



Effect of Organic Manures on Productivity of Greengram-wheat Cropping Sequence under Organic Farming

Patel, J. R. ^{a++*}, Chaudhary, M. G. ^{a#}, Patel, D. M. ^{a†},
Patel, J. C. ^{a‡}, Patel, J. K. ^{b++} and Singh, N. K. ^{c++}

^a Department of Agronomy, C. P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Banaskantha, Gujarat– 385 506, India.

^b Department of Soil Science and Agricultural Chemistry, C. P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Banaskantha, Gujarat– 385 506, India.

^c Department of Microbiology, C. P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Banaskantha, Gujarat – 385 506, India.

Authors' contributions

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

Article Information

DOI: <https://doi.org/10.9734/jeai/2024/v46i72625>

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/118808>

Original Research Article

Received: 25/04/2024

Accepted: 24/06/2024

Published: 27/06/2024

⁺⁺ Assistant Professor;

[#] Retd. Associate Professor;

[†] Professor and Head;

[‡] Retd. Professor and Head;

*Corresponding author: E-mail: janak15688@sda.u.edu.in;

Cite as: J. R., Patel, Chaudhary, M. G., Patel, D. M., Patel, J. C., Patel, J. K., and Singh, N. K. 2024. "Effect of Organic Manures on Productivity of Greengram-Wheat Cropping Sequence under Organic Farming". *Journal of Experimental Agriculture International* 46 (7):714-30. <https://doi.org/10.9734/jeai/2024/v46i72625>.

ABSTRACT

Manures are significant organic source of plant nutrients. Farmer's awareness is increasing towards organic farming. An experiment was conducted during *kharif* and *Rabi* season of the years 2016-17 to 2018-19 (Three years) at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar having loamy sand soil to study the effect of organic manures on productivity of greengram-wheat cropping sequence under organic farming. The experiment was laid out in completely randomized design and replicated eight times with four treatments. On three years pooled results, growing organically wheat after greengram as succeeding crop are recommended to apply 100% recommended nitrogen to greengram and 75% recommended nitrogen to succeeding wheat crop through castor cake for obtaining higher greengram equivalent yield and net return under North Gujarat Agro climatic conditions.

Keywords: Organic manures; castor cake; FYM; nitrogen; greengram and wheat.

1. INTRODUCTION

Pulses are one of the important crop for India. They are important source of protein, quickly growing, generate good profit for farmers and contribute to agricultural and environmental sustainability. Pulses constitute the major source of dietary protein predominantly for vegetarians of the world. Pulses are gaining more significance globally, because of its nutritional quality and suitability to various cropping systems. Among the different pulses Green gram (*Vigna radiata* (L.) Wilczek), is an important crop ranks third in production after Chickpea and Pigeon pea [1]. According to Vavilov (1926), Green gram is native of India and Central Asia [2-5]. Mungbean is also known as greengram, golden gram, mung or oregon pea. Green gram is a self-pollinated legume crop.

Wheat (*Triticum aestivum* L.) is grown all over the world for its high nutritious value. It is ranked among the top three most produced cereal crops in the world, along with corn and rice [6]. Wheat grain is consumed in several ways in a number of industrial and commercial products. It is also a cheaper source of feed for livestock and poultry.

Organic farming is a production system, which avoids or largely excludes the use of synthetic or inorganic fertilizers, pesticides and growth regulators [7]. The role of organic manure provides all nutrients that are required by plants but in limited quantities. It helps in maintaining C:N ratio in the soil and also increased the fertility and productivity of the soil. It is well recognized and considered as a balance manure which supplies macro and micro nutrients

essential to plants. It builds up the soil micro flora, which are useful to maintain the soil fertility. It supplies nitrogen, phosphorus, potassium and micronutrients like Fe, S, Mo and Zn etc. in available form to the plants through biological decomposition and improve physico-chemical properties of soil such as aggregation, aeration, permeability, water holding capacity, slow release of nutrients, increase in cation exchange capacity, stimulation of soil flora and fauna etc. Therefore, it is right time to evaluate the feasibility and efficiency of organic manure for improving and building up the soil fertility.

The application of organic manures viz., FYM, vermicompost and castor cake may serve the source of major (N, P and K) and micronutrients (Fe, Mo and Zn etc.). Addition of organic manure in the soil is not only act as source of nutrient, but also influences its availability. It improves physical and chemical properties and health of soil such as aggregation, aeration, permeability, water holding capacity, slow release of nutrients, increase in Cation Exchange Capacity (CEC), stimulation of soil flora and fauna etc. FYM is one of the oldest manure used by the farmers in growing crops because of its easy availability and presence of all the nutrients required by the plants. On an average, FYM contains 0.5 % N, 0.17 % P₂O₅ and 0.55 % K₂O. Castor cake is not used as animal feed as it contains a toxic alkaloids ricinine and ricin. It widely used as concentrated organic manure. Castor cake also supply micronutrients, improve physical properties of soil, immobilize toxic elements like Al and promote Mo activity [8]. It is a long-term sustainable perspective and should not be thought for a short-term gain. Vermicompost is the product of decomposition process using

various species of worm, usually red wigglers, white worms, and other earthworms. For preparation of mixture of decomposition of vegetable or food waste, bedding materials and vermicast. This process is called vermicomposting, while rearing of worms for this purpose is called vermiculture. Vermicompost contains 1.2 - 1.6% N, 1.8 -2.0% P and 0.5 - 0.75 % K. Castor cake is nitrogen rich organic fertilizer, obtained from treatment of seeds for castor oil, which act progressively and encourages soil microbial activity it has insecticidal properties and acts as a natural pest repellent. Castor cake is produced by crushing castor seeds in expeller to extract oil from it in a control temperature with help of steam. Castor oil cake is one of the most versatile natural manures which enhances the fertility of the soil without causing any damage and decay. Castor cake is also called as a castor meal. Castor cake is not used as animal feed as it contains a toxic alkaloids ricinine and ricin. It widely used as concentrated organic manure. Castor cake contains 5.5 to 5.8% N, 1.8 to 1.9% P₂O₅ and 1.0 to 1.1% K₂O. Nutrient present in castor cake are make easily and quickly available to crop after 15 to 20 days of its application.

The aim of present study was to determine the influence of organic sources of nutrients in

different combination on growth and yield of green gram-wheat cropping sequence grown in organic farming systems.

