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Research Communication

Nutrient management through organic and inorganic sources of nutrition in summer greengram (*Vigna radiata*)

S.S. SASMAL[1], S.S. NANDA[2], SUBHAPRADA DASH[3] AND S. SUBHADARSHI[4]

Faculty of Agricultural Sciences, Siksha 'O' Anusandhan, (Deemed to be University), Bhubaneswar, Odisha 752 054

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ABSTRACT

A field experiment was conducted at Agricultural Research Station, Binjhagiri, Chhatabar of Siksha "O" Anusandhan Deemed to be University, Bhubaneswar (Odisha) during the summer 2023, to study the effect of organic and inorganic sources of nutrition in greengram. The experiment was laid out in a randomized block design replicated thrice with 10 treatments. The results revealed that integrated application of 50% RDF + FYM @ 2 t/ha + *Rhizobium* inoculation @ 200 g/10 kg of seed recorded significantly higher N (3.91%), P (0.30%) & K (2.11%) content of seed over the treatments containing 100% RDF. The same treatment recorded significantly higher nutrient uptake in both seed and stover. It also recorded higher seed (7.5 q/ha) and stover yield (21.00 q/ha) during the summer season. In the case of economics, with 50 % RDF + FYM @ 2 t/ha + *Rhizobium* inoculation @ 200 g/10 kg seed recorded the highest gross monetary return (Rs. 74625/ha), net monetary return (Rs. 42331 /ha) and B:C ratio of 2.31.

Key words: *Azotobacter*, FYM, Neem cake, *Rhizobium*, Vermicompost

Greengram is a cultivated leguminous crop in India serving various purposes as a vegetable, pulse, fodder, and green manure crop. Its seeds are highly palatable, nutritive and digestible in nature. It is a good source of protein and carbohydrates. India is the largest producer of pulses in the world. The area under pulse crops in India during 2021-22 is around 28 million ha with production of 26.53 million tonnes and productivity of about 885 kg/ha (Reddy *et al.,* 2022). Integrated nutrient management with a combination of chemical fertilizers, organic manures, and bio-fertilizers is of paramount importance in the face of declining soil health and fertility (Bhatt *et al*., Kumawat *et al.,*2022). Efficient and balanced fertilization is one of the factors that can help us in achieving desired productivity in pulses (Nawagatla and Patil, 2024). It is challenging to replenish or supplement the inorganic fertiliser in long duration crops. Whereas the nutrient requirements of short-duration crops are not as much as of crops like rice, wheat, maize, sugarcane, etc. Here it is comparatively easy to add or replace the chemical fertiliser with organic sources. Generally, in the summer season, the farmers are focused on providing sufficient moisture to the crops, but nutrient management also has similar importance for better growth and development. In this light, the present investigation is conducted to establish the viable option of nutrient management through different combinations of organic sources such as – FYM, neem cake, bio-fertiliser, and vermicompost with varying doses of chemical fertiliser in summer greengram.

A field experiment was conducted during the summer season of the year 2023 at the Agricultural Research Station, Binjhagiri, Chhatabar of Siksha "O" Anusandhan Deemed to be University, Bhubaneswar. The location has a latitude of 28˚2'N and a longitude of 85˚12'E. It is about 75 km away from the Bay of Bengal at an altitude of 45 meters above mean sea level. The soil was sandy-loamy with a pH of 6.6, organic carbon of 0.4%, medium in available N (205 kg/ha), available P (13.21 kg/ha), and available K (128 kg/ha). The maximum and minimum temperature of 36.2˚C and 22.2˚C was recorded during the crop growing period. The total number of rainy days in between 4-14 standard meteorological week was only 3 days. The average bright sunshine hour per day varied from 3.9 hours to 8.9 hours. The experiment was laid out in a randomized complete block design replicated thrice with 10 treatments (Table 1). The greengram variety *Virat*

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[2]Corresponding author's Email: subahpradadash@8oa.ac.in
[1]M.Sc. (Ag.) Scholar, [2]Professor, [3]Associate Professor, [4]Ph.D. Research Scholar, Department of Agronomy, Faculty of Agricultural Sciences, SOA, Bhubaneswar, Odisha 751029

Table 1. Effect of nutrient management on nutrient content and uptake by summer greengram

