International Journal of Research in Agronomy 2024; 7(6): 740-744

E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; 7(6): 740-744
Received: 21-04-2024
Accepted: 26-05-2024

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Effect of different level of NPK and vermicompost on physico-chemical properties of soil growth and yield of green gram (*Vigna radiata* L.) Nandi-mungo

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DOI: https://doi.org/10.33545/2618060X.2024.v7.i6j.966

Abstract
In the Zaid season (March 2023-June 2023) at Sam Higginbottom University of Agriculture, Technology, and Sciences' main research farm in Prayagraj, an experiment was conducted. Randomized block design with RDF was used in the experiment, along with three levels of NPK (0% NPK, 50% NPK, and 100% NPK) and three levels of vermicompost (0% VC, 50% VC, and 100% VC). The result shows that adding different amounts of organic fertilizers improved the soil's chemical properties, increased growth, and generated more green grams. When RDF, NPK, and VC were applied in treatment T_9 [RDF + @ 100% NPK + @ 100% Vermicompost], the maximum bulk densities at 0 and 15 cm were 1.30 and 1.32 mg m-3, respectively, and the maximum particle densities were 2.56 mg m-3 at 0 and 15 cm.

Keywords: Green gram, yield attributes, grain, soil properties, vermicompost

Introduction
With an average yield of 500 kg ha^{-1}, India is the world's greatest producer and consumer of green gram, producing 1.5 to 2.0 million tonnes of the crop from 3 to 4 million hectares of land. Roughly 10% to 12% of all pulses produced in the nation are green grams. With a combined area of over 30 lakh hectares, Orissa, Madhya Pradesh, Gujarat, Rajasthan, Uttar Pradesh, and Bihar are the major Indian states that grow this crop. Its grains are used to make soup, dal, and animal feed. It serves as fuel and fodder. (Om Prakash Pandey and others, 2019) [5].

Pulses are a good and less expensive source of protein, which shows how important they are to everyday eating routines. Their protein content compensates for millets' and cereals' lack of key amino acids. The world's biggest producer, importer, and consumer of pulses is India. Around 93.18 million hectares are planted with pulses worldwide, yielding 89.82 million tons of output and 964 kg ha^{-1} of productivity. The states of Rajasthan, Madhya Pradesh, Maharashtra, Karnataka, Bihar, Odisha, Gujarat, Andhra Pradesh, and Tamil Nadu account for more than 90% of the world's mungbean production. (M. Kathiravan and others, 2023) [6].

An ecologically appropriate method for managing organic solid waste is vermicomposting. Vermicompost, a solid bio that is used with peas during the planting phase every four weeks, is made from waste crop pulp combined with office paper, cow dung, and other ingredients over a 30-day period. Quantification was done on the effects of vermicompost on the soil. The application of vermicompost increased the nitrogen and potassium content of the soil by 33%, 40%, and 67%, respectively. (Plant & Soil Science International Journal, 2023).

An essential ingredient for all crops is nitrogen. In addition to raising yield, nutrition also raises protein content. Plants that are lacking in certain nutrients may grow slowly and turn yellow-green in color. It speeds up the growth and development of living things as well as the photosynthetic activity of green plants. Green grams are needed per capita at a rate of 60 g for men and 55 g for women, with 42 g being available.

Plant development and growth depend on potassium. The amount of K absorbed by roots is second only to nitrogen for the majority of cultivated plants. Due to its effects on photosynthesis, water consumption efficiency, plant resilience to diseases, drought, and cold, as well as the balancing of proteins and carbohydrates, adequate levels of K are critical for increasing agricultural output and quality. Singh (2017)

Materials and Methods

The study conducted at the Soil Science Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, during the Zaid season of 2023, examined the impact of varying levels of NPK and vermicompost on the physico-chemical properties of soil growth and yield of green gram (*Vigna radiata* L.). Applied with RDF, three NPK levels (0%, 50%, and 100%), and three Vermicompost levels (0%, 50%, and 100% VC). The experiment's goal is to keep an eye on the physical and chemical properties. Muthuvel *et al*., 1992) used a 100 ml graduated measuring cylinder method and process to assess physical parameters such water-holding capacity, bulk density, particle density, and pore space.

