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# Effect of different levels of NPK rhizobium and FYM on soil properties, growth and yield of cowpea (*Vigna unguiculata* L.) Var. Pusa Barsati

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**Abstract**
The present study was entitled as "Effect of different levels of N, P, K, *Rhizobium* and FYM on soil properties, growth and yield of Cowpea (*Vigna unguiculata* L.)". The research was conducted during *Kharif* 2017-2018 at the Field Experimentation Centre of the Department of Soil Science and Agricultural Chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad (U.P). The data were recorded by 9 treatment with control. Based on the mean performance Treatment-8 (100% RDF + *Rhizobium* 20 gm $kg^{-1}$) found best treatment for plant growth and seed yield. This treatment was recorded as high in plant height (cm), pod length (cm), number of pods per plant, number of pod per plant, Weight of pod at 50 and 75 days of crop maturity and also physical properties of soil such as Particle and Bulk density, water holding capacity, porosity %, soil colour and chemical properties of soil like Available Nitrogen, Phosphorus, Potassium, soil pH and EC of soil. Interaction effect of Integrated Nutrient Management was significant for all characters. Thus, it indicates that the process of Integrated Nutrient Management may be better option for physical and chemical Analysis of Soil to achieve with growth and yield attributes of Cowpea.

**Keywords:** NPK, *Rhizobium*, growth parameters, soil properties, cowpea etc.

## Introduction
India is the largest producer of pulses, accounting for about 25 percent of the global share. Being an inseparable ingredient in the diet of the vast majority of vegetarian population and mainstay of sustainable crop production, pulses continue to be an important component of the rainfed agriculture, since time immemorial. About a dozen pulse crops *viz.* chickpea, pigeonpea, mungbean, urdbean, lentil, field pea, lathyrus, cowpea, common bean, mothbean, horse gram and rice bean are cultivated under varied agro-ecological conditions. (Chandramohan and Chandragiri, 2007) [4].

Pulses are second most important group of crops after cereals. During the year 2016, the global pulse production was 54.07 million tonnes from an area of 70.6 million ha, with an average yield of 871 kg $ha^{-1}$. In India, pulse crops are grown over an area of 25.26 million ha with an annual production of 16.47 million tonnes and productivity of 652 kg $ha^{-1}$. In Uttar Pradesh, it is cultivated in 1.87 million hectares with an annual production of 1.22 million tonnes leading to average productivity of 654 kg $ha^{-1}$ (DES, 2016) [6].

Nitrogen is 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 plays key roles in many plant processes such as energy metabolism, nitrogen fixation, synthesis of nucleic acids and membranes, photosynthesis, respiration and enzyme regulation. 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 (Ndakidemi and Dakora, 2007) [9]. According to Oti *et al.* (2004) [10], phosphorus decrease zinc concentration in the cowpea grain, thereby affecting its nutritional quality. It is required for the physiological processes of protein synthesis and energy transfer in plants. Application of phosphorus has been reported by several authors to improve yield of cowpea. Seed yield is, therefore, governed by number of factors which have a direct or indirect impact. Among these factors are yield components such as number of pods per plant, number of seeds per pod and 100-seed weight over a given land area.

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 reduce lodging in maize. Potassium imparts increase vigor and disease resistance to plant (Cobbinah *et al.*, 2011) [5].

Rhizobia are symbiotic diazotrophs (prokaryotic organisms that carry out di-nitrogen fixation) that form a symbiotic association with legumes. This association is symbiotic in that both the plant and rhizobia benefit. The plant supplies the rhizobia with energy in the form of amino acids and the rhizobia fix nitrogen from the atmosphere for plant uptake. The reduction of atmospheric di nitrogen into ammonia is the second most important biological process on earth after photosynthesis (Singh, 2008) [14]. Keep these things, the present investigation effect of different levels of N P K *Rhizobium* and FYM on soil Properties, growth and yield of Cowpea (*Vigna unguiculata* L.) is done.