Treatments	N content (%)		P content (%)		K content (%)		N uptake(kg/ha)			P uptake (kg/ha)			K uptake(kg/ha)		
	Seed	Stover	Seed	Stover	Seed	Stover	Seed	Stover	Total	Seed	Stover	Total	Seed	Stover	Total
T_1, RDF (20:40:20 N:PO:KOkg/ha)	3.65	0.49	0.12	0.07	1.62	0.73	16.37	8.85	25.22	0.54	1.27	1.81	7.29	13.15	20.44
T_2, RDF+ neem cake @ 1 t/ha	3.81	0.60	0.22	0.14	1.78	0.87	26.58	11.44	38.02	1.54	2.67	4.21	12.46	16.58	29.05
T_3, RDF + *Azotobacter* @ 5 kg/ha	3.87	0.65	0.29	0.15	2.00	0.94	28.08	13.03	41.12	2.12	3.01	5.13	14.65	18.85	33.49
T_4, FYM @ 5 t/ha	3.60	0.44	0.10	0.05	1.50	0.66	14.38	7.51	21.89	0.40	0.85	1.26	6.02	11.27	17.29
T_5, Vermicompost@2.5t/ha	3.70	0.53	0.15	0.09	1.64	0.76	19.91	9.57	29.48	0.81	1.62	2.44	8.86	13.72	22.58
T_6, 50 % RDF + FYM @ 2 t/ha + *Rhizobium* @ 200 g /10 kg seed	3.91	0.69	0.30	0.16	2.11	0.99	29.23	14.49	43.72	2.25	3.36	5.62	15.83	20.79	36.62
T_7, 50 % RDF + *Azotobacter* @ 5 kg/ha	3.82	0.62	0.25	0.15	1.85	0.92	25.93	12.42	38.35	1.71	3.00	4.71	12.59	18.42	31.00
T_8, *Rhizobium* @ 200 g /10 kg seed + FYM @ 4t/ha	3.75	0.56	0.20	0.11	1.70	0.83	24.31	10.66	34.97	1.30	2.09	3.40	11.06	15.79	26.84
T_9, *Azotobacter* @ 5 kg/ha + FYM @ 4 t/ha	3.78	0.58	0.21	0.12	1.72	0.85	24.89	11.05	35.94	1.39	2.29	3.68	11.36	16.18	27.54
T_{10}, Neem cake @ 1 t/ha + FYM @ 2 t/ha	3.73	0.50	0.18	0.10	1.64	0.76	22.34	9.06	31.40	1.08	1.82	2.90	9.85	13.77	23.62
SEm±	0.008	0.007	0.005	0.008	0.05	0.006	0.29	0.13	0.28	0.05	0.11	0.14	0.42	0.24	0.46
CD (P=0.05)	0.02	0.02	0.01	0.02	0.16	0.01	0.68	0.39	0.83	0.15	0.34	0.43	1.26	0.71	1.37

was sown with spacing 30 cm × 10 cm on 23rd January 2023. The recommended dose of fertilizer was 20 kg/ha of N, 40 kg/ha of P_2O_5, and 20 kg/ha of K_2O. The seed was inoculated with *Rhizobium* @ 200 g/10kg seed. The nutrient content of the organic sources such as - FYM, neem cake and vermicompost used in this present investigation were 0.47N, 0.18P, 0.45K; 5.0N, 0.8P, 1.1K and 2.5N, 1.8P, 1.7K, respectively.

The nutrient content of N, P, and K related to seed and stover is presented in Table 1. The results revealed that 50% RDF + FYM @ 2 t/ha+ *Rhizobium* inoculation @ 200 g/10 kg of seed recorded higher N content 3.91% in seed and 0.69% in stover. The same trend was also maintained in seed and stover irrespective of P and K content. The lower value was recorded with the application of FYM alone @ 5t/ha irrespective of nutrient content of N, P, and K. Higher content of N, P & K in grain and stover was due to the combined application of organic and chemical fertilizers. Especially when urea was applied, it lowered the C: N ratio, which accelerated nutrient release from organic sources by mineralization (Barkha *et al.,* 2020). In the case of nutrient uptake by crop, the N uptake (29.93 kg/ha) was significantly higher by application of 50% RDF + FYM @ 2 t/ha + *Rhizobium* inoculation @ 200 g/10 kg seed. Next in the order was RDF + *Azotobacter* @ 5 kg/ha (32.92 kg/ha). The N uptake of stover maintained a similar trend as in the case of seed. Similarly, the P uptake in seed (2.25 kg/ha) and stover (3.36 kg/ha) was found higher in the treatment containing 50% RDF + FYM @ 2 t/ha + *Rhizobium* @ 200 g/10kg). The same trend was also maintained in the case of K uptake by seed (15.83 kg/ha) and stover (21.61 kg/ha), with a total uptake of 36.62 kg/ha. Integration of organic and inorganic fertilizers resulted in more uptake of nutrients as compared to the sole use of organic or inorganic. This might be due to the balanced and combined use of various plant nutrient sources, which resulted in the proper absorption, translocation, and assimilation of these nutrients (Tyagi and Upadyay, 2015).

