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The impact of various organic sources on soil nutrient content and nutrient uptake in green gram (*Vigna radiata* L. WILCZEK) under organic farming practices

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Abstract
A study was conducted at ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, In 2020-21. The study aimed to examine the effects of various organic nutrient sources on soil nutrient availability, nutrient uptake, and nutrient content in grain and stover of green gram cultivation in a certified organic farm during the rabi season. Applying organic sources had no significant impact on the nitrogen, phosphorus and potassium content in the grain and stover. Post-harvest, the impact of different treatments on soil organic carbon and the availability of nitrogen, phosphorus and potassium (P_2O_5 and K_2O) was not significant. Treatment T_6, applying 100% recommended nitrogen dose through vermicompost and 1% Enriched Banana Pseudostem Sap (EBPS), exhibited the highest nitrogen, phosphorus and potassium absorption in grain and stover compared to all other treatments. Treatment T_9, which included Ghan-jivamrut at 500 kg/ha and jivamrut at 500 l/ha, exhibited the lowest nitrogen, phosphorus and potassium nutrient uptake values in both grain and stover.

Keywords: Organic farming, green gram, available nutrients in soil, uptake and content of nutrients of the crop

Introduction

The green gram (*Vigna radiata*), also known as mung bean or golden gram, is a major short-duration pulse crop grown in India. It is a versatile crop cultivated for seeds, green manure and forage. It is an effective green manure when mixed into the soil. Green gram, as a legume crop, has low nitrogen requirements. It uses atmospheric nitrogen by establishing symbiotic nitrogen fixation with nodule bacteria to fulfil almost all their nitrogen needs under typical circumstances (Kannaiyan, 1999) [6]. Green gram is a protein-rich food with a protein content of 25% and a high digestibility (Bandani *et al.*, 2014) [1]. It prevents soil erosion by serving as a cover crop. As a short-duration crop, it is suitable for various intensive crop rotations. In North India, it is grown in both the kharif and summer seasons, while in South India, it is cultivated during the rabi season. The Green Revolution boosted food production but led to permanent soil fertility loss because of the increasing gap between nutrient depletion and availability. preventing the decrease of soil organic matter is essential to limit the ongoing soil degradation. The application of organic manures to soil is critical for preserving native soil fertility (Zibilske, 1987) [13]. Vermicompost contains nutrients that are easily accessible to plants, such as nitrate, exchangeable phosphorus, potassium, calcium and magnesium. Edwards and Burrows (1988). The substance also includes biologically active compounds like plant growth regulators (Tomatic *et al.*, 1987) [12]. Continuously adding organic materials to the soil over a prolonged period leads to higher levels of organic matter, organic carbon content, crop productivity, soil biological activity and the quality of the produce (Collins *et al.*, 1992) [3]. Panchagavya, Jeevamrut, Beejamrut, Sasyamrut and Vermiwash are fermented liquid organic manures that contain a wide range of macro and micronutrients, vitamins, essential amino acids, various microorganisms and growth-promoting substances. These substances aid in enhancing plant growth, metabolic processes and resilience against pests and diseases.

Materials and Methods

The study took place at Organic Farm, Navsari Agricultural University, Navsari, in the Rabi season of 2020-21. The farm where the experiment was conducted, the soil belongs to the *Ustochrepts* great group and is classified under the Jalalpur series.

Table 1: treatment details.

T_1	100% RDN through NADEP compost
T_2	100% RDN through NADEP compost + EBPS 1%
T_3	100% RDN through NADEP compost + Cow urine 2%
T_4	100% RDN through NADEP compost + Vermiwash 1%
T_5	100% RDN through vermicompost
T_6	100% RDN through vermicompost + EBPS 1%
T_7	100% RDN through vermicompost + Cow urine 2%
T_8	100% RDN through vermicompost + Vermiwash 1%
T_9	Ghan-jivamrut @500 kg/ha + jivamrut @500l/ha
T_{10}	Ghan-jivamrut @500 kg/ha + jivamrut @500l/ha + EBPS 1%
T_{11}	Ghan-jivamrut @500 kg/ha + jivamrut @500l/ha + Cow urine 2%
T_{12}	Ghan-jivamrut @500 kg/ha + jivamrut@500l/ha + Vermiwash 1%

Organic nutrient sources like NADEP compost, vermicompost, Ghan-jivamrut and jivamrut were added to the soil during sowing based on the treatments. Provided organic sources (EBPS, Cow urine and Vermiwash) using foliar spray three times at 15, 30 and 45 days after sowing. Seeds were treated with Rhizobium and PSB at a rate of 10ml per kilogram for all treatments.

Table 2: Initial physico-chemical properties of the soil of experimental plot

Particulars	Values (0-15 cm)	Methods employed for determination
1. Physical properties		
Sand (%)	18.2	International pipette method (Piper, 1966) [9]
Silt (%)	25.4	
Clay (%)	55.1	
Textural class	Clay	
2. Chemical properties		
EC **(1:2.5)** (dS/m)	0.274	EC meter (Jackson, 1967) [5]
pH **(1:2.5)**	7.8	
Organic Carbon (%)	0.86	Walkley and Black method (Jackson, 1967) [5]
Available Nitrogen(kg/ha)	264.3	Alkaline $KMnO_4$ method (Subbiah and Asija, 1956) [11]
Available Phosphorus(kg/ha)	38.9	Olsen's method (Olsen 1954) [8]
Available Potassium (kg/ha)	502.0	Flame photometric method (Jackson, 1967) [5]

Results and discussion

Nutrient content (%) in grain and stover

The nutrient content in grain and stover does not vary significantly with different treatments. The nitrogen, phosphorus and potassium content in both the grain and stover of green gram did not show significant differences among the various treatments.

Table 3: Effect of different treatments on N, P and K content (%) in grain and stover

Treatments	N (%)		P (%)		K (%)	
	Grain	Stover	Grain	Stover	Grain	Stover
T_1	3.05	0.67	0.69	0.22	1.31	0.80
T_2	2.93	0.71	0.69	0.24	1.34	0.83
T_3	2.97	0.70	0.69	0.24	1.33	0.82
T_4	2.97	0.71	0.68	0.24	1.34	0.82
T_5	3.11	0.69	0.68	0.24	1.32	0.81
T_6	2.91	0.71	0.70	0.25	1.35	0.84
T_7	3.10	0.68	0.69	0.22	1.31	0.80
T_8	2.94	0.71	0.68	0.25	1.34	0.82
T_9	3.06	0.66	0.66	0.21	1.26	0.78
T_{10}	3.07	0.68	0.67	0.22	1.31	0.79
T_{11}	3.11	0.67	0.66	0.22	1.27	0.78
T_{12}	3.13	0.67	0.66	0.22	1.27	0.78
SEm ±	0.09	0.01	0.01	0.01	0.02	0.01
CD (0.05)	NS	NS	NS	NS	NS	NS
CV%	5.16	3.11	3.97	8.20	2.71	2.80

Table 4: Effect of different treatments on uptake of N, P and K by grain and stover

Treatments	N (Kg/ha)		P (Kg/ha)		K (Kg/ha)	
	Grain	Stover	Grain	Grain	Stover	Grain
T_1	19.9	13.41	4.5	19.9	13.41	4.5
T_2	25.6	16.03	6.0	25.6	16.03	6.0
T_3	20.5	15.58	4.8	20.5	15.58	4.8
T_4	24.3	15.78	5.6	24.3	15.78	5.6
T_5	23.4	15.33	5.2	23.4	15.33	5.2
T_6	28.7	16.21	6.3	28.7	16.21	6.3
T_7	23.0	13.66	5.1	23.0	13.66	5.1
T_8	24.7	15.95	5.8	24.7	15.95	5.8
T_9	18.2	12.23	3.9	3.96	7.5	23.33
T_{10}	20.7	12.70	4.5	4.14	8.8	24.52
T_{11}	19.6	12.36	4.2	4.02	8.0	23.46
T_{12}	19.9	12.59	4.2	4.07	8.1	23.88
SEm ±	1.4	0.73	0.3	0.33	0.6	1.39
CD (0.05)	4.0	2.14	0.9	0.98	1.9	4.09
CV%	10.6	8.83	10.5	12.04	11.3	8.86

Nutrient Uptake by Grain and Stover

Nitrogen uptake

The data in Table 4 indicated that nitrogen uptake was significant across the various treatments. Treatment T_6, which consisted of 100% RDN through vermicompost + EBPS 1%, showed significantly higher nitrogen uptake in both grain and stover. However, for grain, it was statistically at par with treatments T_2 and T_8 and for stover, it was at par with treatments T_2, T_3, T_4, T_5 and T_8. Lower nitrogen uptake was observed in grain and stover under treatment T_9 (Ghan-jivamrut @500 kg/ha + jivamrut @500l/ha), it is at par with treatments T_1, T_3, T_{10}, T_{11} and T_{12} for grain, and at par with treatments T_1, T_7, T_{10}, T_{11} and T_{12} for stover. Treatment T_6 showed increased nitrogen uptake possibly due to enhanced nitrogen fixation by bacteria, leading to improved absorption and utilization of plant nutrients, resulting in higher nitrogen and phosphorus content in grain and stover. The results of this study closely aligned with the findings of Davari *et al.*, (2012) [4] and Choudhary *et al.*, (2013) [2] in the green gram crop.

