2.14	2.37	2.57	2.13	2.39	2.61
T_5	Vermicompost @5 tha^{-1}	2.15	2.40	2.59	2.16	2.42	2.65
T_6	RDF + FYM @ 5 tha^{-1}	2.18	2.43	2.63	2.17	2.25	2.69
T_7	RDF + Vermicompost @5 tha^{-1}	2.19	2.48	2.66	2.21	2.51	2.70
T_8	75% RDF + FYM@ 2.5 tha^{-1} + Vermicompost @ 1.0 tha^{-1}	2.20	2.54	2.71	2.22	2.59	2.75
T_9	50% RDF + FYM@ 5 tha^{-1} + Vermicompost @ 2.5 tha^{-1}	2.17	2.42	2.60	2.18	2.44	2.63
T_{10}	25% RDF + FYM@ 10 tha^{-1} + Vermicompost @ 5.0 tha^{-1}	2.08	2.26	2.48	2.12	2.28	2.51
	S.Em.±	0.47	0.07	0.08	0.09	0.11	0.07
	C.D. (0.05)	NS	0.20	0.23	0.26	0.32	0.23

Table 5: Effect of integrated nutrient management on yield attributes of chickpea

Treatment Combinations		Yield attributes					
		No. of pod plant^{-1}		No. of seed/plant^{-1}		100-seed weight	
		2020	2021	2020	2021	2020	2021
T_1	Control	41.38	41.42	12.47	12.58	9.97	10.12
T_2	Farmers practice (50 kg DAP ha^{-1})	45.51	45.81	12.53	12.62	10.52	10.68
T_3	RDF	55.94	56.25	14.13	14.26	13.22	13.41
T_4	FYM @ 10 tha^{-1}	49.88	49.95	12.93	13.12	11.55	11.47
T_5	Vermicompost @5 tha^{-1}	48.02	48.31	12.70	12.88	11.04	11.62
T_6	RDF + FYM @ 5 tha^{-1}	47.57	47.82	12.81	12.92	11.23	11.52
T_7	RDF + Vermicompost @5 tha^{-1}	47.82	47.96	13.02	13.24	11.35	11.41
T_8	75% RDF + FYM@ 2.5 tha^{-1} + Vermicompost @ 1.0 tha^{-1}	59.00	59.51	16.40	16.56	14.45	14.52
T_9	50% RDF + FYM@ 5 tha^{-1} + Vermicompost @ 2.5 tha^{-1}	53.42	53.64	13.93	14.10	12.43	12.46
T_{10}	25% RDF + FYM@ 10 tha^{-1} + Vermicompost @ 5.0 tha^{-1}	49.51	49.84	13.47	13.82	12.25	12.29
	SE m ±	1.27	1.32	0.75	0.81	0.76	0.71
	CD @ 5%	3.86	4.05	2.26	2.51	2.32	2.24

Table 6: Effect of integrated nutrient management on yield (q ha^{-1}) and harvest index (%) of chickpea

Treatment Combinations		Yield (q ha^{-1})							
		Seed yield (q ha^{-1})		Straw yield (q ha^{-1})		Biological yield (q ha^{-1})		Harvest Index (%)	
		2020	2021	2020	2021	2020	2021	2020	2021
T_1	Control	11.92	12.10	21.58	21.84	33.50	33.68	35.63	35.84
T_2	Farmers practice (50 kg DAP ha^{-1})	13.28	13.26	22.46	22.49	35.74	35.82	37.08	37.23
T_3	RDF	19.27	19.34	28.35	28.52	47.62	47.82	40.48	40.56
T_4	FYM @ 10 tha^{-1}	14.74	14.86	23.90	24.12	38.64	38.92	38.07	38.36
T_5	Vermicompost @5 tha^{-1}	14.45	14.52	23.52	23.74	37.96	38.14	37.94	38.21
T_6	RDF + FYM @ 5 tha^{-1}	16.85	16.92	24.56	24.65	45.54	45.69	36.52	36.74
T_7	RDF + Vermicompost @5 tha^{-1}	17.15	17.82	24.95	25.13	45.41	45.72	37.10	37.25
T_8	75% RDF + FYM@ 2.5 tha^{-1} + Vermicompost @ 1.0 tha^{-1}	20.67	20.81	29.50	30.14	50.17	50.49	41.25	41.35
T_9	50% RDF + FYM@ 5 tha^{-1} + Vermicompost @ 2.5 tha^{-1}	18.40	18.56	27.70	27.92	46.10	46.28	39.96	40.21
T_{10}	25% RDF + FYM@ 10 tha^{-1} + Vermicompost @ 5.0 tha^{-1}	17.04	17.24	25.84	25.95	42.89	43.12	39.78	39.89
	SE m ±	1.06	1.12	1.32	1.24	1.57	1.27	2.22	2.41
	CD @ 5%	3.21	3.36	4.00	3.64	4.76	3.76	NS	7.23

Table 7: Effect of integrated nutrient management practices on economics (Rs ha^{-1}) at harvest stages of chickpea during 2020 and 2021

Treatment combination		Cost of cultivation (Rs ha^{-1})		Gross return (Rs ha^{-1})		Net return (Rsha^{-1})		B:C ratio	
		2020	2021	2020	2021	2020	2021	2020	2021
T_1	Control	19307	19850	71491	71751	52184	52658	2.60	2.58
T_2	Farmers practice (50 kg DAP ha^{-1})	20407	20830	79495	79586	59088	60512	2.90	2.91
T_3	RDF	21106	21250	114885	114982	93779	94120	4.44	4.43
T_4	FYM @ 10 tha^{-1}	24307	24624	88102	88564	63795	64125	2.62	2.60
T_5	Vermicompost @5 tha^{-1}	22807	23102	86378	86759	63571	63792	2.79	2.76
T_6	RDF + FYM @ 5 tha^{-1}	22707	23282	110248	111214	87541	88910	3.86	3.82
T_7	RDF + Vermicompost @5 tha^{-1}	24606	24853	114382	114892	89776	90215	3.65	3.63
T_8	75% RDF + FYM@ 2.5 tha^{-1} + Vermicompost @ 1.0 tha^{-1}	22606	22790	123112	123751	100506	101214	4.45	4.44
T_9	50% RDF + FYM@ 5 tha^{-1} + Vermicompost @ 2.5 tha^{-1}	24456	24754	109767	109845	85311	85927	3.49	3.47
T_{10}	25% RDF + FYM@ 10 tha^{-1} + Vermicompost @ 5.0 tha^{-1}	28257	28564	101694	101895	73437	73684	2.70	2.65

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