Application of 50% RDF + FYM @ 2 t/ha + *Rhizobium* inoculation @ 200 g/10 kg of seed recorded significantly higher seed yield of 7.5 q/ha and stover yield of 21.0 q/ha followed by RDF + *Azotobacter* @ 5 kg/ha of 7.3 q/ha seed yield and 20.05 q/ha stover yield (Table 2). The higher yield at 50% RDF + FYM @ 2 t/ha + *Rhizobium* @ 200 g/10 kg seed was due to the positive bearing of growth attributing characters such as plant height, number of nodules per plant, dry matter production and crop growth rate and yield attributing characters like pods/plant, seeds/pod, pod length, and test wt. (Tripathi *et al.,* 2014). The lowest seed yield was observed by the application of FYM @ 5 t/ha.

Table 2. Effect of nutrient management on seed, stover yield and economics of summer greengram

Treatments	Seed yield (q/ha)	Stover yield (q/ha)	Cost of cultivation (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)	Benefit cost : ratio
T_1, RDF (20:40:20 N:PO: KO kg/ha)	4.5	18.01	32,195	47,480	15,284	1.47
T_2, RDF+ neem cake @ 1 t/ha	7.0	19.06	57,795	69,380	11,584	1.20
T_3, RDF + Azotobacter @ 5 kg/ha	7.3	20.05	33,245	72,440	39,194	2.18
T_4, FYM @ 5 t/ha	4.0	17.07	33,800	42,735	8,935	1.26
T_5, Vermicompost@2.5t/ha	5.4	18.05	53,800	55,195	1,395	1.03
T_6, 50 % RDF + FYM @ 2 t/ha + Rhizobium @ 200 g/10 kg seed	7.5	21.00	32,293	74,625	42,331	2.31
T_7-50 % RDF + Azotobacter @ 5 kg/ha	6.8	20.01	30,698	68,145	37,446	2.22
T_8-, FYM @ 4t/ha + Rhizobium @ 200 g /10 kg seed	6.5	19.01	37,445	65,080	27,635	1.74
T_9, FYM @ 4 t/ha + Azotobacter @ 5 kg/ha	6.6	19.03	37,850	65,945	28,095	1.74
T_{10}, Neem cake @ 1 t/ha + FYM @ 2 t/ha	6.0	18.07	58,400	60,335	1,935	1.03
SEm±	0.06	0.17	-	-	-	-
CD (P=0.05)	0.19	0.51	-	-	-	-

It was mentioned that the application of 50% RDF + FYM @ 2 t/ha + *Rhizobium* inoculation of seed @ 200 g/ 10 kg recorded the highest gross return of ₹ 74625 /ha, including the highest net return of ₹ 42331 /ha and highest B: C ratio of 2.31 (Table 2). Banotra *et al*. (2021) found that 75% NPK + 25% N through vermicompost and FYM (1:1) were adjudged as the best treatments with regard to crop-growth parameters, yield and yield attributes, net returns, and benefit: cost ratio. The application of RDF + *Azotobacter* at 5 kg/ha resulted in second best gross, net returns and B:C ratio. The higher seed and stover yields obtained through the application of 50% RDF, FYM, and rhizobium might be the reason for the resultant gross return, net return, and B: C ratio (Lal *et al.,* 2022).

It was concluded that application of 50% RDF + FYM @ 2 t/ha + *Rhizobium* inoculation of seed @ 200 g/10 kg seed recorded the highest seed yield, stover yields along with the highest nutrient content and uptake by the crop. Further, it also recorded the highest net return, gross return, and B: C ratio.

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