# *Original Research Article*

# Effect of Nitrogen and Phosphorus on growth and yield of Cowpea [ *Vigna unguiculata* L.]


## ABSTRACT

Include the importance of *Vigna unguiculata* L. / Take into account any issue or problem that affects to the plant species A field experiment was conducted during *zaid* season of 2021, at crop research farm of Department of Agronomy at Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj in North Eastern plains of Eastern Uttar Pradesh with ( DELETE O ELIMINATE) the objective to study the effect of nitrogen and phosphorus on growth, yield and economics of cowpea (*Vigna unguiculata* L.) Var. Gomati VU 89 under Randomized block design comprising of 9 treatments of which treatments ($T_1$-$T_9$) with different combination of nitrogen along with phosphorus which are replicated thrice. The experimental results revealed that 25 kg N/ha + 50 kg P/ha recorded Maximum plant height (69.02 cm), number of branches/plant (12.33), number of nodules/plant (4.0), Highest plant dry weight (15.32 gm), crop growth rate (4.80 g/m$^2$/day), test weight (18.57 g), number of pods/plant (20.13), number of seeds/pod (15.1), Seed yield (1243.97 Kg/ha), harvest index (32.0 %). The application of $T_9$ 25 kg N/ha + 50 kg P/ha recorded higher net return (34.05 x 10$^3$ ₹/ha), gross return (63.44 x 10$^3$ ₹/ha) and benefit: cost ratio (2.16). Consider an




## INTRODUCTION

India has become self-sufficient with respect to the production of food grains but still lags behind the production of pulses. Moreover, burgeoning population pressure and increasing degree of protein mal-nutrition aggravated the problem and call for stepping up the pulses production. Pivotal role of pulses in human diet and system of farming all over the world is well known. Pulses are the major and cheap source of lysine, which is a rich quality protein, providing supplement to cereal-based diet.

Pulses being the important source of dietary protein have unique ability of maintaining and restoring soil fertility through biological nitrogen fixation along with addition of ample amount of plant residues to the soil. In India, the pulses occupy nearly 29.46-million-hectare area with a production of 22.95 million tonnes and productivity of 779kg/ha (Anonymous,2019). Among the different pulses, cowpea [*Vigna unguiculata* L.] is the important crop grown in arid and semi-arid regions of the state. Cowpea belongs to the family Leguminosae, and commonly referred to as lobia. Cowpea is kharif pulse crop grown for vegetables, grain, forage and green manuring. It has good promise as an alternative pulse crop in dry land farming. It also works as smother crop keeping weed infestation low. Add citation

Cowpea is highly responsive to fertilizer and manures. The adequate application of fertilizers has played a significant role in providing nutrients for growth and development of cowpea. Nitrogen plays an important role in physiological processes of plant and act as constituents of protoplasm. Nitrogen vitally associated with activity of each living cell. Nitrogen is essential constitutents of compounds like amino-acids, enzyme,co-enzyme and alkaloids Add citation. Though, they have the capacity to fix atmospheric nitrogen symbiotically. The nitrogen application at lower dosed in intial (initial) stage before the plant develops sufficient root system, have been beneficial as it provides the nitrogen need of young seedling. Add citation

Phosphorus, an important macronutrient, is among the most needed elements for crop production in most tropical soils, which tend to be deficient in phosphorus availability. In plant tissues, it is present in much smaller amount than nitrogen and potassium although it is the key plant nutrient involved in energy transfer in the plant chemical reactions (Prasad, R 2007) and in the biosynthesis of chlorophyll, where phosphorus as pyridoxal phosphate must be present for the biosynthesis of chlorophyll. Phosphorus is known to promote the development of roots there by flouring the nitrogen fixation in legumes. This increased amount of nitrogen fixed might be utilized by the host plant for its own growth (Rajasree and Pillai 2001).

Include objective of the research.

