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Research Article

Effect of Integrated Nutrient Management on Chemical and Physical Properties of Soil and Yield of Cowpea (*Vigna unguiculata* L.)

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Abstract

An experiment was conducted during Kharif season 2016-17 to study the "Effect of Integrated Nutrient Management on Chemical and Physical Properties of Soil and Yield of Cowpea (*vigna unguiculata L.).*" on central research farm department of Soil Science and Agricultural Chemistry, SHUATS, Allahabad. The soil of experimental area falls in order Inceptisol. The design applied for statistical analysis was carried out with 2x2x2 randomized block design having three factors with levels of NPK 50 and 100 % ha^{-1}, Levels of Rhizobium 50 and 100 % ha^{-1} and Levels of Vermicompost50 and 100 % ha^{-1} respectively. The best treatment was T_8-(N_1+R_1 @ 100% RDF + 20g Rhizobium kg^{-1} seed) showed the increase on enrichment of soil fertility status. The combination of N: P: K, Rhizobium, Vermicompost effect on soil after harvest as slight decrease in particle density 2.39 Mg m^{-3}, bulk density 1.10 Mg m^{-3} and increase in pH 7.29, EC 0.36 dS m^{-1}, OC 0.67 %, pore space 54.22 %, Water holding capacity 55.92 % and available N @ 311.60 kg ha^{-1}, P_2O_5 @ 28.27 kg ha^{-1} and K_2O @ 182.54 kg ha^{-1}. The recorded increase and decrease value in T_8- (N_1+R_1 @ 100% RDF + 20g Rhizobium kg^{-1} seed) observed in post harvest soil. The maximum yield of green pod 73.49 q ha^{-1} in treatment combination T_8=N_1+R_1 @ 100% RDF + 20g/kg seed Rhizobium.

Keywords: Soil nutrients, yield attributes, Rhizobium, Vermicompost, NPK and Cowpea

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Introduction

Cowpea [*Vigna unguiculata*(L.)] is one of the important *kharif* pulses grown in India. Cowpea is mainly grown in Africa; about 90 per cent of the total world acreage is in Africa. It is also grown in Asia, North and South America, Australia, Central and Southern parts of Europe. As a legume, cowpea fixes substantial amounts of atmospheric nitrogen to meet its requirement. In India it is cultivated mainly in UP,MP, Bihar, Punjab, Haryana, Rajasthan, HP etc, where it is grown for both vegetable and pulse purposes and is a highly remunerative crop. Review of existing literature indicates that there is no consensus of opinion on the desirability of inorganic nitrogen for cowpea. Pulses contain a higher percentage of quality protein nearly three times as much as cereals, thus they are cheaper source to overcome protein malnutrition among human being. It is generally believed that a starter dose of nitrogen enhances the yield of crop [1].

Organic manures *viz*., FYM, Vermicompost (VC), poultry manure (PM) and oilcakes help in the improvement of soil structure, aeration and water holding capacity of soil. Further, it stimulates the activity of microorganisms that makes the plant to get the macro and micro-nutrients through enhanced biological processes, increase nutrient solubility, alter soil salinity, sodicity and pH [2].

Rhizobium inoculation increased the root nodulation through better root development and more nutrient availability, resulting in vigorous plant growth and dry matter production which resulted in better flowering, fruiting and pod formation and ultimately there was beneficial effect on seed yield [3].

Nitrogen is a vitally important for plant nutrient. Nitrogen is essential constituent of protein and is present in many other compound of great physiological importance in plant metabolism. Nitrogen is called a basic constituent of life. Phosphorus is a constituent of nucleic acid, phytin and phospho-lipid. Phosphorus compound acts as "energy currency" within plants. Phosphorus is essential for transformation of energy, in carbohydrate metabolism, in fat metabolism, in respiration of plant and early maturity of maize. Potassium play important role in formation of protein and chlorophyll and it provide much of osmotic "pull" that draw water into plant roots. Potassium produces strong stiff straw in maize and reduces lodging in maize. Potassium imparts increase vigour and disease resistance to plant. Phosphorus is critical to cowpea yield because it is reported to stimulate growth, initiate nodule formation as well as influence the efficiency of the rhizobium-legume symbiosis [4].