2. MATERIALS AND METHODS

An experiment was conducted during *kharif* and *Rabi* season of the years 2016-17 to 2018-19 (Three years) at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar having loamy sand soil to study the effect of organic manures on productivity of greengram-wheat cropping sequence under organic farming.. The soil of experimental field was loamy sand in texture. In *kharif* season green gram seeds (17.5 kg/ha) were sown at a row distance of 45 cm and in *rabi* season wheat seeds (125 kg/ha) were sown at a row distance of 22.5 cm. Various growth and yield attributing characters of the crop were measured and studied during the course of investigations. Other management practices were followed as recommended. Statistical analysis of the data of various characters studied in present investigation was carried out with the help of computer as per appropriate procedure suggested by Panse and Sukhatme [9] for the design of experiment.

Chart 1. Treatment details

<i>Kharif</i>	<i>Rabi</i>
Greengram	Wheat
T ₁ : 100% RDN through FYM	T ₁ : 75% RDN through VC
T ₂ : 100% RDN through FYM	T ₂ : 50% RDN through VC
T ₃ : 100% RDN through CC	T ₃ : 75% RDN through CC
T ₄ : 100% RDN through CC	T ₄ : 50% RDN through CC

Note:

1. Bio NPK consortium and bio-fertilizer was applied to both crops as seed inoculation @ 5 ml/kg of seed.
2. Experiment was conducted on fix site.
3. RDN of green gram: 20 kg N/ha and wheat: 120 kg N/ha.
4. Phosphorus will not be applied.

Design : Large plot technique
 Replications : Eight
 Crop and variety : Green gram, Gujarat mung 4, Wheat, GW 451
 Spacing : Green gram : 45 cm Wheat: 22.5 cm
 Seed rate : Green gram : 17.5 kg/ha Wheat : 125 kg/ha

3. RESULTS and DISCUSSION

2017-18: The data presented in Table 6 indicated that application of different organic manures had significant effect on greengram equivalent yield. Significantly the highest greengram equivalent yield (2136 kg/ha) was registered under treatment T₃ (100% RDN through castor cake in greengram and 75% RDN through castor cake in succeeding wheat) over rest of the treatments. However, treatment T₄ (100% RDN through castor cake in greengram and 50% castor cake in succeeding wheat) recorded significantly lower greengram equivalent yield (1779 kg/ha) and remained at par with treatment T₂ (100% RDN through FYM in greengram and 50% RDN through vermicompost in succeeding wheat).

2018-19: The data tabulated in Table 6 revealed that application of different organic manures to greengram-wheat crop sequence had significant effect on greengram equivalent yield. Significantly the highest greengram equivalent yield (2629 kg/ha) was registered under treatment T₃ (100% RDN through castor cake in greengram and 75% RDN through castor cake in succeeding wheat). However, treatment T₄ (100% RDN through castor cake in greengram and 50% castor cake in succeeding wheat) recorded significantly lower greengram equivalent yield (2247 kg/ha) and did not differ significantly over treatment T₂ (100% RDN through FYM in greengram and 50% RDN through vermicompost in succeeding wheat).

2019-20: The data highlighted in Table 6 revealed that application of different organic manures to greengram-wheat crop sequence had significant effect on greengram equivalent yield. Significantly the highest greengram equivalent yield (2969 kg/ha) was registered under treatment T₃ (100% RDN through castor cake in greengram and 75% RDN through castor cake in succeeding wheat). However, treatment T₄ (100% RDN through castor cake in greengram and 50% castor cake in succeeding wheat) recorded significantly lower greengram equivalent yield (2446 kg/ha) but failed to differ significantly over treatment T₂ (100% RDN through FYM in greengram and 50% RDN through vermicompost in succeeding wheat).

3.1 Pooled Results

The pooled data of three years (Table 6) indicated that application of different organic

manures to greengram-wheat crop sequence had significant effect on greengram equivalent yield. Significantly the highest greengram equivalent yield (2578 kg/ha) was registered under treatment T₃ (100% RDN through castor cake in greengram and 75% RDN through castor cake in succeeding wheat). However, treatment T₄ (100% RDN through castor cake in greengram and 50% castor cake in succeeding wheat) recorded significantly lower greengram equivalent yield (2157 kg/ha) and remained at par with treatment T₂ (100% RDN through FYM in greengram and 50% RDN through vermicompost in succeeding wheat). The results indicated that the residual effect of organic manures applied to preceding *kharif* greengram resulted in saving of 25% RDN for succeeding *rabi* wheat.

Castor cake's contribution to higher yields in the wheat-greengram cropping sequence has been documented in several studies. For instance, research by Patel et al. [10] demonstrated that the application of castor cake significantly increased wheat yields in a wheat-greengram rotation system. This increase was attributed to the nutrient-rich composition and slow-release properties of castor cake, as well as its positive impact on soil health and fertility [10]. Furthermore, findings from Sharma et al. [11] support these results, highlighting the beneficial effects of castor cake application on both wheat and greengram yields in a crop rotation system. These studies emphasize the importance of castor cake as an effective organic fertilizer for improving yields and promoting sustainable agricultural practices in wheat-greengram cropping sequences. Also similar result was reported by Mahajan et al. [12] Dubey et al. [13], Nisha et al. [14] and Panwar et al. [15,16].

3.2 Economics

Economics of different treatments (Table 15) showed that maximum gross return (Rs 180460/ha) and net return (Rs 107646/ha) with BCR of 2.48 was obtained with treatment T₃ (100% RDN through castor cake in greengram and 75% RDN through castor cake in succeeding wheat). Which was followed by treatment T₄ (100% RDN through castor cake in greengram and 50% castor cake in succeeding wheat) with net return (Rs. 82438) and BCR of 2.20.

Table 1. Plant population of greengram as influenced by different treatments

Treatments	Plant population per meter row length at 20 DAS				Plant population per meter row length at harvest			
	2017	2018	2019	Pooled	2017	2018	2019	Pooled
Greengram								
T ₁ : 100% RDN through FYM	8.2	9.4	9.6	9.1	7.3	8.9	8.7	8.3
T ₂ : 100% RDN through FYM	9.8	9.1	9.7	9.4	7.6	9.0	8.7	8.4
T ₃ : 100% RDN through CC	9.7	9.4	9.2	9.4	7.4	9.2	8.8	8.5
T ₄ : 100% RDN through CC	9.5	9.4	9.4	9.4	7.8	9.1	8.4	8.4
S.Em. ±	0.3	0.2	0.2	0.3	0.3	0.2	0.3	0.3
CD (P= 0.05)	NS	NS	NS	NS	NS	NS	NS	NS
CV (%)	7.86	6.73	6.86	12.65	7.52	6.73	8.32	12.65
Y x T	-	-	-	NS	-	-	-	NS

Table 2. Plant height and number of branches per plant of greengram as influenced by different treatments