Phosphorus uptake

The data in Table 4 indicated that the uptake of phosphorus was substantial in response to the treatments. In the case of grain, treatment T_6 (100% RDN via vermicompost + EBPS 1%) resulted in significantly higher phosphorus uptake, but it was statistically at par with treatments T_2, T_4 and T_8. Treatment T_6 showed significantly higher phosphorus uptake compared to other treatments (T_2, T_3, T_4, T_5 and T_8) but was statistically at par with them. Significantly lower phosphorus absorption by grain was observed in treatment T_9 (Ghan-jivamrut @500 kg/ha + jivamrut @500l/ha), which was at par with treatments T_1, T_3, T_{10}, T_{11} and T_{12}. Treatment T_9 led to a significant lower in phosphorus uptake compared to treatments T_1, T_7, T_{10}, T_{11} and T_{12}. Treatment T_6 likely led to increased phosphorus uptake due to the presence of organic nutrient sources with high organic matter content, promoting plant growth and higher phosphorus absorption, resulting in greater grain yield. Seed inoculation with PSB facilitated the release of phosphorus from the soil and prevented the fixation of additional phosphate, resulting in higher phosphorus availability for the plants and increased nutrient content in the plant. The results of this study closely matched the findings of Davari *et al.*, (2012) [4] and Choudhary *et al.*, (2013) [2] in the green gram crop.

Potassium uptake

Table 4 results indicated a significant potassium uptake with the treatments. Treatment T_6 (100% RDN through vermicompost + EBPS 1%), showed significantly higher potassium uptake in grains compared to other treatments. However, it was statistically at par with treatment T_2. In terms of potassium uptake in stover, treatment T_6 also showed significantly higher levels but was statistically at par with treatments T_2, T_3, T_4, T_5 and T_8. Lower potassium absorption was observed in grain and stover under treatment T_9 (Ghan-jivamrut @500 kg/ha + jivamrut @500l/ha), which was at par with treatments T_{10}, T_{11} and T_{12} for grain. For stover, it was statistically at par with treatments T_1, T_7, T_{10}, T_{11} and T_{12}. Treatment T_6 led to increased potassium uptake possibly because of enhanced nitrogen fixation by bacteria, facilitating improved absorption and utilization of plant nutrients, resulting in higher nitrogen and phosphorus content in grain and stover. The results of this study closely aligned with the findings of Davari *et al.*, (2012) [4] and Choudhary *et al.*, (2013) [2] in the green gram crop.

Post-harvest nutrient status of soil

The data from Table 5 indicated that the levels of organic carbon, available nitrogen, available phosphorus, and available potassium in the soil did not show any significant differences among the treatments. Treatment T_6 (100% RDN through vermicompost + EBPS 1%), showed the highest levels of organic carbon, available nitrogen, available phosphorus and available potassium in the soil after the harvest.

Table 5: Effect of different treatments on organic carbon and available N, P_2O_5 and K_2O in soil after harvest

Treatments	O.C (%)	Available N (kg/ha)	Available P_2O_5 (kg/ha)	Available K_2O (kg/ha)
T_1	0.82	266.33	59.47	484.67
T_2	0.87	273.00	64.43	503.67
T_3	0.86	272.00	62.34	489.67
T_4	0.87	270.67	63.51	491.67
T_5	0.85	270.00	62.28	489.00
T_6	0.89	283.33	64.97	507.00
T_7	0.84	282.00	60.77	487.33
T_8	0.87	273.33	64.40	495.00
T_9	0.80	269.33	54.47	480.33
T_{10}	0.82	289.67	58.53	483.00
T_{11}	0.81	288.33	54.77	483.33
T_{12}	0.82	285.33	56.13	482.00
SEm ±	0.01	6.35	2.64	6.94
CD (0.05)	NS	NS	NS	NS
CV%	3.98	3.97	7.55	2.45
Initial Value	0.86	264.3	38.9	502.0

Conclusion

The study concluded that the highest uptake of nitrogen, phosphorus and potassium, as well as improvement in soil fertility for green gram, can be achieved by applying Treatment T_6, which consist of 100% RDN through vermicompost along with Enriched Banana Pseudostem Sap at a 1% concentration sprayed at 15, 30 and 45 days after sowing of green gram crop under organic farming.

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Conflict of Interest

I declared that no conflict of interest related to my research. No any external funding involve during the course of experiment and analysis and publication decision.

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