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Effect of pelleted vermicompost and its scheduling on soil properties, nutrient uptake and economics of organic greengram (*Vigna radiata* L.)

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Abstract

A field experiment was conducted during kharif 2022 at the Organic Farming Unit, Rajasthan College of Agriculture, MPUAT, Udaipur to evaluate the effect of pelleted vermicompost and its scheduling on soil properties, nutrient uptake and economics of organic greengram. The experiment was laid out in factorial randomized block design with three replications comprising five levels of pelleted vermicompost (control, 1, 2, 3 and 4 t ha⁻¹) and three scheduling treatments.

The results revealed that application of pelleted vermicompost significantly improved soil organic carbon and available nutrient status. The highest nutrient uptake (N, P, K, Zn and Fe) was recorded under 4 t ha⁻¹ pelleted vermicompost. Among scheduling treatments, split application (50% at sowing + 25% at 4 WAS + 25% at 6 WAS) resulted in significantly higher nutrient uptake. Economic analysis indicated that application of 4 t ha⁻¹ pelleted vermicompost recorded maximum net return (₹ 73,077 ha⁻¹) and benefit:cost ratio.

Thus, application of pelleted vermicompost at 4 t ha⁻¹ along with split scheduling is beneficial for improving soil health, nutrient uptake and profitability of organic greengram.

Keywords: Greengram, vermicompost, soil health, nutrient uptake, economics

Introduction

Sustainable crop production under organic farming systems depends largely on soil health and efficient nutrient cycling. Continuous use of organic inputs plays a crucial role in improving soil physical, chemical and biological properties.

Greengram (*Vigna radiata* L.) is an important pulse crop widely cultivated in India and serves as a major source of dietary protein (Kumar and Ali, 2004) ^[1]. Greengram contributes to soil fertility through biological nitrogen fixation, but its productivity under organic systems depends on efficient nutrient management.

Vermicompost is known to enhance soil organic carbon, microbial activity and nutrient availability.

Pelleted vermicompost offers advantages such as ease of application, reduced losses and slow release of nutrients (Hernandez *et al.*, 2006) ^[4]. However, limited information is available regarding its effect on soil properties, nutrient uptake and economics under greengram cultivation. Therefore, the present study was undertaken.

Materials and Methods

The experiment was conducted during *kharif* 2022 at the Organic Farming Unit, Rajasthan College of Agriculture, MPUAT, Udaipur.

The experiment was laid out in factorial randomized block design (FRBD) with three replications, comprising 15 treatment combinations involving four levels of pelleted vermicompost (1, 2, 3 and 4 t ha⁻¹) along with control, and three scheduling treatments. The treatment combinations were randomized with the help of random number table (Fisher, 1950)

^[2] Greengram variety GM-4 was sown at spacing of 30 cm × 10 cm using seed rate of 15 kg ha⁻¹.

Preparation of vermicompost pellets

Well dried vermicompost is taken after proper sieving into a container and bentonite as binding agent, is thoroughly mixed and then taken into the pellet making machine which makes small cylindrical pellets. The cylindrical pellets are then placed in centrifugal machine which helps in transforming the cylindrical pellets into spherical pellets.

Observations recorded

- Soil properties

Organic carbon (Walkley and Black, 1934) ^[8].

Available N, P, K by Subbiah and Asija (1956) ^[7], Ascorbic acid method (Olsen *et al.* 1954) ^[5], 1N neutral ammonium acetate as an extractant (Hanway and Heidel, 1952) ^[3] and flame photometer, respectively.

- Nutrient uptake (N, P, K, Zn, Fe): Nutrient uptake was calculated based on nutrient content and yield.
- Economics (net return, B:C ratio)

Standard procedures were followed for analysis of soil and plant samples.

Statistical analysis of the individual data of various characters studied in the experiment will be carried out as per Factorial Randomized Block Design (FRBD) as suggested by Panse and Sukhatme (1985) ^[6].

Results and Discussion

Soil Properties

Application of pelleted vermicompost significantly improved soil organic carbon and available nutrient status. The highest organic carbon and available N, P and K were recorded under 4 t ha⁻¹ pelleted vermicompost.