In chemical parameters tested by-

a) Soil pH -by Jackson, M. L. 1958
b) Soil EC (dS m^{-1}) - by Wilcox, 1950
c) Organic Carbon (%) - by Walkley and Black, 1947
d) Available Nitrogen (kg ha^{-1}) - by Subbiah and Asija, 1956
e) Available Phosphorus (kg ha^{-1}) by Olsen *et al.,* 1954
f) Available Potassium (kg ha^{-1}) - by Toth and Prince, 1949

Result and Discussion

Physical Properties of Soil

Bulk density (Mg m-3)

It was discovered that the bulk density of the soil's response to varying NPK and vermicompost levels was not statistically significant. T_9 (@ 100% NPK + @ 100% Vermicompost) had the highest recorded bulk density of 1.30 mg m-3 and 1.32 mg m-3 at 0-15 cm and 15-30 cm, respectively, while treatment T_1 (Absolute Control) had the lowest recorded bulk density of 1.25 mg m-3 and 1.25 mg m-3 at 0-15 cm and 15-30 cm. A similar outcome was noted by Gaund *et al*. (2016).

Particle density (Mg m-3)

The treatment T_9 (@ 100% NPK + @ 100% Vermicompost) recorded the maximum particle density of 2.56 Mg m-3 and 2.58 Mg m-3 at 0-15 cm and 15-30 cm, respectively, while treatment T_1 (Absolute Control) recorded the minimum particle density of 2.47 Mg m-3 and 2.47 Mg m-3 at 0-15 cm and 15-30 cm, respectively. Adekiya *et al*. (2017) [1] reported a similar outcome.

Pore space (%)

The impact of NPK and vermicompost on the soil's pore space was shown to be significant. In treatment T_9 (@ 100% NPK + @ 100% Vermicompost), the maximum and lowest pore spaces of the soil were observed at 0-15 and 15-30 cm, respectively, and 41.62 and 40.43 percent, respectively, in treatment T_1 (Absolute Control). Adekiya *et al*. (2017) [1] reported a similar outcome.

Water holding capacity (%)

The effect of NPK and vermicompost was discovered to significantly affect the soil's responsive water retention capacity. The treatment T_9 (@ 100% NPK + @ 100% Vermicompost) recorded the highest water holding capacity of 41.90% and 42.75% at 0-15 cm and 15-30 cm, respectively, while treatment T_1 (Absolute Control) recorded the minimum water holding capacity of 38.60%and 39.75% at 0-15 cm and 15-30 cm, respectively. Sharma *et al*. (2013) reported a similar outcome.

Chemical Properties of Soil pH (1:2.5) w/v

The effects of NPK and vermicompost on soil pH were found to be non-significant. The pH values of the soil were 7.19 and 7.21 at 0- 15 cm and 15-30 cm, respectively, in treatment T_9 (@ 100% NPK + @ 100% Vermicompost), and 7.35 and 7.37 at 0-15 cm and 15-30 cm, respectively, in treatment T_1 (Absolute control). Singh *et al*. (2007) reported a similar outcome.

Soil EC (dS m-1)

It was discovered that the reaction of the soil's EC to the effects of NPK and vermicompost was not substantial. Treatment T_9 (@ 100% NPK + @ 100% Vermicompost) recorded the maximum EC of soil at 0.38 dSm-1 and 0.39 dSm-1 at 0-15 cm and 15-30 cm, respectively, while treatment T_1 (Absolute Control) recorded the minimum EC of soil at 0.30 dSm-1 and 0.32 dSm-1 at 0-15 cm and 15-30 cm. Kansotia *et al*. (2013) reported a similar outcome.

Organic carbon (%)

It was discovered that the response of soil organic carbon to NPK and vermicompost was considerable. At 0-15 and 15-30 cm, the maximum organic carbon (OC) of the soil was recorded in treatment T_9 (@ 100% NPK + @ 100% Vermicompost), while the minimum was observed in treatment T_1 (Absolute Control) at 0-15 and 15-30 cm, respectively. Sharma *et al*. (2013) reported a similar outcome.

