



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

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## 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

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% 100% h<sup>-1</sup> and NPK @ 0, 50 and 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<sub>9</sub> [NPK @ 100% + poultry manure @ 100% ha<sup>-1</sup>] respectively. In post soil samples of fertilizer observations were resulted in significant increase in depth 0-15 cm. In treatment T<sub>9</sub> the highest pod yield of cowpea 71.58 q ha<sup>-1</sup> was obtained. Use of T<sub>9</sub> [NPK @ 100% + poultry manure @ 100% ha<sup>-1</sup>] on crop and analysing the effect of T<sub>9</sub> 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.

## 1. INTRODUCTION

“Cowpea (*Vigna unguiculata*) with chromosome 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” [1]. “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” [2]. “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 flourishing 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” [3]. “Use of organic manure alone or in combination with 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 to allow the mineralization of the PM” [4]. 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” [5]. “Recently, much emphasis has been placed on the use of organic fertiliser in cowpea production in order to reduce plant and soil contamination” [6]. “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” [7].

## 2. MATERIALS 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°57' N latitude,

**Table 1. Treatment combination of cowpea**

Treatments	Treatment combinations
T <sub>1</sub>	Absolute control
T <sub>2</sub>	(RDF @ 0%+PM @ 50%)
T <sub>3</sub>	(RDF @ 0%+PM @ 100%)
T <sub>4</sub>	(RDF @ 50%+PM @ 0%)
T <sub>5</sub>	(RDF @ 50%+PM @ 50%)
T <sub>6</sub>	(RDF @ 50%+PM @ 100%)
T <sub>7</sub>	(RDF @ 100%+PM @ 0%)
T <sub>8</sub>	(RDF @ 100%+PM @ 50%)
T <sub>9</sub>	(RDF @ 100%+PM @ 100%)

Source: ICAR (2010)

RDF = N = 20 kg ha<sup>-1</sup>, P<sub>2</sub>O<sub>5</sub> = 60 kg ha<sup>-1</sup> & K<sub>2</sub>O = 40 kg ha<sup>-1</sup> (DAP & MOP)  
 Poultry manure = 4 t ha<sup>-1</sup> (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 <i>et al.</i> , 1992
Water holding capacity (%)	Muthuaval <i>et al.</i> , 1992
Soil pH (1:2.5) (w/v)	Jackson [8]
Soil EC (dS m <sup>-1</sup> )	Wilcox, 1950
Organic Carbon (%)	Walkley and Black, 1947
Available Nitrogen (kg ha <sup>-1</sup> )	Subbiah and Asija, 1956
Available Phosphorus (kg ha <sup>-1</sup> )	Olsen <i>et al.</i> , 1954
Available Potassium (kg ha <sup>-1</sup> )	Toth and Prince, 1949

81°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°C – 48°C and seldom falls as low as 4°C – 5°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.

### 3. RESULTS AND DISCUSSION

#### 3.1 Soil Parameters

The treatment composition T<sub>9</sub> of NPK and Poultry manure have significant increasement on the physical and chemical parameters of soil. The

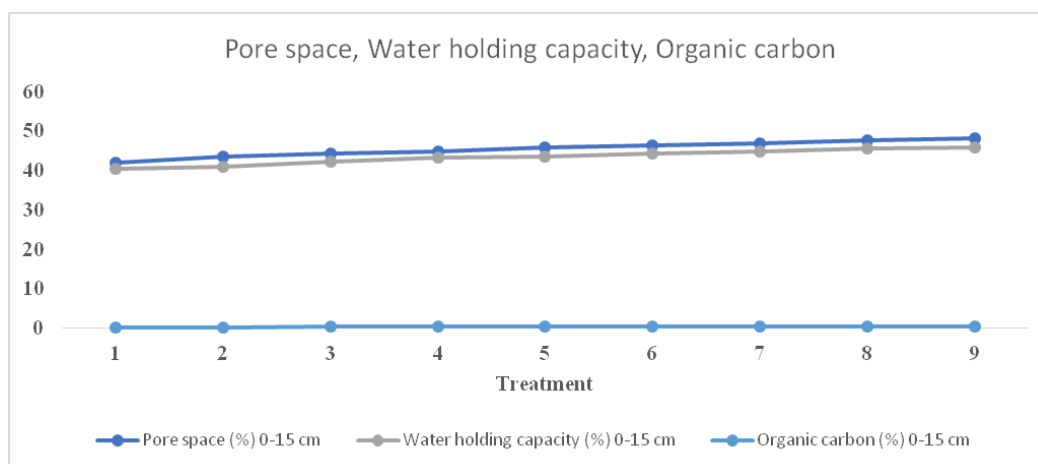
increasement of pore space %, water holding capacity %, organic carbon, available nitrogen, phosphorus and potassium with the improvement of soil parameters in, Table 3 shows that application of different levels of NPK and Poultry manure have significant role on soil properties. In treatment T<sub>1</sub> lowest data observed of pore space 42.02%, water holding capacity 40.37%, organic carbon 0.28%, nitrogen 219.30 kg ha<sup>-1</sup>, phosphorus 18.62 kg ha<sup>-1</sup>, potassium 175.62 kg ha<sup>-1</sup> and the treatment combination T<sub>9</sub> [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<sup>-1</sup>, phosphorus 23.47 kg ha<sup>-1</sup> and potassium 208.47 kg ha<sup>-1</sup> in sample of 0-15 cm depth of soil [9,10].