The improvement in soil properties may be attributed to addition of organic matter, enhanced microbial activity and improved

nutrient mineralization under vermicompost application.

Split application (S₃) also recorded higher values compared to S₂ and S₁, indicating better synchronization of nutrient release with crop demand.

Nutrient Uptake

Nitrogen, Phosphorus and Potassium Uptake

Nutrient uptake (N, P and K) increased significantly with increasing dose of pelleted vermicompost. The highest uptake was recorded under 4 t ha⁻¹, which was significantly superior over lower doses.

Among scheduling treatments, split application (S₃) recorded higher uptake due to continuous availability of nutrients throughout crop growth.

The increase in nutrient uptake may be attributed to improved root growth, higher biomass production and enhanced nutrient availability.

Micronutrient Uptake (Zn and Fe)

Zinc and iron uptake were also significantly influenced by pelleted vermicompost. The highest uptake was recorded under 4 t ha⁻¹ and split application treatment.

This may be due to increased solubility of micronutrients and enhanced microbial activity in soil.

Economics

Economic analysis revealed that application of pelleted vermicompost significantly influenced profitability of greengram cultivation.

The highest net return (₹ 73,077 ha⁻¹) and benefit: cost ratio were recorded under 4 t ha⁻¹ pelleted vermicompost. Split application (S₃) also resulted in higher economic returns compared to other scheduling treatments.

The higher profitability may be attributed to increased yield and better nutrient use efficiency.

Table 1: Effect of pelleted vermicompost and its scheduling on organic carbon and nutrient status of soil after crop harvest of organic greengram

Treatments	Organic Carbon (%)	Available nitrogen (kg ha ⁻¹)	Available phosphorus (kg ha ⁻¹)	Available potassium (kg ha ⁻¹)
Doses of pelleted vermicompost				
Control	0.624	259.43	18.62	263.68
1 t ha ⁻¹	0.631	263.33	18.73	267.53
2 t ha ⁻¹	0.634	264.20	19.06	268.00
3 t ha ⁻¹	0.639	268.63	19.22	272.95
4 t ha ⁻¹	0.642	269.11	19.52	273.88
S.Em.±	0.006	4.660	0.238	5.663
C.D.(P=0.05)	NS	NS	NS	NS
Scheduling of pelleted vermicompost				
100% at sowing	0.630	261.34	18.69	265.60
50% at sowing + 50% at 4 WAS	0.632	265.66	19.10	269.93
50% at sowing + 25% at 4 WAS + 25% at 6 WAS	0.640	267.83	19.31	272.10
S.Em.±	0.005	3.609	0.184	4.386
C.D.(P=0.05)	NS	NS	NS	NS

Table 2: Effect of pelleted vermicompost and its scheduling on soil nutrient status after crop harvest of organic greengram

Treatments Available zinc (mg ha ⁻¹)	Available iron (mg ha ⁻¹)
Doses of pelleted vermicompost	
Control	2.365
1 t ha ⁻¹	2.378
2 t ha ⁻¹	2.387
3 t ha ⁻¹	2.394
4 t ha ⁻¹	2.398
S.Em.±	0.032
C.D.(P=0.05)	NS

Scheduling of pelleted vermicompost		
100% at sowing	2.347	4.790
50% at sowing + 50% at 4 WAS	2.392	4.813
50% at sowing + 25% at 4 WAS + 25% at 6 WAS	2.413	4.945
S.Em.±	0.025	0.057
C.D.(P=0.05)	NS	NS

Table 3: Effect of pelleted vermicompost and its scheduling on nutrient uptake by organic greengram