Treatments	Plant height (cm)				Number of branches per plant			
	2017	2018	2019	Pooled	2017	2018	2019	Pooled
Greengram								
T ₁ : 100% RDN through FYM	45.1	50.8	52.7	49.5	4.4	5.9	6.3	5.6
T ₂ : 100% RDN through FYM	44.0	49.7	51.8	48.5	4.8	5.7	6.1	5.6
T ₃ : 100% RDN through CC	47.1	52.1	53.9	51.0	4.4	6.4	7.0	5.9
T ₄ : 100% RDN through CC	46.2	50.9	54.4	50.5	4.4	6.3	6.7	5.8
S.Em. ±	1.5	1.5	1.8	1.0	0.2	0.2	0.2	0.2
CD (P= 0.05)	NS	NS	NS	NS	NS	NS	NS	NS
CV (%)	10.01	8.33	9.32	8.71	11.96	9.74	9.79	10.28
Y x T	-	-	-	NS	-	-	-	NS

Table 3. Number of pods per plant and length of pod of greengram as influenced by different treatments

Treatments	Number of pods per plant				Length of pod (cm)			
	2017	2018	2019	Pooled	2017	2018	2019	Pooled
Greengram								
T ₁ : 100% RDN through FYM	15.7	18.3	20.2	18.1	4.6	5.1	5.3	5.2
T ₂ : 100% RDN through FYM	15.6	18.0	20.1	17.9	4.4	5.3	6.1	5.3
T ₃ : 100% RDN through CC	17.1	20.0	22.2	19.8	4.8	5.2	5.9	5.3
T ₄ : 100% RDN through CC	16.2	18.5	21.5	18.7	4.6	5.5	6.3	5.4
S.Em. ±	0.6	0.5	0.63	0.3	0.2	0.2	0.2	0.1
CD (P= 0.05)	NS	NS	NS	0.9	NS	NS	NS	NS
CV (%)	9.86	8.09	8.51	8.72	13.81	10.65	9.35	11.14
Y x T	-	-	-	NS	-	-	-	NS

Table 4. Seeds per pod and Seed yield per plant of greengram as influenced by different treatment

Treatments	Seed per pod				Seed yield per plant (g)			
	2017	2018	2019	Pooled	2017	2018	2019	Pooled
Greengram								
T ₁ : 100% RDN through FY M	8.7	9.5	9.5	9.2	7.1	8.2	8.4	7.9
T ₂ : 100% RDN through FYM	8.4	9.3	9.4	9.1	7.0	8.1	8.3	7.8
T ₃ : 100% RDN through CC	9.9	10.9	10.7	10.5	7.3	8.5	8.6	8.2
T ₄ : 100% RDN through CC	8.7	9.4	9.3	9.1	7.1	8.4	8.7	8.0
S.Em. ±	0.2	0.1	0.2	0.1	0.1	0.1	0.2	0.1
CD (P= 0.05)	0.4	0.4	0.5	0.2	NS	NS	NS	0.2
CV (%)	4.70	4.11	4.90	4.63	3.62	4.11	5.46	4.50
Y x T	-	-	-	NS				NS

Table 5. Test weight of greengram as influenced by different treatments

Treatments	Test weight (g)			
	2017	2018	2019	Pooled
Greengram				
T ₁ : 100% RDN through FYM	36.53	37.09	37.43	37.02
T ₂ : 100% RDN through FYM	35.68	36.39	37.35	36.47
T ₃ : 100% RDN through CC	36.86	37.54	37.38	37.39
T ₄ : 100% RDN through CC	36.02	36.48	37.51	36.67
S.Em. ±	0.31	0.32	0.54	0.23
CD (P= 0.05)	NS	NS	NS	0.64
CV (%)	2.43	2.45	4.06	3.10
Y x T	-	-	-	NS

Table 6. Seed and stover yield of greengram as influenced by different treatments

Treatments	Seed yield (kg/ha)				Stover yield (kg/ha)			
	2017	2018	2019	Pooled	2017	2018	2019	Pooled
Greengram								
T ₁ : 100% RDN through FY M	415	490	536	480	862	948	1078	963
T ₂ : 100% RDN through FYM	410	495	523	475	812	1009	1075	965
T ₃ : 100% RDN through CC	420	514	552	495	906	1036	1025	989
T ₄ : 100% RDN through CC	413	507	541	487	844	1097	1121	1021
S.Em. ±	12	12	19	9	30	26	30	28
CD (P= 0.05)	NS	NS	NS	NS	NS	75.82	NS	NS
CV (%)	7.94	6.66	10.08	8.60	10.01	7.13	7.95	28.09
Y x T	-	-	-	NS	-	-	-	NS

Table 7. Plant population of wheat as influenced by different treatments

Treatments	Plant population at 20 DAS				Plant population at harvest			
	2017	2018	2019	Pooled	2017	2018	2019	Pooled
Wheat	26.0	26.3	26.8	26.3	24.4	24.6	24.6	24.6
T ₁ : 75% RDN through VC	26.0	25.4	26.3	25.9	24.6	23.6	24.1	24.1
T ₂ : 50% RDN through VC	26.3	26.6	27.0	26.6	24.8	25.6	25.5	25.3
T ₃ : 75% RDN through CC	26.1	26.4	26.9	26.5	25.3	25.6	25.9	25.6
T ₄ : 50% RDN through CC	0.9	0.9	1.0	0.5	0.8	0.8	0.9	0.4
S.Em. ±	NS	NS	NS	NS	NS	NS	NS	NS
CD (P= 0.05)	9.21	9.53	10.24	9.70	8.77	8.72	9.61	9.13
CV (%)	-	-	-	NS	-	-	-	NS
Y x T								

Table 8. Plant height and number of effective tillers/plant of wheat as influenced by different treatments

Treatments	Plant height (cm)				Number of effective tillers/plant			
	2017	2018	2019	Pooled	2017	2018	2019	Pooled
Wheat	68.1	71.0	72.8	70.6	4.1	4.3	4.8	4.4
T ₁ : 75% RDN through VC	62.7	65.3	69.3	65.8	3.8	4.0	4.2	4.0
T ₂ : 50% RDN through VC	74.8	77.5	80.2	77.5	4.7	5.0	5.569	5.1
T ₃ : 75% RDN through CC	66.3	68.3	71.8	68.8	4.0	4.2	4.3	4.1
T ₄ : 50% RDN through CC	2.2	2.1	2.4	1.2	0.2	0.2	0.2	0.1
S.Em. ±	6.5	6.0	6.9	3.4	0.5	0.6	0.6	0.3
CD (P= 0.05)	9.14	8.21	9.12	8.81	11.30	12.11	12.03	11.84
CV (%)	-	-	-	NS	-	-	-	NS
Y x T								

