# Effect of Organic Sources of Nitrogen on Soil Fertility of Cowpea [*Vigna unguiculata* (L.) Walp]

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## ABSTRACT

**Background:** Cowpea [*Vigna unguiculata* (L.) Walp] is most widely grown pulse-cum-vegetable crop. It plays an important role in maintaining soil fertility. Besides, nitrogen which is fixed in the soil from the atmosphere by the crop specific *Rhizobium* found in root nodules of this crop, phosphorus is another important element which inter-alia enhances the nitrogen fixation capability of the crop. In addition to biologically fixed nitrogen, crop also requires nitrogen through fertilization to meet its initial requirement (Mishra and Baboo, 1999).

**Methods:** A field experiment was on conducted during *kharif* season of the year 2015 at Agronomy Instructional Farm, C.P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar Gujarat. The experiment was laid out in randomized block design with four replications and 10 treatments comprising of integration of different organic sources.

**Result:** Our investigation in the significant improvement in N content in seed and N uptake by cowpea were noted with the application of 50% N through FYM + 50% N through vermicompost + PSB (T8), whereas, higher N content in stover and P content in seed were recorded under treatment $T_9$ (50% N through castor cake + 50% N through vermicompost + PSB) and $T_{10}$: RDF (20+40+00 kg ha$^{-1}$ NPK through Fertilizer), respectively. Treatment $T_{10}$ contributed to raise potassium content in seed, uptake of P and K by cowpea and available NPK in soil after harvest of crop.


**Key words:** Castor cake, Cowpea, FYM, PSB, Quality, *Rhizobium,* Vermicompost, Yield.

## INTRODUCTION

Cowpea [*Vigna unguiculata* (L.) Walp] is most widely grown pulse-cum-vegetable crop. It plays an important role in maintaining soil fertility. Besides, nitrogen which is fixed in the soil from the atmosphere by the crop specific *Rhizobium* found in root nodules of this crop, Phosphorus is another important element which inter-alia enhances the nitrogen fixation capability of the crop. In addition to biologically fixed nitrogen, crop also requires nitrogen through fertilization to meet its initial requirement (Mishra and Baboo, 1999). Grain legumes occupy the most significant place in all tropical and sub- tropical countries, where their importance is second to cereal as nutritious source of human and animal food. Cowpea is short duration, high yielding and quick growing crop providing quick and thick cover on ground thus, helping in conservation of soil. It is grown as alternative crop in dry land farming (Khandelwal *et al*., 2012). The use of organic fertilizers is directly related to soil fertility, soil carbon sequestration, greenhouse gas (GHG) emissions and crop yield. Organic fertilizers have higher organic matter and richer nutrient elements, although they are not readily available to the plant and they have to be microbially mineralized before becoming available to the plant (Seufert *et al.,* 2012). In turn, the use of organic fertilizers has usually been associated with lower crop yields (Alaru *et al.,* 2014). However, there are studies in which the application of manure acted as a better fertilizer than mineral fertilizers for increasing crop yields (Jannoura *et al.,* 2014; Cai *et al.,* 2019). In terms of soil, organic fertilizers lead to the increase of carbon stocks, which enhances the benefits for plant growing and reduces soil erosion (Brunori *et al.,* 2016; Puig-Montserrat *et al.,* 2017). They can enhance the physical properties of soil such as aggregate stability, as well as biological and biochemical properties and optimize the soil's microbial community structure (Mäder *et al*., 2002; Blair *et al.,* 2006; Wang *et al.,* 2011; Bottinell *et al*., 2017). In contrast to mineral fertilizers, the use of organic fertilizers results in positive long-term effects (Parham *et al*., 2002). In addition, they can reduce the environmental impact in terms of GHG emissions, since organic farming uses N more efficiently by increasing the soil organic carbon (SOC) and N storage and thus it is responsible for the lower GHG emissions (Abbona *et al*., 2007; Chiriacò *et al.,* 2019).

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## MATERIALS AND METHODS

A field experiment was conducted during *kharif* season of the year 2015 at Agronomy Instructional Farm, Chimanbhai