## MATERIALS AND METHODS

A field experiment was conducted during kharif season of 2021, at Crop research farm of Department of Agronomy at Sam Higginbottom University of Agriculture, Technology, and Sciences, Prayagraj which is located at 25° 24' 42" N latitude, 81° 50' 56" E longitude and 98 m altitude above the mean sea level (MSL). To assess the effect of nitrogen and phosphorus on growth and yield of cowpea (*Vigna unguiculata* L.). The experiment was laid out in Randomized Block Design comprising of 9 treatments which are replicated thrice. Each treatment net plot size is 3m × 3m. The treatment are categorized as with recommended dose of potash 20 kg $ha^{-1}$ through Muriate of Potash, in addition with Nitrogen and Phosphorus when applied in combinations as follows, ($T_1$) 15kg/ha nitrogen + 30kg/ha phosphorus, ($T_2$) 15kg/ha nitrogen + 40kg/ha phosphorus, ($T_3$) 15kg/ha nitrogen + 50kg/ha phosphorus, ($T_4$) 20kg/ha nitrogen + 30kg/ha phosphorus , ($T_5$) 20kg/ha nitrogen + 40kg/ha phosphorus , ($T_6$) 20kg/ha nitrogen + 50kg/ha phosphorus , ($T_7$) 25 kg/ha nitrogen + 30kg/ha phosphorus, ($T_8$) 25 kg/ha nitrogen + 40kg/ha phosphorus, ($T_9$) 25 kg/ha nitrogen + 50kg/ha phosphorus. The cowpea crop was harvested treatment wise at harvesting maturity stage. Growth parameters viz. plant height (cm), number of branches, dry matter accumulation g $plant^{-1}$ were recorded manually on five randomly selected representative plants from each plot of each replication separately and after harvesting, seeds were separated from each net plot and were dried under sun for three days. Later winnowed, cleaned and seed yield per ha was computed and expressed in tonnes per hectare. After complete drying under sun for 10 days stover yield from each net plot was recorded and expressed in tonnes per hectare. The data was computed and analysed by following statistical method of Gomez and Gomez (1984). The benefit: cost ratio was worked out after price value of seed with straw and total cost included in crop cultivation.

## RESULTS AND DISSCUSIONS

**Effect on growth parameters:**

**Plant height**

It is evident from Table 1. that plant height measured increased with advancement in crop growth. At harvest the treatment $T_9$ (25 kg N/ha + 50 kg P/ha) recorded maximum height of 69.02 cm. At harvesting stage maximum plant height was measured in $T_9$ and treatments $T_8$ was found statistically at par to $T_9$. The highest plant height in treatment $T_9$ may be ascribed due to the continuous supply of nutrients throughout all growth stages with beneficial association between Nitrogen and Phosphorus along with Potassium. Increasing levels of nitrogen application up to 40 kg N ha recorded significantly higher plant height throughout the crop growth period. This was reported by Jalbi et al. (2015) and Hamid et al. (2011).The probable reason for increase in plant height in the application of 60 kg/ha P might have resulted in increased carbohydrate accumulation and their remobilization to reproductive parts of the plants, being the closest sink and hence, resulted in increased plant growth. It is also critical in biological energy transfer processes that are vital for life and growth of the plant. Beneficial effect of P plant growth reported by Khandelwal *et al*. (2012).

**Number of branches/plant**

At harvesting stage maximum number of branches (12.3) are produced by $T_9$ (25 kg N/ha + 50 kg P/ha) and $T_6$ and $T_8$ are statistically at par to maximum. The findings of the present study indicate that growth attributes of crop such as number of branches had marked variation under various nitrogen levels. Highest level of nitrogen fertilizer 40 kg $has^{-1}$ produced significantly higher growth attributes due to increased plant nutrient availability. These findings are supported by Kaiser *et al.* (2010). The probable reason for increase in branches/plant in the application of 60 kg/ha P might have resulted due to balance increased in phosphorus. In similar way that adequate P levels promote root growth and stimulate branches/tillers of plant and also, the effect of nutrients on productivity of cowpea genotype Pusa Komal was recorded by Sharma *et al.* (2015) in the experiment application of 80kg $P_2O_5$/ha.

**Dry matter accumulation**

The treatment $T_9$ (25 kg N/ha + 50 kg P/ha) recorded maximum dry matter accumulation of 15.32 (g) at the harvesting stage and $T_6$, $T_8$ treatments are found statistically at par to maximum dry matter accumulation. Dry matter accumulation is more important because all other vegetative characters contained it. Nitrogen is one of the most important nutrients for crop growth and development because it affects dry matter production by influencing the leaf area development and maintenance as well as photosynthesis efficiency. A similar statement was also found by Asaduzzaman (2008), Saini and Thakur (2008) and Kumar *et al.* (2009). Application of phosphorus P 60 kg/ha significantly increased the dry matter yield of cowpea. This is reported by Rakesh Kumar *et al.* (2016).