Table 9. Length of spike and number of spikelet/spike of wheat at harvest as influenced by different treatments

Treatments	Length of spike (cm)				Number of spikelet/spike			
	2017	2018	2019	Pooled	2017	2018	2019	Pooled
Wheat	6.7	7.0	7.3	7.0	11.7	12.8	13.6	12.7
T ₁ : 75% RDN through VC	6.0	6.6	6.6	6.4	10.7	11.8	12.9	11.8
T ₂ : 50% RDN through VC	7.4	7.8	8.2	7.8	13.0	14.2	15.3	14.2
T ₃ : 75% RDN through CC	6.2	6.4	7.0	6.5	11.1	12.4	13.4	12.3
T ₄ : 50% RDN through CC	0.2	0.2	0.2	0.1	0.4	0.4	0.4	0.2
S.Em. ±	0.6	0.7	0.7	0.4	1.2	1.2	1.3	0.7
CD (P= 0.05)	8.32	9.56	9.55	9.24	10.02	8.81	9.14	9.35
CV (%)	-	-	-	NS	-	-	-	NS
Y x T								

Table 10. Number of grain per earhead and test weight of wheat of wheat at harvest as influenced by different treatments

Treatments	Number of grain per earhead				Test weight (g)			
	2017	2018	2019	Pooled	2017	2018	2019	Pooled
Wheat								
T ₁ : 75% RDN through VC	36.38	37.20	39.10	37.56	40.13	40.38	41.06	40.52
T ₂ : 50% RDN through VC	30.24	31.98	33.46	31.89	39.94	39.38	39.38	39.56
T ₃ : 75% RDN through CC	39.95	41.69	43.19	41.61	40.25	40.63	41.93	40.94
T ₄ : 50% RDN through CC	34.86	35.88	37.70	36.14	40.00	40.25	41.34	40.53
S.Em. ±	1.14	1.38	1.35	0.71	0.87	0.88	0.93	0.50
CD (P= 0.05)	3.35	4.06	3.96	20.20	NS	NS	NS	NS
CV (%)	9.12	10.63	9.93	9.94	6.17	6.16	6.40	6.25
Y x T	-	-	-	NS	-	-	-	NS

Table 11. Grain yield of wheat as influenced by different treatments

Treatments	Grain yield (kg/ha)				Straw yield ((kg/ha)			
	2017	2018	2019	Pooled	2017	2018	2019	Pooled
Wheat								
T ₁ : 75% RDN through VC	3213	4396	3913	3841	5266	5472	5337	5358
T ₂ : 50% RDN through VC	2899	4116	3660	3559	4654	4813	4740	4736
T ₃ : 75% RDN through CC	3550	4795	4389	4245	5688	5975	5874	5845
T ₄ : 50% RDN through CC	2723	3910	3397	3344	4874	4990	4832	4898
S.Em. ±	122	110	123	65	152	158	171	89
CD (P= 0.05)	358	322	361	185	447	465	503	251
CV (%)	11.11	7.20	9.03	8.91	8.40	8.41	9.31	8.72
Y x T	-	-	-	NS	-	-	-	NS

Table 12. Greengram equivalent yield as influenced by different treatments

Treatments	Greengram equivalent yield (kg/ha)					
	Greengram	Wheat	2017	2018	2019	Pooled
T ₁ : 100% RDN through FYM		T ₁ : 75% RDN through VC	1965	2430	2703	2366
T ₂ : 100% RDN through FYM		T ₂ : 50% RDN through VC	1824	2304	2535	2221
T ₃ : 100% RDN through CC		T ₃ : 75% RDN through CC	2136	2629	2969	2578
T ₄ : 100% RDN through CC		T ₄ : 50% RDN through CC	1779	2247	2446	2157
S.Em. ±			49	43	61	29
CD (P= 0.05)			144	127	179	82
CV (%)			7.17	5.08	6.45	6.24
Y x T			-	-	-	NS

Table 13. Economics of *kharif* greengram as influenced by different treatments (Pooled data of 2017-18, 2018-19 and 2019-20)

Treatments Greengram	Yield(kg/ha)		Gross return (Rs/ha)	Cost of cultivation (Rs/ha)	Net return (Rs/ha)	BCR
	Seed	Stover				
T ₁ : 100% RDN through FYM	480	963	35526	28400	7126	1.25
T ₂ : 100% RDN through FYM	475	965	35180	28400	6780	1.24
T ₃ : 100% RDN through CC	495	989	36628	24544	12084	1.49
T ₄ : 100% RDN through CC	487	1021	36132	24544	11588	1.47

Rate of different input:
 i) FYM: Rs 1.50/kg ii) Castor cake: Rs 6.0/kg (Rs 300/50 kg bag of castor cake)
 iii) Rate of sell of produce of greengram: iv) Seed: Rs 70.00/kg seed Stover: Rs. 2.00/kg stalk

Table 14. Economics of *rabi* wheat as influenced by different treatments (Pooled data of 2017-18, 2018-19 and 2019-20)

Treatments Wheat	Yield (kg/ha)		Gross Return (Rs/ha)	Cost of Cultivation (Rs/ha)	Net Return (Rs/ha)	BCR
	Grain	Straw				
T ₁ : 75% RDN through VC	3841	5358	85212	60790	24422	1.40
T ₂ : 50% RDN through VC	3559	4736	78270	52530	25740	1.49
T ₃ : 75% RDN through CC	4245	5845	93945	48270	45675	1.95
T ₄ : 50% RDN through CC	3344	4898	74886	44008	30878	1.70

Rate of sell of produce of wheat:
 (i) Seed: Rs 18.00/kg seed
 (ii) VC: Rs 4.00/kg
 (iii) Straw: Rs. 3.00/kg stalk
 (iv) Castor cake: Rs 6.0/kg (Rs 300/50 kg bag of castor cake)

Table 15. Economics of greengram-wheat crop sequence as influenced by different treatments (Pooled data of 2017-18, 2018-19 and 2019-20)

Treatments Greengram	Wheat	Greengram equivalent yield (kg/ha)	Gross return (Rs/ha)	Cost of cultivation (Rs/ha)	Net return (Rs/ha)	BCR
T ₁ : 100% RDN through FYM	T ₁ : 75% RDN through VC	2366	165620	89190	76430	1.86
T ₂ : 100% RDN through FYM	T ₂ : 50% RDN through VC	2221	155470	80930	74540	1.92
T ₃ : 100% RDN through CC	T ₃ : 75% RDN through CC	2578	180460	72814	107646	2.48
T ₄ : 100% RDN through CC	T ₄ : 50% RDN through CC	2157	150990	68552	82438	2.20