Available nitrogen (kg ha^{-1}): The available nitrogen response of the soil was shown to be significantly affected by NPK and vermicompost. The treatment T_9 (@ 100% NPK + @ 100% Vermicompost) recorded the maximum available nitrogen of soil at 275.75 kg ha^{-1} and 274.58 kg ha^{-1} at 0-15 cm and 15-30 cm, respectively, while treatment T_1 (Absolute Control) recorded the minimum available nitrogen at 265.38 kg ha^{-1} and 264.34 kg ha^{-1} at 0-15 cm and 15-30 cm, respectively. Wyngaard *et al*. (2012) [23] reported a similar outcome.

Available phosphorus (kg ha^{-1})

The effect of NPK and vermicompost was found to be significantly influenced by the amount of phosphorus available in the soil. The treatment T_9 (@ 100% NPK + @ 100% Vermicompost) recorded the highest available phosphorus of the soil at 20.61 kg ha^{-1} and 19.86 kg ha^{-1} at 0-15 cm and 15-30 cm, respectively. Treatment T_1 (Absolute Control) recorded the minimum available phosphorus at 18.42 kg ha^{-1} and 17.46 kg ha^{-1} at 0-15 cm and 15-30 cm, respectively. A comparable outcome was noted by Raja and Takankhar (2017)

Available potassium (kg ha^{-1})

It was discovered that the soil's reaction to potassium that was available had a major impact on the effects of NPK and vermicompost. The treatment T_9 (@ 100% NPK + @ 100% Vermicompost) recorded the highest available potassium of the soil at 191.31 kg ha^{-1} and 189.71 kg ha^{-1} at 0-15 cm and 15-30 cm, respectively, while treatment T_1 (Absolute Control) recorded the minimum available potassium at 181.38 kg ha^{-1} and 178.38 kg ha^{-1} at 0-15 cm and 15-30 cm, respectively. A comparable outcome has been documented by Khandelwal *et al*. (2012).

Table 1: Effect of NPK and Vermicompost on bulk density (Mg m-3), particle density (Mg m-3), pore space (%) and water holding capacity (%) of soil after crop harvest

	Treatments	Bulk density (Mg m-3)		Particle density (Mg m-3)		Pore space (%)		Water holding capacity (%)	
		0 - 15 cm	15 - 30 cm	0 - 15 cm	15 - 30 cm	0 - 15 cm	15 - 30 cm	0 - 15 cm	15 - 30 cm
T_1	Absolute control	1.25	1.25	2.47	2.47	41.62	40.43	38.60	39.75
T_2	@ 0% NPK + @ 50% Vermicompost	1.25	1.26	2.46	2.48	41.88	40.62	38.75	39.95
T_3	@ 0% NPK + @ 100% Vermicompost	1.27	1.24	2.48	2.49	42.60	41.60	39.50	40.75
T_4	@ 50% NPK + @ 0% Vermicompost	1.29	1.27	2.47	2.48	41.75	41.55	38.65	40.23
T_5	@ 50% NPK + @ 50% Vermicompost	1.26	1.25	2.48	2.49	42.96	41.70	39.73	40.56
T_6	@ 50% NPK + @ 100% Vermicompost	1.27	1.26	2.45	2.46	43.68	42.51	40.25	41.98
T_7	@ 100% NPK + @ 0% Vermicompost	1.24	1.28	2.44	2.45	42.77	41.88	39.68	40.44
T_8	@ 100% NPK + @ 50% Vermicompost	1.26	1.29	2.49	2.50	44.04	43.56	41.75	42.50
T_9	@ 100% NPK + @ 100% Vermicompost	1.30	1.32	2.56	2.58	44.76	43.28	41.90	42.75
	F-Test	NS	NS	NS	NS	S	S	S	S
	S.EM. (±)	-	-	-	-	0.08	0.94	0.78	1.11
	C.D. at 0.5%	-	-	-	-	1.85	2.00	1.67	2.36