## Materials and Methods

A field experiment was conducted during *Kharif* in 2017-2018 at the Field Experimentation Centre of the Department of Soil Science and Agricultural Chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad (U.P). The experiment was carried out in Randomized Block Design with three levels of NPK, *Rhizobium* and FYM. The treatments were replicated three times and were allocated at random in each replication. The soil of experimental area falls in order of Inceptisol and in Experimental plot will be alluvial soil. The soil samples will be randomly collected from each plot in the experiment plot. Nitrogen, Phosphorus and Potassium are applied basal dose in to the field. The FYM was applied before 30 days of sowing the seed with two different levels i.e. (control), 5 t $ha^{-1}$ and 10t $ha^{-1}$.

## Results and Discussions

### Effect on growth and yield attributes

Among these treatments, treatment $T_8$ (100%RDF + 20g/kg seed *Rhizobium*) was found significantly higher plant height (59.07 cm), Pod length (16.66 cm), No. of Pods $Plant^{-1}$ (14.08) and No. of seed $Pod^{-1}$ (12.24). Initial boost of nitrogen which might have helped in higher chlorophyll formation and ultimately higher photosynthesis. Phosphorus is also known to encourage cell division and hence contributed to taller plants (Beg and Singh, 2009) [2]. More number of pods mainly due to more survival of flower under high supply of photosynthetic. Higher photosynthetic produced due to better nitrogen and phosphorus availability, better translocation within plants and favorable sink source ratio of photosynthetic (Badar *et al*. 2015) [1]. Pivotal role of *Rhizobium* in fixation of atmospheric nitrogen which might have enhanced the supply and translocation of N which influences the development of photosynthetic organs (Silva *et al*. 2013) [12]. Steady and higher availability of major, secondary and micronutrients during the crop growth period which have enhanced the growth and yield attributes and finally augmented to better seed yield (Stamford *et al*. 2013) [3, 5].

**Table 1:** Effect of Different Levels of N, P, K, *Rhizobium* and FYM on Growth and Yield attributes of Cowpea

| Treatments | | Growth and Yield attributes | | | |
|---|---|---|---|---|---|
| | | Plant height (cm) (60 DAS) | Number of Pods $plant^{-1}$ (75 DAS) | Length of Pod (cm) | No. of Seed $Pod^{-1}$ |
| $T_0$ | (Control) | 41.57 | 5.32 | 10.27 | 7.14 |
| $T_1$ | 50%RDF + 5 t $ha^{-1}$. FYM | 48.00 | 6.97 | 11.42 | 8.30 |
| $T_2$ | 100%RDF + 5 t $ha^{-1}$. FYM | 48.90 | 7.46 | 11.90 | 8.81 |
| $T_3$ | 50%RDF + 10 t $ha^{-1}$. FYM | 50.23 | 8.00 | 12.82 | 9.09 |
| $T_4$ | 100%RDF + 10 t $ha^{-1}$. FYM | 52.20 | 8.46 | 13.51 | 9.61 |
| $T_5$ | 50%RDF + 10 g $kg^{-1}$ seed *Rhizobium* | 53.17 | 9.24 | 14.50 | 10.04 |
| $T_6$ | 100%RDF + 10 g $kg^{-1}$ seed *Rhizobium* | 55.10 | 10.07 | 15.87 | 10.60 |
| $T_7$ | 50%RDF + 20 g $kg^{-1}$ seed *Rhizobium* | 57.03 | 11.73 | 16.16 | 11.37 |
| $T_8$ | 100%RDF + 20 g $kg^{-1}$ seed *Rhizobium* | 59.07 | 14.08 | 16.66 | 12.24 |
| F- test | | S | S | S | S |
| S. Ed. (±) | | 0.33 | 0.41 | 0.38 | 0.44 |
| C. D. (P = 0.05) | | 0.7 | 0.87 | 0.82 | 0.93 |

