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# Performance of Cowpea (*Vigna unguiculata*) Genotypes during Summer under Different Levels of Phosphorus Application

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**ABSTRACT**

*A field experiment was carried out on vertisols during summer 2012 at Bijapur districtof the farmer's field (Mattihal Village of Basavan Bagewadi Taluk). To study the "Performance of cowpea genotypes (KBC-2, KM-5, IT-38956-1 and C-152) with different levels of phosphorus (25, 50 and75 $P_20_5$kg $ha^{-1}$ ) " under irrigated condition, The results indicated that seed yield (1397 kg $ha^{-1}$ ) and harvest index ( 0.51) higher with IT-38956-1 owing to higher number of pods per plant ( 16.78), number of seeds per pod (13.89) seed yield per plant (12.74g) and 100 seed weight ( 12.92g ) as compared to other genotypes such as (KBC-2, KM-5 and C-152) and among different levels of phosphorus, application of 50 kg $P_2O_5$ $ha^{-1}$ significantly higher seed yield (1087 kg $ha^{-1}$) than 25 and 75 kg $P_2O_5$ $ha^{-1}$ due to higher yield contributing characters.*

***Key words:*** *Cowpea, Genotypes, