Influence of Organic Manure and Inorganic Fertilizer on Soil Health, Growth and Yield of Cowpea (*Vigna unguiculata* L.) var. Gomati

ABSTRACT

An experiment was conducted on **"Influence of Organic Manure and Inorganic Fertilizer on Soil Health, Growth and Yield of Cowpea (*Vigna unguiculata* L.) var. Gomati."** during kharif season 2022-23 at the research farm Department of soil science and agricultural chemistry, NAINI, SHUATS, Prayagraj. The design applied was RBD having three levels of poultry-manure @ 0%,50 % 100% h^{-1} and NPK @ 0, 50and 100%. The variety of cowpea Gomati was taken for research trial. The soil pore space, water holding capacity, organic carbon, nitrogen, phosphorus and potassium were recorded maximum in T_9 [NPK @ 100% + poultry manure @ 100% ha^{-1}] respectively. In post soil samples of fertilizer observations were resulted in significant increase in depth 0-15 cm. In treatment T_9 the highest pod yield of cowpea 71.58 q ha^{-1} was obtained. Use of T_9 [NPK @ 100% + poultry manure @ 100% ha^{-1}] on crop and analysing the effect of T_9 treatment on soil physical as well as chemical properties of soil. It was also revealed that the application with organic manures was excellent source for fertilization than fertilizers for nutrients supply.

Keywords: Soil properties, nutrients, cowpea, poultry manure *etc*.

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INTRODUCTION

Cowpea (*Vigna unguiculata*) with chromososme number 2n=22, belongs to the family Leguminosae sub family Fabaceae and genus Vigna. It is self-pollinated and response to photoperiod. It is mainly grown for its long pods, seeds and foliage and for fodder. It is commonly known as southern bean, yard-long bean, asparagus bean. It is also known as vegetable meat. **(Goud *et al*., 2020)**. Pulses have long been recognized and valued as "Soil building" crops. Growing pulses improves soil quality through their beneficial effects on soil biological, chemical and physical conditions. Organic materials are intrinsic and essential components of all soils and it makes a living dynamic system in the soil that supports all life residing in soil. Organic matter plays a vital role in improving the physical, chemical, and biological condition of soil **(Uma devi *et al*., 2019)**. Besides, addition of N, P, K organic manures are a potential source of micronutrients and improve soil structure by providing binding action to soil aggregates, increases water holding capacity and improve buffering capacity of soils. Although release of nutrients is slow but steadily for longer duration thus preventing their losses by leaching and other means and improves nutrient use efficiency of the crop. The nutrients supplementation through organic sources also has been found to be a good carrier for flourishment of microbes resulting into sustained soil productivity and enhanced enzymatic activities of soil which play a vital role in the transformation of unavailable form of nutrient into available form and gives rise an organic recycling process along with improving soil health **(Kumari *et al*., 2018)**. Use of organic manure alone or in combination with

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Comment [R5]: why bold do as per journal standard format chemical fertilizers, helps in improving physico-chemical properties of the soil, improves the efficient utilization of applied fertilizers resulted in higher seed yield and quality. The increasing use of NPK fertilizers generally devoid of micronutrients, had no doubt remarkably increased the food production but it brought with a host of problems related to micro nutrient deficiencies by depleting their resources in soil. For integrated nutrient management in maize cultivation, PM is usually applied to the prepared soil two weeks before planting **(Uwah *et al*., 2011)** to allow the mineralization of the PM. Potassium plays 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 reduce lodging in maize. Potassium imparts increase vigor and disease resistance to plant **(Cobbinah *et al*., 2011).** Recently, much emphasis has been placed on the use of organic fertiliser in cowpea production in order to reduce plant and soil contamination **(Ahmed and Elzaawel., 2010)**. Urea may be applied to maize farms in different growing stages. Delaying or early application of urea to plants may have an implication on soil chemical properties, growth, and yield of the crop. Many researchers have suggested that N should be applied at the time it is needed by the crop **(Ogunboye *et al.* 2020).**

MATERIAL AND METHODS

The investigation **"Influence of Organic Manure and Inorganic Fertilizer on Soil Health, Growth and Yield of Cowpea (*Vigna unguiculata* L.) var. Gomati."** comprises of a field experiment which was carried out at the Soil Science Research Farm, Sam Higginbottom University of Agriculture Technology, Prayagraj during Kharif season 2022. The details about the experiment site, soil and climate are described in this chapter together with the experimental design, layout plan, cultural practice, particulars of treatments, planting material and techniques employed for the parameters.

The experiment was conducted at research farm of soil science at NAI, SHUATS, Prayagraj, the area is situated on the south of Prayagraj on the right side of the river Yamuna on the south of rewa road at a distance of about 6 km from Prayagraj city. It is situated at $25^{0}57^{"}$ N latitude, $81^{0}59^{"}$ E longitude and at the altitude of 98 meter above the sea level, comes under subtropical belt in the South east of Uttar Pradesh, which experience extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46^{0}C – 48^{0}C and seldom falls as low as 4^{0}C – 5^{0}C. The relative humidity ranged between 20 to 94 percent. The average rainfall in this area is around 1100 mm annually.

The soil samples were randomly collected from one site in the experiment plot prior to tillage operation from a depth of 0-15 cm. The volume of the soil sample was reduced by conning and quartering the composites soil samples were air dried and passed through a 2 mm sieve by way of preparing the sample for physical and chemical analysis.

Table 1. Treatment combination of cowpea

Treatments	Treatment combinations

T_1	Absolute control
T_2	(RDF @ 0%+PM @ 50%)
T_3	(RDF @ 0%+PM @ 100%)
T_4	(RDF @ 50%+PM @ 0%)
T_5	(RDF @ 50%+PM @ 50%)
T_6	(RDF @ 50%+PM @ 100%)
T_7	(RDF @ 100%+PM @ 0%)
T_8	(RDF @ 100%+PM @ 50%)
T_9	(RDF @ 100%+PM @ 100%)

Source: ICAR (2010)

RDF = N = 20 kg ha^{-1}, P_2O_5 = 60 kg ha^{-1} & K_2O = 40 kg ha^{-1} (DAP & MOP)

Poultry manure = 4 t ha^{-1} (N = 3.0 %, P = 1.0 % & K = 1.5 %)

Table 2. Protocols for physical and chemical analysis of soil

Particular	Scientist, Year
Textural class (Sand, Silt, Clay) %	Bouyoucos, 1962
Pore space (%)	Muthuaval *et al.*, 1992
Water holding capacity (%)	Muthuaval *et al.*, 1992
Soil pH (1:2.5) (w/v)	Jackson, 1958
Soil EC (dS m^{-1})	Wilcox, 1950
Organic Carbon (%)	Walkley and Black, 1947
Available Nitrogen (kg ha^{-1})	Subbiah and Asija, 1956
Available Phosphorus (kg ha^{-1})	Olsen et al, 1954
Available Potassium (kg ha^{-1})	Toth and Prince, 1949

RESULTS AND DISCUSSION

Soil parameters

The treatment composition T_9 of NPK and Poultry manure have significant increasement on the physical and chemical parameters of soil. The increasement of pore space %, water holding capacity %, organic carbon, available nitrogen, phosphorus and potassium with the improvement of soil parameters in, table 3 shows that application of different levels of NPK and Poultry manure have significant role on soil properties. In treatment T_1 lowest data observed of pore space 42.02%, water holding capacity

40.37%, organic carbon 0.28%, nitrogen 219.30 kg ha^{-1}, phosphorus 18.62 kg ha^{-1}, potassium 175.62 kg ha^{-1} and the treatment combination T_9 [NPK @ 100 % + PM @ 100 %] shows the highest pore space 48.12, water holding capacity 45.99%, organic carbon 0.46%, nitrogen 285.41 kg ha^{-1}, phosphorus 23.47 kg ha^{-1} and potassium 208.47 kg ha^{-1} in sample of 0-15 cm depth of soil.

Treatments	**Pore space (%)**	**Water holding capacity (%)**	**Organic carbon (%)**	**Nitrogen (kg ha^{-1})**	**Phosphorus (kg ha^{-1})**	**Potassium (kg ha^{-1})**
	0-15 cm	**0-15cm**	**0-15 cm**	**0-15 cm**	**0-15 cm**	**0-15 cm**
T_1	42.02	40.37	0.28	258.97	18.62	175.62
T_2	43.66	41.02	0.31	261.79	19.27	178.27
T_3	44.37	42.30	0.34	269.47	19.85	183.25
T_4	44.92	43.21	0.36	274.00	20.47	187.09
T_5	45.98	43.45	0.38	275.73	21.11	192.85
T_6	46.52	44.37	0.40	279.31	21.61	196.47
T_7	46.88	44.80	0.42	282.31	22.25	202.11
T_8	47.64	45.59	0.44	283.08	23.09	205.61
T_9	48.12	45.99	0.46	285.41	23.47	208.47
F-test	S	S	S	S	S	S
S. Ed (±)	0.520	0.671	0.027	1.128	0.642	0.682

Table 3. Effect of different levels of NPK and Poultry manure on soil properties

C.D. (@5%)	1.072	1.384	0.057	2.327	1.326	1.407

Effect of different levels of NPK and poultry manure on soil properties

In fig 1. and 2. the treatment T_9 is the maximum potential of soil parameters that improve the soil followed by T_8. It eventually shows that the NPK and poultry manure application is the beneficial effect on the soil, that will maintain the soil. T_1 shows that lowest effect on the soil.