#### 3.2 Effect of Different Levels of NPK and Poultry Manure on Soil Properties

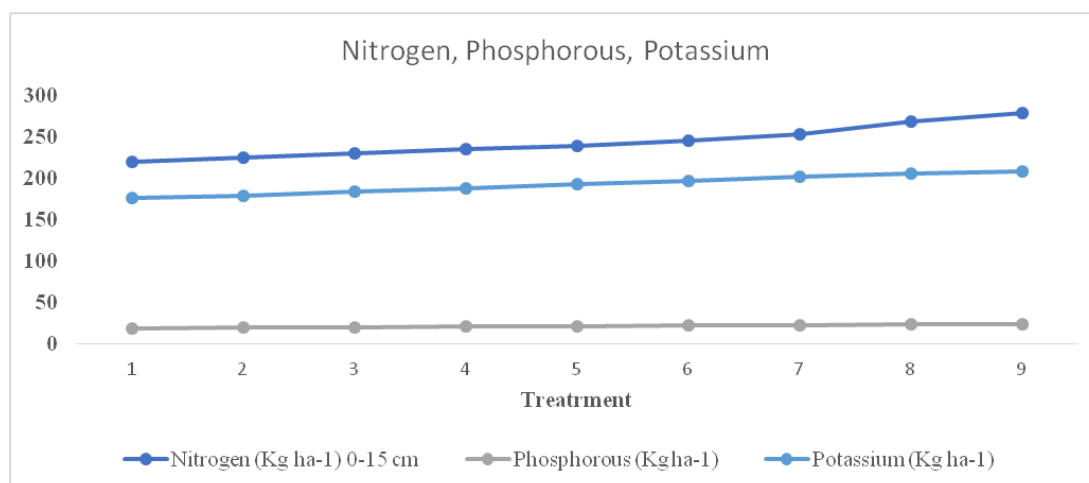
In Figs. 1 and 2, the treatment T<sub>9</sub> is the maximum potential of soil parameters that improve the soil followed by T<sub>8</sub>. It eventually shows that the NPK and poultry manure application is the beneficial effect on the soil, that will maintain the soil. T<sub>1</sub> shows that lowest effect on the soil.

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

Treatments	Pore space (%)	Water holding capacity (%)	Organic carbon (%)	Nitrogen (kg ha <sup>-1</sup> )	Phosphorus (kg ha <sup>-1</sup> )	Potassium (kg ha <sup>-1</sup> )
	0-15 cm	0-15cm	0-15 cm	0-15 cm	0-15 cm	0-15 cm
T <sub>1</sub>	42.02	40.37	0.28	258.97	18.62	175.62
T <sub>2</sub>	43.66	41.02	0.31	261.79	19.27	178.27
T <sub>3</sub>	44.37	42.30	0.34	269.47	19.85	183.25
T <sub>4</sub>	44.92	43.21	0.36	274.00	20.47	187.09
T <sub>5</sub>	45.98	43.45	0.38	275.73	21.11	192.85
T <sub>6</sub>	46.52	44.37	0.40	279.31	21.61	196.47
T <sub>7</sub>	46.88	44.80	0.42	282.31	22.25	202.11
T <sub>8</sub>	47.64	45.59	0.44	283.08	23.09	205.61
T <sub>9</sub>	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
C.D. (@5%)	1.072	1.384	0.057	2.327	1.326	1.407



**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<sup>-1</sup>**

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

Treatment	Treatment Combination	Pod yield (q ha <sup>-1</sup> )
T <sub>1</sub>	Absolute control	35.73
T <sub>2</sub>	(RDF @ 0%+PM @ 50%)	39.58
T <sub>3</sub>	(RDF @ 0%+PM @ 100%)	44.86
T <sub>4</sub>	(RDF @ 50%+PM @ 0%)	48.66
T <sub>5</sub>	(RDF @ 50%+PM @ 50%)	58.96
T <sub>6</sub>	(RDF @ 50%+PM @ 100%)	63.67
T <sub>7</sub>	(RDF @ 100%+PM @ 0%)	64.58
T <sub>8</sub>	(RDF @ 100%+PM @ 50%)	68.10
T <sub>9</sub>	(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<sup>-1</sup> found in T<sub>9</sub> [NPK @ 100 % + PM @ 100 %] followed by T<sub>8</sub> [NPK @ 100 %+ @ PM 50 %] and the minimum

pod yield  $q\ ha^{-1}$  was found in  $T_1$  which was 35.73  $q\ ha^{-1}$  respectively.

#### 4. CONCLUSION

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.

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#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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