Patel College of Agriculture, Sardarkrushinagar Dantiwada Gujarat. It is situated at 24°-19′ North latitude, 72°-19′ East longitude with an elevation of 154.52 metres above the mean sea level and situated in the North Gujarat Agro-climatic region. The climate of this region is sub-tropical monsoon type and falls under semi-arid region. In general, monsoon (July-September) is warm and moderately humid. The annual average rainfall is about 620.9 mm in about 27 rainy days. Experiment was conducted under loamy sand soil having low organic carbon (0.17%), nitrogen (160.7 kg $ha^{-1}$) and medium phosphorus (38.90 kg $ha^{-1}$) and high potash (286.0 kg $ha^{-1}$) content. In all, 10 treatments comprising of integration of different organic sources such as $T_1$: 100%N through FYM+PSB $T_2$: 100%N through castor cake + PSB $T_3$: 100%N through vermicompost + PSB $T_4$: 75% N through FYM+PSB + *Rhizobium* $T_5$: 75%N through castor cake + PSB + *Rhizobium* $T_6$: 75%N through vermicompost + PSB + *Rhizobium* $T_7$: 50%N through FYM+50%N through castor cake + PSB $T_8$: 50%N through FYM+50%N through vermicompost + PSB $T_9$: 50%N through castor cake+50%N through vermicompost + PSB $T_{10}$: RDF (20-40-0 kg N-P-K through fertilizer), *Rhizobium strain, Bradyrhizobium (Vigna)* @ 200 gm/8 kg seed and PSB strain PSB 10 @ 200 gm/8 kg seed was used) was laid out in randomized block design with four replications. Cowpea, variety GC5 was used in the present investigation. Plant sample were collected for chemical analysis of nitrogen, phosphorus and Potassium in seed and straw samples. In seed and straw sample nitrogen was estimated by Micro Kjeldhal, Phosphorus by Vanodomolybdophosphoric yellow colour method and K constituent by Flame photo meter method respectively (Jackson, 1973). The total uptake of nitrogen, phosphorus and potassium by cowpea crop was calculated by using the following formula:

$$\text{Nutrient uptake (kg/ha)} = \frac{\text{Nutrient content (\%)} \times \text{yield (kg/ha)}}{100}$$

Prior to sowing, composite soil sample was taken and analyzed for N,P and K status. After harvest of the crop the soil sample were again taken from each plot and analyzed for N, P and K status as per the prescribed procedure.

## Results and Discussion

### Nutrient content and uptake

N content in seed and stover and P and K content in seed were affected significantly due to different treatments (Table 1). Significantly higher (3.60%) nitrogen content in seed was recorded with the application of 50% N through FYM + 50% N through vermicompost+ PSB ($T_8$), but it was statistically at par with treatments $T_{10}$ (3.52%) and $T_9$ (3.66%). Significantly higher N content in stover (0.83%) was registered under treatments $T_9$ (50% N through caster cake + 50% N through vermicompost + PSB) and $T_{10}$ (RDF 20+40+00 $kg^{-1}$ NPK through Fertilizer), but they remained statistically at par with treatments $T_2$ (0.81%), $T_8$ (0.80%), $T_1$ (0.80%), $T_3$ (0.79%) and $T_7$ (0.79%). Significantly higher

**Table 1:** N, P K Content in seed and stover, nutrient uptake, available N, P K in soil after harvest of cowpea as influenced by organic sources of nitrogen.

| Treatment | N Content (%) | | P Content (%) | | K Content (%) | | Nutrient uptake by cowpea crop (kg $ha^{-1}$) | | | Available nutrient in soil (kg $ha^{-1}$) After harvest | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Seed | Stover | Seed | Stover | Seed | Stover | N | P | K | N | P | K |
| $T_1$ 100%N through FYM+PSB | 3.30 | 0.80 | 0.42 | 0.20 | 1.44 | 1.98 | 45.31 | 7.17 | 48.20 | 147.6 | 23.3 | 264.3 |
| $T_2$ 100%N (Castor cake) + PSB | 3.30 | 0.81 | 0.45 | 0.20 | 1.45 | 1.99 | 42.92 | 7.09 | 47.50 | 178.1 | 25.7 | 266.3 |
| $T_3$ 100%N (Vermicompost) + PSB | 3.29 | 0.79 | 0.44 | 0.20 | 1.47 | 2.02 | 45.40 | 7.30 | 48.60 | 171.5 | 24.8 | 265.3 |
| $T_4$ 75%N (FYM) +PSB + *Rhizobium* | 3.37 | 0.77 | 0.39 | 0.21 | 1.50 | 2.08 | 41.20 | 7.13 | 47.03 | 189.4 | 25.2 | 268.3 |
| $T_5$ 75%N (Castor cake) + PSB + *Rhizobium* | 3.27 | 0.78 | 0.40 | 0.21 | 1.52 | 2.14 | 41.29 | 7.35 | 49.18 | 201.0 | 26.9 | 271.0 |
| $T_6$ 75%N (Vermicompost) + PSB + *Rhizobium* | 3.31 | 0.77 | 0.41 | 0.20 | 1.50 | 2.13 | 42.04 | 7.40 | 48.99 | 200.4 | 26.5 | 269.8 |
| $T_7$ 50%N (FYM) + 50% (Castor cake) + PSB | 3.41 | 0.79 | 0.45 | 0.21 | 1.45 | 1.99 | 47.49 | 8.31 | 51.36 | 166.2 | 24.3 | 264.5 |
| $T_8$ 50%N (FYM) + 50%N (Vermicompost) + PSB | 3.60 | 0.80 | 0.45 | 0.20 | 1.45 | 2.01 | 51.38 | 8.06 | 52.44 | 164.9 | 23.5 | 264.3 |
| $T_9$ 50%N (Castor cake) + 50%N (Vermicompost) + PSB | 3.46 | 0.83 | 0.46 | 0.21 | 1.50 | 2.09 | 51.07 | 8.34 | 54.03 | 193.5 | 26.1 | 268.8 |
| $T_{10}$ RDF (20-40 kg NP $ha^{-1}$ through fertilizer) | 3.52 | 0.83 | 0.46 | 0.21 | 1.54 | 2.18 | 50.52 | 8.41 | 55.81 | 208.1 | 29.4 | 273.0 |
| S.Em.± | 0.06 | 0.01 | 0.01 | 0.01 | 0.02 | 0.07 | 1.70 | 0.21 | 1.43 | 5.1 | 1.1 | 2.0 |
| C.D. (P=0.05) | 0.17 | 0.04 | 0.04 | NS | 0.05 | NS | 4.93 | 0.61 | 4.16 | 14.8 | 3.3 | 5.8 |
| C.V. % | 3.39 | 5.42 | 5.82 | 3.28 | 2.24 | 6.62 | 7.41 | 5.46 | 5.7 | 5.59 | 8.91 | 1.49 |