Treatments	Nitrogen			Phosphorus			Potassium		
	Seed	Haulm	Total	Seed	Haulm	Total	Seed	Haulm	Total
Doses of pelleted vermicompost									
Control	27.03	24.42	51.45	3.99	6.70	10.69	9.40	28.03	37.43
1 t ha ⁻¹	33.66	31.09	64.75	4.89	8.58	13.46	11.83	37.35	49.18
2 t ha ⁻¹	37.97	36.35	74.32	5.39	9.86	15.25	13.21	43.64	56.85
3 t ha ⁻¹	43.64	39.85	83.49	6.09	11.26	17.35	15.10	48.62	63.71
4 t ha ⁻¹	47.56	43.40	90.96	6.64	12.79	19.43	16.59	54.32	70.90
S.Em.±	0.934	0.949	1.385	0.133	0.248	0.295	0.332	1.267	1.370
C.D.(P=0.05)	2.706	2.748	4.011	0.384	0.718	0.854	0.962	3.671	3.967
Scheduling of pelleted Vermicompost									
100% at sowing	35.03	31.30	66.33	4.95	9.08	14.04	11.94	37.71	59.65
50% at sowing + 50% at 4 WAS	37.83	34.99	72.82	5.38	9.73	15.11	13.23	42.02	55.25
50% at sowing + 25% at 4 WAS + 25% at 6 WAS	41.07	38.77	79.84	5.86	10.70	16.56	14.50	47.44	61.94
S.Em.±	0.724	0.735	1.072	0.103	0.192	0.228	0.257	0.982	1.061
C.D.(P=0.05)	2.096	2.128	3.107	0.298	0.556	0.661	0.745	2.844	3.073

Table 4: Effect of pelleted vermicompost and its scheduling on zinc and iron uptake by organic greengram

Treatments	Zinc			Iron		
	Seed	Haulm	Total	Seed	Haulm	Total
Doses of pelleted vermicompost						
Control	196.30	320.05	516.34	473.22	789.89	1263.11
1 t ha ⁻¹	246.38	427.07	673.45	599.46	1023.35	1622.81
2 t ha ⁻¹	274.45	489.26	763.71	665.82	1153.58	1819.40
3 t ha ⁻¹	317.25	554.40	871.66	760.86	1273.48	2034.34
4 t ha ⁻¹	355.50	618.54	974.04	842.05	1400.10	2242.15
S.Em.±	7.884	15.333	17.616	18.691	31.184	40.869
C.D.(P=0.05)	22.838	44.419	51.032	54.145	90.338	118.392
Scheduling of pelleted vermicompost						
100% at sowing	253.41	428.88	682.29	609.39	1028.82	1638.21
50% at sowing + 50% at 4 WAS	275.33	473.90	749.23	662.85	1111.50	1774.35
50% at sowing + 25% at 4 WAS + 25% at 6 WAS	305.19	542.81	848.00	732.60	1243.93	1976.53
S.Em.±	6.107	11.877	13.645	14.478	24.155	31.657
C.D.(P=0.05)	17.691	34.407	39.529	41.940	69.975	91.706

Table 5: Effect of pelleted vermicompost and its scheduling on economic of organic greengram

Treatments	Gross return (₹ ha ⁻¹)	Net return (₹ ha ⁻¹)	B-C ratio
Doses of pelleted vermicompost			
Control	75653	57743	4.22
1 t ha ⁻¹	90974	66264	3.68
2 t ha ⁻¹	99348	67838	3.15
3 t ha ⁻¹	109976	71666	2.87
4 t ha ⁻¹	118187	73077	2.62
S.Em.±	2079	2079	0.065
C.D.(P=0.05)	6022	6022	0.189
Scheduling of pelleted vermicompost			
100% at sowing	92371	61661	3.13
50% at sowing + 50% at 4 WAS	98080	66570	3.27
50% at sowing + 25% at 4 WAS + 25% at 6 WAS	106032	73722	3.52
S.Em.±	1610	1610	0.051
C.D.(P=0.05)	4665	4665	0.147

Conclusion

Application of pelleted vermicompost significantly improved soil properties, nutrient uptake and economics of organic greengram. Among treatments, 4 t ha⁻¹ pelleted vermicompost proved most effective.

Split application (50% at sowing + 25% at 4 WAS + 25% at 6 WAS) further enhanced soil health and nutrient uptake. Thus, application of pelleted vermicompost at 4 t ha⁻¹ along with split scheduling can be recommended for sustainable and profitable cultivation of organic greengram.

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