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Effect of integrated nutrient management and greengram [*Vigna radiata* (L.) Wilczek] cultivars on soil properties in Bundelkhand region of Uttar Pradesh

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Abstract
A field investigation was conducted during *Kharif* season 2019 at the research farm of Banda University of Agriculture and Technology, Banda (U.P) to study the effect of Integrated Nutrient Management and Greengram cultivars on soil properties in Bundelkhand region. An experiment was laid out in factorial randomized block design (FRBD) replicated thrice with 12 treatments comprised with application of organic (Vermicompost) and inorganic fertilizers (DAP) nutrient management with their combinations itself and Greengram variety. Application of 50% RDF with 50% Vermicompost @ 1.5 t ha^{-1}; was found to be responsible for highest availability of nitrogen (220 kg ha^{-1}), phosphorous (19.4 kg ha^{-1}) and potassium (222 kg ha^{-1}) in soil compared to other combinations and control treatment while variety IPM 2-3 was also higher all nutrients availability compared to Virat after harvest of greengram.

Keywords: Greengram, INM, cultivars, soil properties

1. Introduction
Pulses are integral part of Indian dietary system because of its richness in proteins and other important micro and macro nutrient nutrients such as Ca & Fe and number of vitamins viz., carotene, thiamine, riboflavin and niacin (Kamboj *et al.* 2018) [6], (Devi *et al.* 2023) [2]. Indian people is predominantly vegetarian and protein requirement for the growth and development of the human being is mostly met with pulses crops. They are said to be poor man's meat and rich man's vegetables. As per recommendation of WHO minimum requirement of pulses is 80 g per capita per day. Its area, production and productivity at national level is 4.2 million ha, 2.09 million tonnes and 472 kg per ha; respectively. In Uttar Pradesh area, production and productivity of Greengram was 0.72 lakh ha, 0.40 lakh tones and 555 kg per ha; respectively during 2017-18 (Kumar 2022) [7]. In Bundelkhand region of Uttar Pradesh Greengram are cultivated mainly in *Kharif* season; because during this season adequate moisture availability is there for crop cultivation. The area, production and productivity of Greengram in Banda district of Uttar Pradesh is 2848 hectares, 893.8tonnes and 318 kg per ha respectively during 2016-17 (www.upkrishi.org).Green gram is an important pulse crop having high nutritive value in the human diet and also playing an important role in increase the soil fertility levels by fixing free atmospheric nitrogen (Meena *et al.* 2018) [8]. Soil is a medium for plants germination, emergence, growth and development. Production of crop is mainly depends on phyco-chemical and biological properties of soil viz., (organic matter, soil texture, strictures, porosity, aeration, P^H, bulk density, particle density, number of beneficial micro-organism) and nutrient management practices of crop. Organic matter crucial tends to maintain the fertility levels of soil because it increase the ability of fall soil store water, and increase the infiltration rate of fine- textured soil (Nwite., 2017) [9]. Organic and inorganic nutrient management is crucial factors that greatly affect the crop growth, development and yield of Greengram. Nitrogen is an important nutrient for all crops. It increases the upper plant height and also increases the protein content in produce. In sufficient of nitrogen in plants may have stunted growth and develop yellow-green color.

It accelerates the photosynthetic behavior of green plants as well as the growth and development of living tissues specially tiller count in cereals. Phosphorus is the second most important primary nutrient that must be added to the soil to maintain plant root growth and sustain crop yield. It stimulates early root development and growth and thereby helps to establish seedlings quickly. Large quantities of Phosphorus are found in seed and fruit and it is considered essential for seed formation. It enhances the activity of rhizobia and increased the formation of root nodules. Vermicompost is an environmentally friendly technique that is used for organic solid waste management (Gupta *et al.* 2019) [5]. Waste crop pulp blended with cow dung and office paper was vermicomposted over 30 days to produce Vermicompost which is a solid bio with peas at the planting phase every four weeks. The impacts of Vermicompost on the soil were quantified. Application of Vermicompost resulted in a 33%, 40%, and 67% increase in the soil nitrogen potassium content respectively. The intensive cropping coupled with imbalanced nutrition supplementation has resulted in a deficiency of certain essential macro and micro nutrient in the soil (Shukla *et al.* 2018) [11]. To improve productivity, balanced crop nutrition has an imminent role for which the use of organic and inorganic sources of crop nutrition can be an one option.