**Yield and Yield Attributes:**

**Number of pods/plant**

Significant effect was observed by the statistical analysis of number of pods per plant. Treatment 25 kg N/ha + 50 kg P/ha recorded significant and highest number of pods per plant (19.37). However, 25 kg N/ha + 40 kg P/ha recorded statistical parity with 25 kg N/ha + 50 kg P/ha. This might be attributed to triggered nitrogen metabolism of crop and extended retention of moisture by the treated crop especially during moisture stress period, which might have helped to bear a greater number of pods per plant at harvest. These results are in conformity with the findings of Singh, R.P. and Dasharath Singh (2017) illustrating advantage of foliar application for incremental yield enhanced in pulses.

**Seed yield**

Seed yield was significantly influenced with different combinations of Nitrogen and Phosphorus with Potassium. The highest seed yield was obtained with the treatment 25 kg N/ha + 50 kg P/ha (1243.9), however no other treatments are statistically at par with the treatment 25 kg N/ha + 50 kg P/ha. Application of nitrogen and phosphorus improves the growth and development of grain yield through increasing nutrient status in plant and their translocation towards sink. Phosphorus played vital role in energy transformation, metabolic process of plant and better development of root system which resulted in increasing grain yield. Significant improvement due to nitrogen and phosphorus as observed under present investigation are in close conformity with findings of Gawai *et. al.* (2006) and Shaik *et. al.* (1998).

**Straw yield**

The application of Nitrogen and Phosphorus had also significantly influenced the straw production of the cowpea crop. Highest straw yield (2656.21 kg/ha) was recorded 25 kg N/ha + 50 kg P/ha however, 20 kg N/ha + 50 kg P/ha, 25 kg N/ha + 40 kg P/ha were found to be statistically on par with 25 kg N/ha + 50 kg P/ha. Application of nitrogen and phosphorus improves the growth and development of straw yield through increasing nutrient status in plant and their translocation towards sink. Phosphorus played vital role in energy transformation, metabolic process of plant and better development of root system which resulted in increasing straw yield. Significant improvement due to nitrogen and phosphorus as observed under present investigation are in close conformity with findings of Gawai *et. al.* (2006) and Shaik *et. al.* (1998).

Note. Include pictures or figures

**Economics:**

1. Among the different combination of nutrient source 25 kg N/ha + 50 kg P/ha recorded higher net return (34.05 x $10^3$ ₹/ha), gross return (63.44 x $10^3$ ₹/ha) and benefit: cost ratio (2.16).

## CONCLUSION

Treatment 25 kg N/ha + 50 kg P/ha recorded highest seed yield (1243.97 kg/ha), gross return (63.44x $10^3$ ₹/ha), net return (34.05x $10^3$ ₹/ha) and benefit: cost ratio (2.16) which may be more preferable for farmers since it is economically more profitable and hence, can be recommended to the farmers.

Add a little more information according to the results

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**Table 1. Effect of Nitrogen and Phosphorus on growth parameters of cowpea var. 'Gomati (VU 89)'at harvest**

| S.No | T.No. | Treatments | Plant height (cm) | No. of branches plant $^{-1}$ | Dry matter accumulation (g plant$^{-1}$) |
|---|---|---|---|---|---|
| 1 | $T_1$ | 15 kg N/ha + 30 kg P/ha | 62.99 | 9.80 | 14.52 |
| 2 | $T_2$ | 15 kg N/ha + 40 kg P/ha | 64.50 | 10.27 | 14.66 |
| 3 | $T_3$ | 15 kg N/ha + 50 kg P/ha | 65.90 | 10.53 | 14.71 |
| 4 | $T_4$ | 20 kg N/ha + 30 kg P/ha | 65.39 | 10.40 | 14.69 |
| 5 | $T_5$ | 20 kg N/ha + 40 kg P/ha | 66.75 | 11.27 | 14.81 |
| 6 | $T_6$ | 20 kg N/ha + 50 kg P/ha | 67.45 | 11.47 | 15.03 |
| 7 | $T_7$ | 25 kg N/ha + 30 kg P/ha | 66.14 | 10.80 | 14.78 |
| 8 | $T_8$ | 25 kg N/ha + 40 kg P/ha | 68.13 | 12.00 | 15.24 |
| 9 | $T_9$ | 25 kg N/ha + 50 kg P/ha | 69.02 | 12.33 | 15.32 |
| | | SEm (±) | 0.33 | 0.29 | 0.10 |
| | | CD (P 0.05) | 1.00 | 0.85 | 0.31 |