Rate of different input:
 (i) FYM: Rs 1.50/kg ii) Castor cake: Rs 6.0/kg (Rs 300/50 kg bag of castor cake)
 (ii) Rate of sell of produce of greengram: Seed: Rs 70.00/kg seed
 (iii) Stover: Rs. 2.00/kg stalk **Rate of sell of produce of wheat:** Seed: Rs 18.00/kg seed Straw: Rs. 3.00/kg stalk
 (iv) VC: Rs 4.00/kg
 (v) Castor cake: Rs 6.0/kg (Rs 300/50 kg bag of castor cake)

Table 16. Soil population of *Rhizobium*, *Azotobacter* and PSB in greengram-wheat based cropping sequence

Treatments	Population of microorganisms in soil (x 10 ⁵ CFU/g of soil)																							
	Greengram												Wheat											
	<i>Rhizobium</i>				<i>Azotobacter</i>				PSB				<i>Rhizobium</i>				<i>Azotobacter</i>				PSB			
	2017	2018	2019	Pooled	2017	2018	2019	Pooled	2017	2018	2019	Pooled	2017	2018	2019	Pooled	2017	2018	2019	Pooled	2017	2018	2019	Pooled
Before sowing	5.7	5.9	6.6	6.1	6.4	7.0	7.4	6.9	7.5	7.9	8.8	8.1	8.6	9.1	9.6	9.1	10.5	10.8	11.7	11.0	12.8	12.1	13.2	12.7
After harvest																								
T ₁	10.6	10.4	12.2	11.1	12.4	12.0	14.6	13.0	14.7	14.5	16.4	15.20	11.7	12.0	15.5	13.07	15.1	15.2	16.7	15.7	18.1	19.0	20.4	19.2
T ₂	10.7	10.3	11.2	10.7	12.2	13.0	13.3	12.8	14.4	15.0	15.3	14.90	12.5	12.6	13.1	12.73	14.8	15.0	15.6	15.1	17.5	17.9	18.8	18.1
T ₃	12.6	12.9	13.4	13.0	14.6	15.0	15.8	15.1	16.8	17.1	18.5	17.47	14.2	15.3	17.8	15.77	16.4	16.7	18.2	17.1	20.4	21.0	23.4	21.6
T ₄	12.4	12.1	12.8	12.4	14.5	14.3	14.9	14.6	16.4	16.8	17.2	16.80	13.4	14.1	15.3	14.27	15.7	16.0	17.2	16.3	19.4	18.8	21.5	19.9
S.Em±	0.36	0.45	0.51	0.20	0.47	0.62	0.49	0.33	0.53	0.41	0.57	0.23	0.62	0.44	0.55	0.49	0.67	0.52	0.71	0.1	0.43	0.49	0.66	0.30
CD(P=0.05)	1.05	1.31	1.47	0.69	1.37	1.78	1.42	1.13	1.56	1.22	1.68	0.80	1.76	1.28	1.65	1.69	1.95	1.18	2.06	0.5	1.26	1.52	1.87	1.04
CV (%)	2.63	3.67	3.18	2.94	2.86	3.84	4.55	4.08	3.34	3.68	4.35	2.49	4.61	4.75	4.62	6.05	5.21	4.97	4.72	1.6	3.66	4.81	4.32	2.64

* Population of microorganisms in soil are expressed in terms of CFU (CFU=Colony Forming Units) /gm of soil

Table 17. N, P and K content in greengram seed as influenced by different treatments

Treatments	N content (%)				P content (%)				K content (%)			
	2017	2018	2019	Pooled	2017	2018	2019	Pooled	2017	2018	2019	Pooled
Greengram												
T ₁ : 100% RDN through FYM	3.31	6.86	3.20	4.50	0.23	0.22	0.22	0.22	1.40	1.19	1.29	1.29
T ₂ : 100% RDN through FYM	3.24	3.34	3.34	3.27	0.20	0.18	0.19	0.19	1.69	0.92	1.02	1.01
T ₃ : 100% RDN through CC	3.34	3.24	3.24	3.30	0.23	0.23	0.23	0.23	1.45	1.20	1.32	1.32
T ₄ : 100% RDN through CC	3.23	3.32	3.31	3.26	0.20	0.18	0.16	0.19	1.19	0.98	1.10	1.10
S.Em. ±	0.030	0.030	0.030	1.045	0.010	0.010	0.003	0.003	0.030	0.030	0.030	0.019
CD (P= 0.05)	NS	NS	NS	NS	0.010	0.020	0.010	0.010	0.100	0.100	0.100	0.050
CV (%)	2.65	2.65	2.62	2.60	6.72	7.82	6.92	7.15	7.52	9.00	8.26	8.22
Y x T				NS				NS				NS

Table 18. N, P and K content in stover of greengram as influenced by different treatments

Treatments	N content (%)				P content (%)				K content (%)			
	2017	2018	2019	Pooled	2017	2018	2019	Pooled	2017	2018	2019	Pooled
Greengram												
T ₁ : 100% RDN through FYM	0.91	0.82	0.83	0.85	0.15	0.16	0.16	0.16	2.68	2.53	2.55	2.58
T ₂ : 100% RDN through FYM	0.83	0.74	0.73	0.77	0.11	0.11	0.11	0.11	2.45	2.30	2.35	2.37
T ₃ : 100% RDN through CC	0.91	0.82	0.82	0.85	0.15	0.16	0.16	0.16	2.68	2.60	2.60	2.62
T ₄ : 100% RDN through CC	0.80	0.74	0.72	0.75	0.11	0.11	0.12	0.11	2.40	2.29	2.33	2.34
S.Em. ±	0.030	0.020	0.030	0.014	0.003	0.003	0.003	0.020	0.020	0.030	0.020	0.012
CD (P= 0.05)	0.080	0.070	0.080	0.040	0.010	0.010	0.010	0.010	0.060	0.080	0.060	0.030
CV (%)	9.16	8.76	9.47	9.14	8.55	9.05	9.40	9.01	2.11	3.04	2.23	2.48
Y x T				NS				NS				NS

Table 19. N, P and K uptake by greengram seed as influenced by different treatments