2. Materials and Methods

The experiment was conducted at Agriculture Farm of Banda University of Agriculture & Technology, Banda during the *kharif* season 2019, which is situated in Bundelkhand part of Uttar Pradesh and lies between 25.526940 North latitude and 80.342200 East longitude at an elevation of 123 meters from the sea level. This region falls under agroclimatic zone VIII (Central Plateaus & Hills Region) of Uttar Pradesh. Most of the facilities are available on this farm Response of greengram [*Vigna radiata* (L.) Wilczek] cultivars to integrated nutrient management in Bundelkhand region of Uttar Pradesh and finding out best suitable integrated nutrient management practice. The experiment consist two treatment factor viz., Greengram cultivar (V1 IPM2-3, V2 Virat) INM practices, N_1: Control, N_2 100% RDF, N_3:100% Vermicompost, N_4: 100% RDF + 100% Vermicompost, N_5: 75% RDF + 50% Vermicompost, N_6 50% RDF + 50% Vermicompost with treatment combination 12 (table 1) and thrice replicated. Where 100% RDF means 100 kg DAP/ha; and 100% Vermicompost = 2.5 t/h The soil of the experiment field was slightly alkaline black with electrical conductivity 0.22, Bulk density 1.59, low available nitrogen and phosphors (212 kg ha^{-1}, 8.95 kg ha^{-1} respectively) and organic carbon (0.42%) and medium available Potassium (219 kg ha^{-1}).

Table 1: Treatment combination

S.No.	Symbol	Treatment details
1.	T_1;V_1N_1	Control + IPM 2-3
2.	T_2;V_1N_2	100% RDF + IPM 2-3
3.	T_3;V_1N_3	100% VC (2.5 t/ha) + IPM 2-3
4.	T_4;V_1N_4	100% RDF +100% VC (2.5 t/ha) + IPM 2-3
5.	T_5;V_1N_5	75% RDF + 50% VC (1.25 t/ha) + IPM 2-3
6.	T_6;V_1N_6	50% RDF + 50% VC (1.25 t/ha) + IPM 2-3
7.	T_7;V_2N_1	Control + Virat
8.	T_8;V_2N_2	100% RDF + Virat
9.	T_9;V_2N_3	100% VC (2.5 t/ha) + Virat
10.	T_{10};V_2N_4	100% RDF +100% VC (2.5 t/ha) + Virat
11.	T_{11};V_2N_5	75% RDF + 50% VC (1.25 t/ha) + Virat
12.	T_{12};V_2N_6	50% RDF + 50% VC (1.25 t/ha) + Virat

3. Results and Discussion

3.1 Soil pH, Electrical conductivity and Organic carbon

Data from the Table 2 showed that soil pH Electrical conductivity and organic carbon were not significantly affected but numerically change the soil properties from initial soil values by various integrated nutrient management treatment and Greengram cultivars. Results revealed that cultivar V_1 "IPM 2-3" was better over the variety V_2 "Virat" in respect to improvement of soil properties (Table 2).The Higher soil pH was found in treatment N_1 (Control) while higher electrical conductivity and organic carbon was observed in application of 50% RDF + 50% VC (1.25 t/ha). The increase in organic carbon content might be attributed to addition of organic materials and better root growth of Greengram.