Materials and Methods

A field experiment was conducted on research farm of Department of Soil Science and Agricultural Chemistry, Naini Agricultural Institute, SHUATS Allahabad, (U.P.) India. The soil of experimental area falls in order Inceptisol and the experimental field is alluvial in nature. The design applied for statistical analysis was carried out with 3x3 randomized block design having three factors withlevels of N: P: K @50 and 100 % ha^{-1}, Levels of Rhizobium @ 50 and 100 % ha^{-1}, Level of Vermicompost @ 50 and 100 % ha^{-1} respectively. The source of N: P: K, Rhizobium, Vermicompost as Urea, DAP, MOP, respectively. Basal dose of fertilizer was applied in respective plots according to treatment allocation unifurrows opened by about 5cm. depth before sowing seeds in soil at the same time sowing of seeds was sown on well prepared beds in shallow furrows, at the depth of 5cm, row to row distance was maintained at 30cm and plant to plant distance was 10cm, during the course of experiment, observations were recorded as mean values of the data.

Table 1 Treatment Combinations

S. No.	Symbol	Treatment Combination
1	(T_0= Control)	(Control)
2	($T_1=N_2 + V_2$)	(@ 50%RDF + 3 t/ha. Vermicompost)
3	($T_2=N_1 + V_2$)	(@ 100%RDF + 3 t/ha. Vermicompost)
4	($T_3=N_2 + V_1$)	(@ 50%RDF + 6 t/ha. Vermicompost)
5	($T_4=N_1 + V_1$)	(@ 100%RDF + 6 t/ha. Vermicompost)
6	($T_5= N_2+ R_2$)	(@ 50%RDF + 10g/kg seed Rhizobium)
7	($T_6= N_1+ R_2$)	(@ 100%RDF + 10g/kg seed Rhizobium)
8	($T_7= N_2+ R_1$)	(@ 50%RDF + 20g/kg seed Rhizobium)
9	($T_8= N_1+ R_1$)	(@ 100%RDF + 20g/kg seed Rhizobium)

Table 2 Physical and Chemical analysis of soil before sowing of Cowpea (*vigna unguiculata L.)*

Parameters	Method employed	Result
Bulk density (Mg m^{-3})	Muthuaval*et al.*(1992) [5]	1.44
Particle density (Mg m^{-3})	Muthuaval*et al.*(1992)	2.66
Pore Space (%);8	Muthuaval*et al.*(1992)	44.24
Water holding capacity (%)	Black (1965) [6]	48.35
Soil pH (1:2)	Jackson (1958) [7]	7.25
Soil EC (dS m^{-1})	Wilcox (1950) [8]	0.21
Organic Carbon (%)	Walkley and Black's (1947) [9]	0.59
Available Nitrogen (Kg ha^{-1})	Subbaih and Asija (1956) [10]	293.48
Available Phosphorus (Kg ha^{-1})	Olsen *et al* (1950) [11]	24.04
Available Potassium (Kg ha^{-1})	Toth and Prince (1949) [12]	158.65

Results and Discussions

The table shows the interaction effects of N P K, Rhizobium, and Vermicompost are generally influenced physical and chemical properties of post-harvest soil.

Physical properties

The interaction effects of N P K, Rhizobium and Vermicompost on bulk density (Mg m^{-3}), particle density (Mg m^{-3}), pore space (%) and water holding capacity (%). The maximum particle density, bulk density of after crop harvest soil was recorded as 2.55 Mg m^{-3}, 1.39 Mg $m^{-3,}$ respectively in T_0 (control). The highest pore space and water holding capacity of soil was recorded 54.22 %, 55.92 % in T_8-N_1+R_1 @ 100% RDF + 20g/kg seed Rhizobium. Similar findings were reported by [13].

Chemical properties of post soil

During the course of study, it was observed that the highest pH was recorded in7.56 T_0-(Control) ha^{-1} and the lowest of 7.29 was recorded with the application of Treatment T_8-N_1+R_1 @ 100% RDF + 20g kg^{-1} seed Rhizobium. If we compare the pH of pre sowing soil sample which was 7.25 with that of after crop harvest soil, there was increase in pH after crop harvest. Increasing dose of N P K, Rhizobium and Vermicompost increase pH of the post-harvest soil. The increase in pH might be due to higher growth of crops as respiration is more. Respiration evolves carbon dioxide and reacts with water to form carbonic acid in soil. The electric conductivity (dSm^{-1}), organic carbon (%), available nitrogen, phosphorus and potassium (kg ha^{-1}), was increase of soil after crop harvests. The chemical properties were affected by different treatment combination of N P K, Rhizobium and Vermicompost. The maximum chemical properties of after crop harvest soil was recorded electric conductivity (dSm^{-1}), organic carbon (%), available nitrogen, phosphorus, potassium (kg ha^{-1}), 0.36, 0.67, 311.60, 28.27, 182.54. Similar findings were reported by [14].