**Table 2. Effect of Nitrogen and Phosphorus on yield and yield attributing characters of cowpea var. 'Gomati (VU 89)'**

| S. No | T. No | Treatments | No. of pods/plant | No. of seed/plant | Seed Yield (t/ha) | Straw Yield (t/ha) |
|---|---|---|---|---|---|---|
| 1 | $T_1$ | 15 kg N/ha + 30 kg P/ha | 16.13 | 12.13 | 0.79 | 1.67 |
| 2 | $T_2$ | 15 kg N/ha + 40 kg P/ha | 16.50 | 12.50 | 0.74 | 1.76 |
| 3 | $T_3$ | 15 kg N/ha + 50 kg P/ha | 17.10 | 13.77 | 0.88 | 2.03 |
| 4 | $T_4$ | 20 kg N/ha + 30 kg P/ha | 17.03 | 13.29 | 0.84 | 1.96 |
| 5 | $T_5$ | 20 kg N/ha + 40 kg P/ha | 18.57 | 14.43 | 1.05 | 2.32 |
| 6 | $T_6$ | 20 kg N/ha + 50 kg P/ha | 18.77 | 14.63 | 1.10 | 2.40 |
| 7 | $T_7$ | 25 kg N/ha + 30 kg P/ha | 17.87 | 13.87 | 0.97 | 2.17 |
| 8 | $T_8$ | 25 kg N/ha + 40 kg P/ha | 19.37 | 14.70 | 1.14 | 2.48 |
| 9 | $T_9$ | 25 kg N/ha + 50 kg P/ha | 20.13 | 15.13 | 1.24 | 2.66 |
| | | SEm (±) | 0.29 | 0.32 | 0.03 | 0.10 |
| | | CD (P 0.05) | 0.89 | 0.94 | 0.10 | 0.30 |

**Table 3. Effect of Nitrogen and Phosphorus on economics of cowpea var. 'Gomati VU 89'**

| S.No | T.No. | Treatments | Cost of cultivation# (x $10^3$ ₹ $ha^{-1}$) | Gross return (x $10^3$ ₹ $ha^{-1}$) | Net return (x $10^3$ ₹ $ha^{-1}$) | Benefit: Cost ratio |
|---|---|---|---|---|---|---|
| 1 | $T_1$ | 15 kg N/ha + 30 kg P/ha | 28,270.00 | 64,000.00 | 35,730.00 | 1.26 |
| 2 | $T_2$ | 15 kg N/ha + 40 kg P/ha | 28,820.00 | 59,200.00 | 30,380.00 | 1.05 |
| 3 | $T_3$ | 15 kg N/ha + 50 kg P/ha | 29,360.00 | 70,400.00 | 41,040.00 | 1.39 |
| 4 | $T_4$ | 20 kg N/ha + 30 kg P/ha | 28,290.00 | 67,200.00 | 38,910.00 | 1.37 |
| 5 | $T_5$ | 20 kg N/ha + 40 kg P/ha | 28,830.00 | 84,000.00 | 55,170.00 | 1.91 |
| 6 | $T_6$ | 20 kg N/ha + 50 kg P/ha | 29,370.00 | 88,000.00 | 58,630.00 | 1.99 |
| 7 | $T_7$ | 25 kg N/ha + 30 kg P/ha | 28,300.00 | 77,600.00 | 49,300.00 | 1.74 |
| 8 | $T_8$ | 25 kg N/ha + 40 kg P/ha | 28,840.00 | 91,200.00 | 62,360.00 | 2.16 |
| 9 | $T_9$ | 25 kg N/ha + 50 kg P/ha | 29,390.00 | 99,200.00 | 69,810.00 | 2.37 |

**#Data not subjected to statistical analysis.**