Table: 2: Soil pH and electrical conductivity affected by Greengram cultivars and various INM treatments

Treatment	Soil pH	Soil electrical conductivity	Organic carbon %
Variety (V)			
V_1: IPM 2-3	7.4	0.123	0.443
V_2: Virat (IPM 205-7)	7.6	0.122	0.430
SE(d)±	1.63	0.005	0.010
CD (P=0.05)	ns	ns	ns
INM Protocols (N)			
N_1: Control	7.76	0.120	0.415
N_2: 100% RDF	7.65	0.120	0.430
N_3: 100% VC (2.5 t/ha)	7.58	0.120	0.435
N_4: 100% RDF + 100% VC (2.5 t/ha)	7.53	0.120	0.440
N_5: 75% RDF + 50% VC (1.25 t/ha)	7.38	0.125	0.445
N_6: 50% RDF + 50% VC (1.25 t/ha)	7.35	0.130	0.455
SE(d)±	0.282	0.005	0.017
CD (P=0.05)	ns	ns	ns
Initial values	7.3	0.22	0.42

3.2 Available soil nutrients after harvest of Greengram

Availability of nutrients viz., nitrogen, phosphorus and potassium are significantly influenced by various INM treatment combination in after harvesting of Greengram crop while non- significant response Greengram cultivar but numerically higher nutrient availability "IPM 2-3" compared to Cultivar "Virat". The nutrient combination results are show Application of combined organic and inorganic source of nutrient management significantly increased the content of nitrogen in soil after harvest of Greengram crop. Highest increase was found in treatment 50% RDF + 50% VC (1.25 t/ha which was lowest in control. The data indicated that available nitrogen content improvement in almost all the treatment. Significantly improved of soil available nitrogen in various INM treatments combination might be attributed to the direct addition of nitrogen through Vermicompost and DAP fertilizers to the available pool of soil along with increased activity of N fixing bacteria and increased organic N fixation of soil due to biochemical degradation and mineralization, there by resulting in higher accumulation of nitrogen in soil.

3.3 Available phosphorus

The data presented in (Table 3) indicates that significantly highest available phosphorus of soil was observed in INM treatment N6: (50% RDF + 50% VC (1.25 t/ha) while variety V_1 (IPM 2-3) However; it was at par with N_5 75% RDF + 50% VC (1.25 t/ha). Significantly lowest available phosphorus of soil was observed in treatment N_1 (control) and variety Virat. An increased phosphorus level in soil after harvest was observed in various organic and inorganic nutrient management treatments. The increase in available phosphorus content of soil might be due to the addition of organic (Vermicompost) and inorganic fertilizers (DAP).

3.4 Available potassium

Availability of potassium significantly affected by application of organic and inorganic source of nutrient management while non-significant affected by geengram variety. The highest available potassium of soil was found in INM treatment N_6 (50% RDF + 50% VC (1.25 t/ha); while which found to be at par with N_3, N_4 and N_5. (Table 3). Significantly lowest available potassium in soil was found in treatment N_1 (control). Available potassium content in soil was also affected by Greengram variety, the maximum availability of potassium was recorded with variety IPM 2-3 compared to Virat. The increase in available Potassium in soil might be due to attributed to the beneficial effect of organic manure through addition of K by vermicompost, and inorganic fertilizer to the available pool of soil. These finding are in close conformity with the results of (Ahamad *et al.* 2011) [1], (Gohain *et al.* 2013) [3] and (Sahu *et al.* 2021) [10]

Table 3: Available Soil nutrients (kg per hectare) after harvest affected by Greengram cultivars and various INM treatments

Treatment	Available Nitrogen	Available Phosphorus	Available Potassium
Variety (V)			
V_1: IPM 2-3	203	16.9	206
V_2: Virat (IPM 205-7)	204	17.6	208
SE(d)±	4.40	0.380	4.49
CD (P=0.05)	ns	ns	ns
INM Protocols (N)			
N_1: Control	183	15.6	188
N_2: 100% RDF	201	15.4	194
N_3: 100% VC (2.5 t/ha)	202	16.5	209
N_4: 100% RDF + 100% VC (2.5 t/ha)	207	18.1	214
N_5: 75% RDF + 50% VC (1.25 t/ha)	208	18.9	218
N_6: 50% RDF + 50% VC (1.25 t/ha)	220	19.4	222
SE(d)±	7.63	0.658	7.78
CD (P=0.05)	15.92	1.37	16.24
Initial values	212	8.95	219

4. Conclusion

It can be concluded from the present experiment that Integrated Nutrient Management with combine application of organic and inorganic sources of nutrient management is beneficial for increasing availability status of Nitrogen, Phosphorus and Potassium along with improvement in organic carbon content in soil.

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