Treatments	N uptake (kg/ha)				P uptake (kg/ha)				K uptake (kg/ha)			
	2017	2018	2019	Pooled	2017	2018	2019	Pooled	2017	2018	2019	Pooled
Greengram												
T ₁ : 100% RDN through FYM	10.41	12.60	14.42	12.51	7.86	8.35	8.89	8.37	10.44	12.56	12.52	11.84
T ₂ : 100% RDN through FYM	10.01	13.17	13.78	12.31	6.75	7.69	7.77	7.43	9.72	12.13	12.72	11.52
T ₃ : 100% RDN through CC	10.69	13.39	15.00	13.01	8.18	8.85	9.20	8.71	10.69	13.36	14.28	12.78
T ₄ : 100% RDN through CC	10.11	13.48	15.04	12.85	6.74	7.97	8.00	7.51	9.71	12.26	12.99	11.64
S.Em. ±	0.40	0.38	0.66	0.56	0.41	0.40	0.50	0.24	0.38	0.38	0.63	0.270
CD (P= 0.05)	NS	NS	NS	NS	1.20	NS	NS	0.69	NS	NS	NS	0.76
CV (%)	10.9	8.08	12.77	12.12	15.66	13.76	16.68	15.45	10.63	8.53	13.63	11.35
Y x T	-	-	-	NS	-	-	-	NS	-	-	-	NS

Table 20. N, P and K uptake by greengram stover as influenced by different treatments

Treatments	N uptake (kg/ha)				P uptake (kg/ha)				K uptake (kg/ha)			
	2017	2018	2019	Pooled	2017	2018	2019	Pooled	2017	2018	2019	Pooled
Greengram												
T ₁ : 100% RDN through FYM	7.86	8.35	8.89	8.37	1.32	1.62	1.67	1.56	23.65	25.74	27.44	25.71
T ₂ : 100% RDN through FYM	6.75	7.69	7.77	7.40	0.91	1.14	1.18	1.07	19.91	23.72	24.62	22.74
T ₃ : 100% RDN through CC	8.18	8.85	9.20	8.74	1.38	1.66	1.75	1.60	24.21	28.48	29.03	27.24
T ₄ : 100% RDN through CC	6.74	7.97	8.00	7.55	0.92	1.19	1.25	1.12	20.11	24.83	25.65	23.53
S.Em. ±	0.41	0.41	0.50	0.24	0.05	0.80	0.05	0.03	0.76	0.86	1.11	0.51
CD (P= 0.05)	1.2	NS	NS	0.69	0.14	0.23	0.16	0.10	2.22	2.52	3.26	1.45
CV (%)	15.66	13.76	16.68	15.45	11.68	16.09	10.62	13.17	9.80	9.44	11.74	10.51
Y x T	-	-	-	NS	-	-	-	NS	-	-	-	NS

Table 21. N, P and K content in wheat grain as influenced by different treatments

Treatments	N content (%)				P content (%)				K content (%)			
	2017	2018	2019	Pooled	2017	2018	2019	Pooled	2017	2018	2019	Pooled
Wheat												
T ₁ : 75% RDN through VC	2.19	2.10	2.219	2.17	0.30	0.29	0.31	0.29	0.67	0.65	0.62	0.63
T ₂ : 50% RDN through VC	2.10	2.22	2.102	2.14	0.28	0.31	0.29	0.30	0.55	0.59	0.55	0.56
T ₃ : 75% RDN through CC	2.22	2.11	2.188	2.17	0.31	0.29	0.28	0.31	0.62	0.64	0.61	0.63
T ₄ : 50% RDN through CC	2.12	2.20	2.100	2.14	0.28	0.30	0.32	0.30	0.58	0.59	0.55	0.57
S.Em. ±	0.03	0.03	0.04	0.04	0.01	0.01	0.01	0.10	0.02	0.02	0.02	0.01
CD (P= 0.05)	NS	0.10	NS	NS	NS	NS	NS	NS	0.05	NS	0.06	0.03
CV (%)	4.49	4.45	4.85	4.60	7.92	9.00	7.92	8.41	8.77	9.16	9.81	9.25
Y x T	-	-	-	NS	-	-	-	NS	-	-	-	NS

Table 22. N, P and K content in wheat straw as influenced by different treatments

Treatments	N content (%)				P content (%)				K content (%)			
	2017	2018	2019	Pooled	2017	2018	2019	Pooled	2017	2018	2019	Pooled
Wheat												
T ₁ : 75% RDN through VC	0.93	0.82	0.82	0.86	0.15	0.14	0.14	0.14	1.04	0.98	0.96	1.00
T ₂ : 50% RDN through VC	0.84	0.75	0.74	0.78	0.12	0.10	0.11	0.11	0.93	0.85	0.84	0.87
T ₃ : 75% RDN through CC	0.95	0.82	0.78	0.84	0.15	0.14	0.14	0.14	1.06	0.99	0.96	1.00
T ₄ : 50% RDN through CC	0.84	0.75	0.76	0.78	0.11	0.101	0.11	0.11	0.93	0.82	0.81	0.85
S.Em. ±	0.03	0.022	0.021	0.011	0.003	0.003	0.003	0.002	0.031	0.030	0.031	0.017
CD (P= 0.05)	NS	0.06	NS	0.04	0.01	0.01	0.01	0.01	0.10	0.09	0.09	0.05
CV (%)	9.30	7.53	8.44	8.54	9.55	8.91	9.59	9.37	9.20	9.42	9.90	9.53
Y x T	-	-	-	NS	-	-	-	NS	-	-	-	NS

Table 23. N, P and K uptake by wheat grain as influenced by different treatments

Treatments	N uptake (kg/ha)				P uptake (kg/ha)				K uptake (kg/ha)			
	2017	2018	2019	Pooled	2017	2018	2019	Pooled	2017	2018	2019	Pooled
Wheat												
T ₁ : 75% RDN through VC	70.50	92.40	86.89	83.26	9.72	12.52	11.07	11.10	33.49	28.52	24.20	28.73
T ₂ : 50% RDN through VC	60.90	91.22	77.04	76.38	8.22	12.66	11.26	10.71	27.19	24.35	20.25	23.93
T ₃ : 75% RDN through CC	78.75	101.01	96.21	91.99	10.92	13.60	12.53	12.35	37.38	29.58	28.22	31.73
T ₄ : 50% RDN through CC	56.06	85.45	71.38	70.96	7.74	11.89	10.21	9.95	24.76	22.21	18.17	21.71
S.Em. ±	2.780	2.560	3.300	2.896	0.470	0.490	0.500	0.486	1.810	1.080	1.420	0.839
CD (P= 0.05)	8.180	7.540	9.690	NS	1.380	NS	1.480	NS	5.340	3.180	4.180	2.370
CV (%)	11.82	7.84	11.25	10.16	14.46	10.85	12.65	12.47	16.71	11.67	17.69	15.67
Y x T	-	-	-	NS	-	-	-	NS	-	-	-	NS