Table 2: Effect of NPK and Vermicompost on pH (1:2.5) w/v, EC (dSm-1), organic carbon (%), available nitrogen (kg ha^{-1}), available phosphorus (kg ha^{-1}) and available potassium (kg ha^{-1}) of soil after crop harvest

	Treatments	Soil pH (1:2.5) w/v		EC (dS m-1)		Organic carbon (%)		Available nitrogen (kg ha^{-1})		Available phosphorus (kg ha^{-1})		Available potassium (kg ha^{-1})	
		0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
T_1	Absolute control	7.35	7.37	0.30	0.32	0.39	0.37	265.38	263.34	18.42	17.46	181.38	178.38
T_2	@ 0% NPK + @ 50% Vermicompost	7.33	7.35	0.32	0.33	0.40	0.38	266.45	264.05	18.15	17.32	182.29	179.72
T_3	@ 0% NPK + @ 100% Vermicompost	7.30	7.32	0.34	0.35	0.41	0.40	267.35	265.85	17.35	16.86	183.33	178.67
T_4	@ 50% NPK + @ 0% Vermicompost	7.34	7.36	0.31	0.32	0.39	0.37	269.70	268.65	19.25	18.15	184.75	182.11
T_5	@ 50% NPK + @ 50% Vermicompost	7.28	7.31	0.35	0.36	0.42	0.41	271.65	270.02	19.15	17.95	185.97	184.17
T_6	@ 50% NPK + @ 100% Vermicompost	7.25	7.30	0.36	0.37	0.43	0.42	272.65	271.05	18.85	17.09	186.67	185.15
T_7	@ 100% NPK + @ 0% Vermicompost	7.32	7.34	0.34	0.35	0.44	0.43	273.05	272.65	21.03	20.88	187.65	186.84
T_8	@ 100% NPK + @ 50% Vermicompost	7.23	7.23	0.37	0.38	0.40	0.39	274.32	273.60	20.45	19.45	189.17	187.87
T_9	@ 100% NPK + @ 100% Vermicompost	7.19	7.21	0.38	0.39	0.45	0.44	275.75	274.58	20.61	19.86	191.31	189.71
	F-Test	NS	NS	NS	NS	S	S	S	S	S	S	S	S
	S.EM. (±)	-	-	-	-	0.07	0.08	4.78	4.99	0.28	0.43	3.36	3.75
	C.D. at 0.5%	-	-	-	-	0.16	0.17	10.19	10.63	0.60	0.93	7.17	10.11