**Table 2:** Effect of Different Levels of N, P, K, *Rhizobium* and FYM on soil properties of Cowpea

| Treatments | | Soil properties | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | BD (Mg $m^{-3}$) | PD (Mg $m^{-3}$) | Pore space (%) | pH | OC (%) | EC(dS $m^{-1}$at 25°C) | WHC (%) | N (kg $ha^{-1}$) | P (kg $ha^{-1}$) | K (kg $ha^{-1}$) |
| $T_0$ | (Control) | 1.41 | 2.60 | 43.50 | 7.64 | 0.49 | 0.357 | 44.97 | 284.33 | 21.11 | 150.37 |
| $T_1$ | 50%RDF + 5 t/ha. FYM | 1.37 | 2.54 | 46.00 | 7.50 | 0.54 | 0.350 | 46.97 | 289.43 | 22.09 | 158.80 |
| $T_2$ | 100%RDF + 5 t/ha. FYM | 1.36 | 2.56 | 48.66 | 7.48 | 0.55 | 0.347 | 49.03 | 292.42 | 22.96 | 155.47 |
| $T_3$ | 50%RDF + 10 t/ha. FYM | 1.34 | 2.48 | 49.72 | 7.57 | 0.57 | 0.337 | 50.73 | 294.58 | 23.55 | 159.13 |
| $T_4$ | 100%RDF + 10 t/ha. FYM | 1.31 | 2.42 | 51.30 | 7.58 | 0.59 | 0.337 | 52.23 | 297.32 | 24.54 | 162.80 |
| $T_5$ | 50%RDF + 10g/kg seed *Rhizobium* | 1.28 | 2.39 | 51.08 | 7.39 | 0.59 | 0.330 | 52.60 | 302.48 | 25.28 | 167.10 |
| $T_6$ | 100%RDF + 10g/kg seed *Rhizobium* | 1.21 | 2.37 | 53.73 | 7.37 | 0.61 | 0.323 | 54.33 | 304.21 | 25.95 | 171.83 |
| $T_7$ | 50%RDF + 20g/kg seed *Rhizobium* | 1.18 | 2.38 | 54.34 | 7.34 | 0.64 | 0.323 | 56.53 | 308.51 | 26.32 | 178.83 |
| $T_8$ | 100%RDF + 20g/kg seed *Rhizobium* | 1.15 | 2.36 | 55.07 | 7.26 | 0.68 | 0.317 | 57.03 | 312.27 | 28.29 | 184.00 |
| F- test | | S | S | S | NS | S | S | S | S | S | S |
| S. Ed. (±) | | 0.33 | 0.03 | 0.63 | 0.11 | 0.02 | 0.004 | 0.91 | 0.65 | 0.36 | 1.72 |
| C. D. (P = 0.05) | | 0.7 | 0.06 | 1.33 | 0.24 | 0.04 | 0.008 | 1.93 | 1.37 | 0.77 | 3.65 |

**Note:** B.D. - Bulk density; P.D.- Particle density; O.C- Organic carbon; EC- Electronic conductivity; WHC- Water holding capacity; N- Nitrogen; P- Phosphorus; K- Potassium

**Effect on soil properties**

Among these treatments, treatment $T_8$ (100% RDF + 20g $kg^{-1}$ seed *Rhizobium*) was found significantly best treatment with Bulk density (1.15 mg $m^{-3}$), Pore space (55.07 %), Water holding capacity (57.03 %), pH (7.26), EC (0.317 dS $m^{-1}$ at 25°C), Nitrogen (312.27 kg $ha^{-1}$) and Phosphorus (28.29 kg $ha^{-1}$). Addition of organic manures can improve the soil physical properties is a well-documented and scientifically proven fact but any significant changes in the soil physical properties can be recorded when organic manure treatment compared with chemical fertilizer treatment. (Berger *et al*. 2013) [3]. Application of FYM has favorable effect on physical, chemical and biological properties of soil and hence provided better environment for root growth and proliferation thereby creating maximum absorptive power by crop (Saravanan and Kumar, 2013) [11]. Reduction in pH might be due to production of organic acid by manure on decomposition. (Silva *et al*. 2012) [15]. Organic manure in improving porosity and hydraulic conductivity which might have resulted in enhanced leaching of the salts thereby reducing the EC values. (Khandelwal *et al*. 2012) [7]. Significantly higher O.C attributed to bulk posting of organic matter rich in nitrogen which enhanced microbial activity in the soil and thereby greater conversion of organically bound nitrogen to inorganic form by the activities of microbes (Menon *et al.* 2010) [8]. The higher available N attributed to higher activity of N- fixing bacteria, thereby making N greatly available in the soil by (Singh and Mukherjee 2009) [13]. Significantly higher available phosphorus might be due to the lower loss of nutrients due to slow available nutrients in soil (Wagadre *et al*. 2010) [16].

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