Table 24. N, P and K uptake by wheat straw as influenced by different treatments

Treatments	N uptake (kg/ha)				P uptake (kg/ha)				K uptake (kg/ha)			
	2017	2018	2019	Pooled	2017	2018	2019	Pooled	2017	2018	2019	Pooled
Wheat												
T ₁ : 75% RDN through VC	35.94	44.78	43.35	41.36	5.62	7.78	7.37	6.92	41.42	53.62	52.58	49.51
T ₂ : 50% RDN through VC	30.85	35.79	34.99	33.88	4.50	4.98	5.04	4.84	53.43	40.55	39.53	38.51
T ₃ : 75% RDN through CC	39.80	48.87	45.88	44.85	6.21	8.44	8.14	7.60	45.24	58.90	57.12	53.76
T ₄ : 50% RDN through CC	28.62	37.33	36.48	34.14	3.81	5.12	5.27	4.75	31.56	41.13	40.08	37.59
S.Em. ±	1.46	1.43	1.75	0.88	0.35	0.35	0.32	0.20	2.28	1.90	2.01	1.20
CD (P= 0.05)	4.29	4.21	5.16	2.48	1.03	1.02	0.93	0.61	6.69	5.55	5.92	3.37
CV (%)	12.19	9.71	12.34	12.40	19.73	14.90	13.82	15.88	16.76	11.07	12.02	13.07
Y x T	-	-	-	NS	-	-	-	NS	-	-	-	NS

Table 25. EC and pH of soil after completion of cycle as influenced by different treatments

Treatments	Wheat	EC(dSm ⁻¹)				pH			
		2017	2018	2019	Pooled	2017	2018	2019	Pooled
Greengram	Wheat								
T ₁ : 100% RDN through FYM	T ₁ : 75% RDN through VC	0.12	0.11	0.11	0.12	7.70	7.74	7.67	7.70
T ₂ : 100% RDN through FYM	T ₂ : 50% RDN through VC	0.13	0.12	0.13	0.13	7.80	7.63	7.84	7.75
T ₃ : 100% RDN through CC	T ₃ : 75% RDN through CC	0.12	0.11	0.11	0.12	7.63	7.80	7.63	7.68
T ₄ : 100% RDN through CC	T ₄ : 50% RDN through CC	0.13	0.12	0.12	0.12	7.74	7.70	7.79	7.74
S.Em. ±		0.003	0.002	0.003	0.004	0.05	0.05	0.05	0.05
CD (P= 0.05)		NS	NS	NS	NS	NS	NS	0.16	NS
CV (%)		9.00	8.01	8.98	8.69	1.97	1.97	1.96	1.97
Y x T					NS				NS
Initial		0.12	-	-	-	7.7	-	-	-

Table 26. Organic carbon (%) and available N content in soil after completion of cycle as influenced by different treatments

Treatments	Wheat	Organic carbon (%)				Available N (kg ha ⁻¹)			
		2017	2018	2019	Pooled	2017	2018	2019	Pooled
Greengram	Wheat								
T ₁ : 100% RDN through FYM	T ₁ : 75% RDN through VC	0.32	0.30	0.30	0.30	173	164	165	167
T ₂ : 100% RDN through FYM	T ₂ : 50% RDN through VC	0.30	0.32	0.32	0.31	164	173	170	169
T ₃ : 100% RDN through CC	T ₃ : 75% RDN through CC	0.32	0.30	0.30	0.30	173	165	164	167
T ₄ : 100% RDN through CC	T ₄ : 50% RDN through CC	0.30	0.32	0.32	0.31	165	174	172	170
S.Em. ±		0.01	0.01	0.01	0.008	3.12	2.89	2.79	2.90
CD (P= 0.05)		NS	NS	NS	NS	NS	NS	NS	NS
CV (%)		7.13	8.08	7.13	7.46	5.03	4.86	4.69	4.86
Y x T					NS				NS
Initial		0.3	-	-	-	143	-	-	-

Table 27. Available phosphorus and potassium content in soil after completion of cycle as influenced by different treatments

Treatments	Wheat	Available P ₂ O ₅ (kg/ha)				Available K ₂ O (kg/ha)			
		2017	2018	2019	Pooled	2017	2018	2019	Pooled
Greengram	Wheat								
T ₁ : 100% RDN through FYM	T ₁ : 75% RDN through VC	47.24	43.76	44.86	45.29	267.84	264.79	265.76	266.13
T ₂ : 100% RDN through FYM	T ₂ : 50% RDN through VC	44.86	48.15	47.21	46.74	265.76	274.10	274.11	271.33
T ₃ : 100% RDN through CC	T ₃ : 75% RDN through CC	48.45	44.73	48.15	47.01	274.16	265.76	264.91	268.28
T ₄ : 100% RDN through CC	T ₄ : 50% RDN through CC	43.78	47.23	43.51	44.84	265.66	268.89	269.03	267.86
S.Em. ±		1.25	1.26	1.27	1.26	2.59	2.53	2.54	2.55
CD (P= 0.05)		NS	NS	NS	NS	NS	NS	NS	NS
CV (%)		7.72	7.73	7.83	7.76	6.73	6.57	7.01	6.53
Y x T		-	-	-	NS	-	-	-	NS
Initial		40.90	-	-	-	253.20	-	-	-

Table 28. Available sulphur content in soil after completion of cycle as influenced by different treatments

Treatments		Available S (ppm)			
Greengram	Wheat	2017	2018	2019	Pooled
T ₁ : 100% RDN through FYM	T ₁ : 75% RDN through VC	10.84	10.29	10.28	10.47
T ₂ : 100% RDN through FYM	T ₂ : 50% RDN through VC	10.28	10.54	10.60	10.47
T ₃ : 100% RDN through CC	T ₃ : 75% RDN through CC	10.54	10.36	10.31	10.40
T ₄ : 100% RDN through CC	T ₄ : 50% RDN through CC	10.31	10.83	10.73	10.62
S.E.m. ±		0.17	0.16	0.17	0.17
CD (P= 0.05)		NS	NS	NS	NS
CV (%)		4.63	4.33	4.71	4.56
Y x T		-	-	-	NS
Initial		9.8	-	-	-

3.3 Microbial Studies

The soil population of *Rhizobium*, *Azotobacter* and PSB in greengram-wheat cropping sequence were influenced by the treatments (Table 16). The population of microorganisms were evaluated using serial dilution and standard plating. The population of soil bacteria showed significant variation among the treatments under investigation. The treatment T₃ [100% RDN through castor cake in greengram; 75% RDN through castor cake in wheat] showed highest number of *Rhizobium*, *Azotobacter*, and PSB which was followed by the treatment T₄ [100% RDN through castor cake in greengram; 50% RDN through castor cake in wheat].