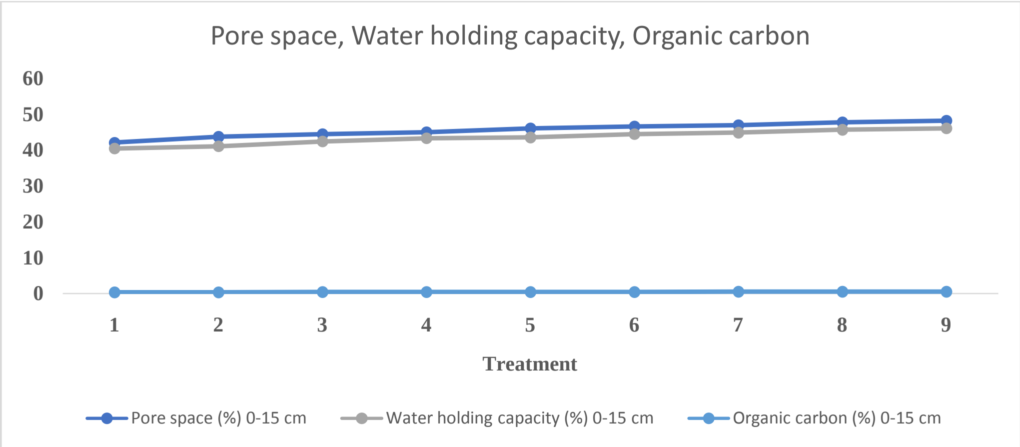

Fig 1. Effect of different levels of NPK and Poultry manure on pore space, water holding capacity

and organic carbon

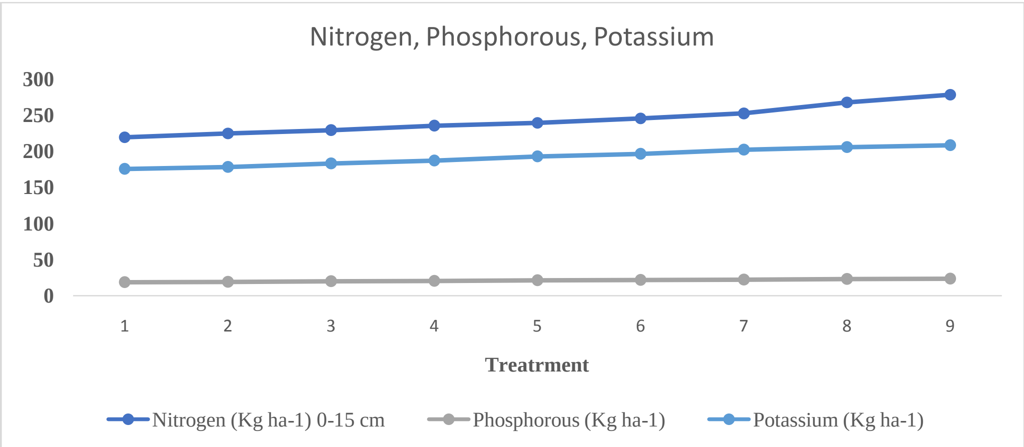

Fig 2. Effect of different levels of NPK and poultry manure on nitrogen, phosphorus and potassium

kg ha^{-1}

Table 4. Influence of organic manure and inorganic fertilizers on yield of cowpea

Treatment	Treatment Combination	Pod yield (q ha^{-1})
T_1	Absolute control	52.83
T_2	(RDF @ 0%+PM @ 50%)	54.58
T_3	(RDF @ 0%+PM @ 100%)	54.86
T_4	(RDF @ 50%+PM @ 0%)	56.66
T_5	(RDF @ 50%+PM @ 50%)	58.96
T_6	(RDF @ 50%+PM @ 100%)	63.67
T_7	(RDF @ 100%+PM @ 0%)	64.58
T_8	(RDF @ 100%+PM @ 50%)	67.63
T_9	(RDF @ 100%+PM @ 100%)	71.58
	F-test	S
	S. Ed (±)	0.657
	C.D. (@5%)	1.356

As depicted in table 4 that the maximum pod yield of cowpea was 71.58 q ha^{-1} found in T_9 [NPK @ 100 % + PM @ 100 %] followed by T_8 [NPK @ 100 %+ @ PM 50 %] and the minimum pod yield q ha^{-1} was found in T_1 which was 52.83 q ha^{-1} respectively.

CONCLUSION

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It revealed from the research that the treatment combination T_9 [NPK @ 100 % + PM @ 100 %] shows best results in comparison to other treatment combinations and gave highest yield 71.58 q ha^{-1}. According to the outcomes of treatment T_9 we can recommend farmers to apply integrated nutrients *i.e.*, NPK and poultry manure for profitable production of cowpea, economics and to maintain good soil health and productivity.

ACKNLOWDGEMENT

Success is the manifestation of diligence, perseverance, inspiration, motivation and innovations. It is my proud privilege to express a deep sense of gratitude to my Advisor (Dr.) Arun Alfred David, Associate Professor, Department of Soil Science and Agricultural Chemistry, SHUATS, Prayagraj, whose generous help, untiring guidance, supervision, critical suggestions and his positive attitude towards my abilities enabled me to complete this work.

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