N.S.: Non significant.

P content in seed (0.46%) was recorded under the treatments $T_9$ (50% N through caster cake + 50% N through vermicompost + PSB) and $T_{10}$ (RDF 20+40+00 $kg^{-1}$ NPK through Fertilizer). However, these treatments remained statistically at par with treatments $T_2$ (0.45%), $T_3$ (0.44%) and treatment $T_1$ (0.42%). P content in stover remained unaffected due to different treatments. K content in seed was influenced by different treatments. Significantly higher K content (1.54%) was recorded with application of RDF 20+40+00 $kg^{-1}$ NPK through Fertilizer ($T_{10}$). However, it remained statistically at par with treatments $T_5$ (1.52%), $T_9$ (1.50%), $T_4$ (1.50%) and $T_6$ (1.50%).

Nitrogen, phosphorus and potash uptake (kg $ha^{-1}$) by cowpea crop were also significantly due to the different treatments. Significantly higher nitrogen uptake (51.38 kg $ha^{-1}$) was recorded by application of 50% N through FYM + 50% N through vermicompost + PSB ($T_8$), however, it was statistically at par with treatments $T_9$ (51.07 kg $ha^{-1}$), $T_{10}$ (50.52 kg $ha^{-1}$) and $T_7$ (47.49 kg $ha^{-1}$). Significantly higher phosphorus (8.41 kg $ha^{-1}$) and potash (55.81 kg $ha^{-1}$) uptake were recorded with the application of RDF 20+40+00 $kg^{-1}$ NPK through fertilizer ($T_{10}$), being at par with treatments $T_9$ (8.34 kg $ha^{-1}$), $T_7$ (8.31 kg $ha^{-1}$) and $T_8$ (8.06 kg $ha^{-1}$) for phosphorus uptake and with treatments $T_9$ (54.03 kg $ha^{-1}$) and $T_8$ (52.44 kg $ha^{-1}$) for potash uptake, respectively. The increase in nutrient uptake under these treatments might be due to more nitrogen fixation resulting in to better utilization of nutrient by plant, ultimately nitrogen, phosphorus and potassium content and uptake in seed and straw and protein content in seed. These results are in close conformity with of Wagadre *et al.* (2010), Patra *et al.* (2011), Khandelwal *et al.* (2012) and Shrma *et al.* (2014).

**Available soil nutrient**

Different treatments significantly influenced the nutrient status of the soil after harvest of cowpea (Table 1). Significantly higher values of available N (208.1 kg $ha^{-1}$), P (29.4 kg $ha^{-1}$) and K (273.0 kg $ha^{-1}$) were recorded with application of treatment RDF 20+40+00 $kg^{-1}$ NPK through Fertilizer ($T_{10}$), but remained statistically at par treatments $T_5$ (75% N through caster cake + PSB + *Rhizobium*), $T_6$ (75% N through vermicompost + PSB + *Rhizobium*) and $T_9$ (50% N caster cake through + 50% N through vermicompost + PSB). Increase in availability of nutrients might be due to direct addition through organic manures and greater multiplication of soil microbes, which could convert organically bound N to inorganic form. Similar results have also been reported by Dekhane *et al.* (2011), Bapi *et al.* (2011) and Khan *et al.* (2013).

## CONCLUSION

It is observed that N.P,K content in seed and stover, nutrient uptake, available N.P,K in soil after harvest of cowpea have great influenced through combine application farm yard manure, vermicompost, caster cake, recommended dose of fertilizer and phosphorus solubilizing bacteria in treatment $T_{10}$, $T_9$, $T_8$ respectively. So i suggest to farmer should be used organic manure so that increase nutrient content and nutrient uptake by crops and availability of nutrient in soils.

**Conflict of interest:** None.

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