3.4 Chemical Studies

3.4.1 Nutrient content in seed and stover of green gram

The perusal of data presented in Table 17 showed that treatment T₁ registered maximum N content in greengram seed on pooled basis. Whereas, significantly higher P and K content in seed was observed under treatment T₃ but, it was at par with treatment T₁ on pooled basis. The data given in Table 18 indicated that treatment T₁ recorded significantly higher N and P content in greengram stover but, it was at par with treatment T₃ on pooled basis. While, treatment T₃ registered significantly higher K content in stover, which remained at par with treatment T₁ on pooled basis.

3.4.2 N, P and K uptake by greengram seed

The data presented in Table 19 revealed that maximum N uptake by green gram seed was observed under treatment T₃. While, significantly higher P uptake by green gram seed was registered by treatment T₃, but it was at par with treatment T₁, whereas treatment T₃ resulted in significantly the highest K uptake by greengram seed over rest of the treatments on pooled basis.

3.4.3 N, P and K uptake by greengram stover

The data presented in Table 20 showed that significantly higher N and P uptake by greengram stover was observed with the application of 100% RDN through CC (T₃) but did not differ with treatment T₁ in case of N and P uptake by green gram stover on

pooled basis. However, treatment T₃ recorded significantly the highest K uptake by greengram stover.

3.4.4 Nutrient content in wheat grain and straw

The data presented in Table 21 revealed that maximum content of N in wheat grain was recorded by T₁ treatment, whereas maximum content of P was registered by T₃ treatment on pooled basis. While treatment T₁ resulted in significantly higher K content (0.629%) in grain, but it was at par with treatment T₃ on pooled basis. Treatment T₁ registered significantly higher N and P content in wheat straw but, it was at par with treatment T₃ on pooled basis. Whereas, treatment T₃ was resulted in significantly higher K content in wheat straw, but it was at par with treatment T₁ (Table 22).

3.4.5 N, P and K uptake by wheat grain

A perusal of data (Table 23) indicated that maximum N and P uptake by wheat grain was observed under treatment T₃ on pooled basis. Treatment T₃ resulted in significantly higher K uptake by wheat grain over rest of the treatments on pooled basis. On the contrary, significantly the highest N, P and K uptake by wheat straw was noted under treatment T₃ on pooled basis (Table 24).

3.4.6 EC and pH of soil after completion of cycle

The data presented in Tables 25 to 28 on EC, pH, organic carbon, available N, P₂O₅, K₂O and S content in soil after completion of crop cycle did not differ due to various treatments in pooled results.

4. CONCLUSION

Based on findings of three years experimentation, it is concluded that application of 100% recommended nitrogen to greengram and 75% recommended nitrogen to succeeding wheat crop through castorcake for obtaining higher greengram equivalent yield and net return.

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.

REFERENCES

- Dixit GP. Project coordinators report. annual group meet (*kharif*, 2005). Indian Inst. Pulses Res., Kanpur; 2005.
- Mohan J, Negi N, Bharti B. Integrated Nutrient Management in Wheat (*Triticum aestivum* L.): An Overview. J. Exp. Agric. Int. [Internet]. 2024;46(6):699-706.
[Accessed On:2024 Jun. 7]
Available:<https://journaljeai.com/index.php/JEAI/article/view/2526>
- Prakash BG, Dawson J, Naveena K, Reddy RVK. Influence of Various Methods of Sowing and Organic Manures on the Productivity of Wheat (*Triticum aestivum* L.). Int. J. Plant Soil Sci. 2024;36(3):258-63.
[Accessed On:2024 Jun. 7]
Available:<https://journalijpss.com/index.php/IJPSS/article/view/4421>
- Jannoura R, Joergensen RG, Bruns C. Organic fertilizer effects on growth, crop yield, and soil microbial biomass indices in sole and intercropped peas and oats under organic farming conditions. European Journal of Agronomy. 2014;52:259-70.
- Ali N, Khan MN, Ashraf MS, Ijaz S, Saeed-ur-Rehman H, Abdullah M, Ahmad N, Akram HM, Farooq M. Influence of different organic manures and their combinations on productivity and quality of bread wheat. Journal of Soil Science and Plant Nutrition. 2020;20:1949-60.
- Byerlee, D. Polanco EH. Wheat in the world food economy increasing role in developing countries. Food Pol. 1983;8: 67–75.
- Reddy SS, Shivaraj B, VC, Reddy, Ananda MG. Direct effect of fertilizer and residual effect of organic manure on yield and nutrient uptake of maize (*Zea may* L.) in groundnut-maize cropping system. Crop Res. Hsiao. 2005;29:390–395
- Lima RSL, Severino Liv, Sampaio LR, Sofiatti V. Blends of castor meal and castor husks for optimized use as organic fertilizer. Industrial Crops and Products. 2011;33(2):364-368.
- Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research Publication. 1985;87-89.
- Patel RK, Prajapati KM, Patel VJ. Effect of organic and inorganic sources of nutrient on yield and quality of wheat (*Triticum aestivum* L.). International Journal of Chemical Studies, 2019;7(3): 1694-1698.
- Sharma A, Kumar A, Singh RK, Singh US. Influence of Integrated Nutrient Management on Yield, Quality and Soil Health in Wheat (*Triticum aestivum* L.)–Green Gram (*Vigna radiata* L.) Cropping System. International Journal of Current Microbiology and Applied Sciences. 2020;9(9):579-586.
- Mahajan S, Dahiya MS. Effect of organic manures on wheat (*Triticum aestivum*)-greengram (*Vigna radiata*) cropping system in an entisol of semi-arid region. The Journal of Agricultural Sciences. 2017;12(1):22-27.
- Dubey DP, Singh VP. Influence of organic and inorganic sources of nutrient on yield, nutrient uptake, quality and economics of wheat (*Triticum aestivum*) and greengram (*Vigna radiata*) cropping system. International Journal of Pure and Applied Bioscience. 2018; 6(3):556-564.
- Nisha K, Yadav RK, Gangwar B. Influence of organic manures and bio-fertilizers on growth, yield and economics of wheat (*Triticum aestivum* L.)–Greengram (*Vigna radiata* L.) cropping system. International Journal of Current Microbiology and Applied Sciences. 2018;7(4): 1496-1504.
- Panwar RK, Yadav LS. Effect of organic and inorganic sources of nutrients on productivity, profitability and soil fertility in wheat (*Triticum aestivum*)-greengram

- (*Vigna radiata*) cropping system. The Pharma Innovation Journal. 2019;8(6): 225-229.
16. Vavilov NI. The origin, variation, immunity and breeding of cultivated plants. Chronica Botanica. 1951;13(1–6):1–366.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of the publisher and/or the editor(s). This publisher and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.

© Copyright (2024): Author(s). The licensee is the journal publisher. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:

<https://www.sdiarticle5.com/review-history/118808>