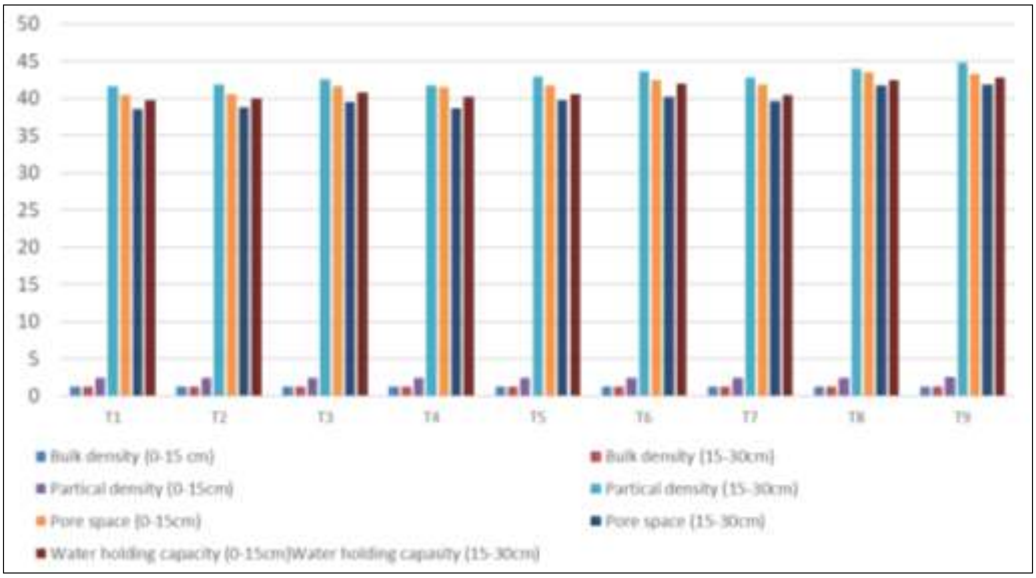

Fig 1: Effect of different level of NPK nd Vermicompost on bulk dendity (Mg m^{-3}), partical density (Mg m^{-3}), pore space(%) and water holding capacity(%) of soil after crop harvest

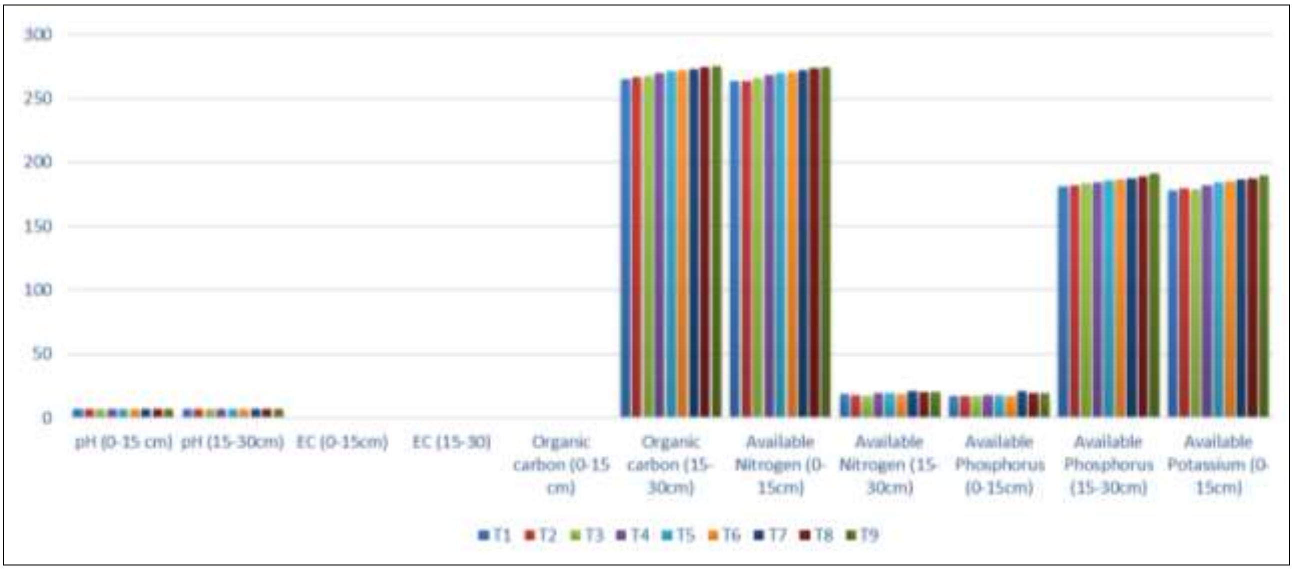

Fig 2: Effect of different level of NPK and Vermicompost on pH, EC (dSm^{-1}), organic carbon (%), available nitrogen (kg ha^{-1}), available phosphprus (kg ha^{-1}), available potassium (kg ha^{-1}) of soil after crop harvest

Conclusion

Vermicompost and NPK applied to the field can enhance crop yield and soil conditions in green gram. The greatest treatment for significantly improving the physical and chemical qualities of soil is T_9 (@ 100% NPK + @ 100% Vermicompost). Additionally, it aids in the management of soil resources and fertility.

Acknowledgements

He authors thank the Hon'ble Vice Chancellor SHUATS of the Naini Agricultural Institute's Department of Soil Science and Agricultural Chemistry for his keen interest in and support of the research endeavor.

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