Table 1 Study of N P K, Rhizobium and Vermicompost on Post-harvest soil properties of Cowpea (*vigna unguiculata L.*)

Treatment combination	Bd (Mg m^{-3})	Pd (Mg m^{-3})	Pore space (%)	pH	EC (dSm^{-1})	O.C. (%)	N ($kgha^{1}$)	P_2O_5 (kg ha^{1})	K_2O (kg ha^{-1})	(%) water holding Capacity
T_0 (**Control**)	1.39	2.55	43.79	7.56	0.32	0.53	286.19	21.02	152.49	47.95
T_1(**N_2+V_2**)	1.36	2.51	45.61	7.51	0.33	0.57	287.78	21.96	155.07	50.70
T_2(**N_1+V_2**)	1.35	2.52	50.79	7.53	0.33	0.57	290.67	22.79	155.60	51.03
T_3(**N_2+V_1**)	1.32	2.48	49.45	7.5	0.33	0.59	293.03	23.24	158.00	51.14
T_4(**N_1+V_1**)	1.29	2.43	52.90	7.44	0.34	0.61	297.57	24.82	161.17	52.66
T_5(**N_2+R_2**)	1.24	2.39	51.03	7.3	0.34	0.58	300.65	25.65	166.03	53.06
T_6(**N_1+R_2**)	1.17	2.42	53.88	7.4	0.35	0.62	303.64	26.44	170.76	53.28
T_7(**N_2+R_1**)	1.15	2.41	54.61	7.3	0.35	0.61	308.93	26.47	177.30	54.19
T_8(**N_1+R_1**)	1.10	2.39	54.22	7.29	0.36	0.67	311.60	28.27	182.54	55.92
F- test	S	NS	NS	S	NS	NS	S	NS	S	NS
S. Em (±)	0.027	0.072	3.954	0.010	0.044	0.067	0.129	2.437	3.59	3.141
C. D. at 5%	0.056	0.148	8.161	0.022	0.091	0.139	0.373	5.031	7.410	6.483

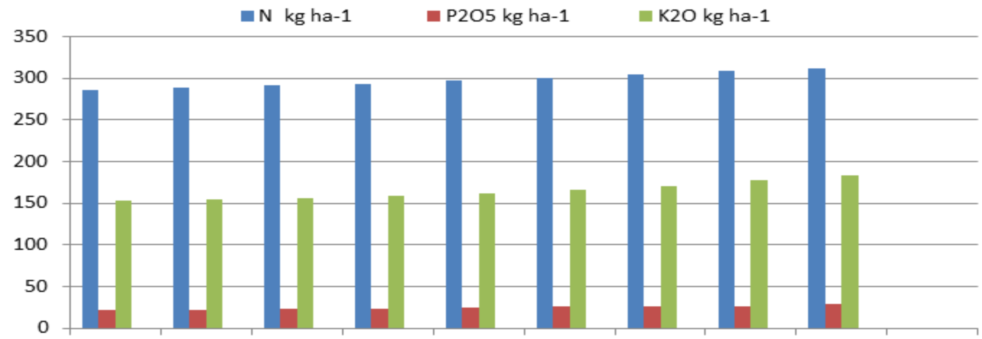

Figure 1 Effect of INM on N P K in post harvest soil

Conclusion

It was concluded from trial that the various level of N P K, Rhizobium and Vermicompost from different sources in the experiment. The treatment combination T_8(N_{20} P_{60} K_{40} Kg ha^{-1} and Rhizobium 200 g/ 10 kg seed) is the best.Thus it could be recommended for profitable production of Cowpea [*Vigna unguiculata*(L.)] and good for soil physical and chemical properties. Integrated nutrient management is better for soil health and Cowpea production.

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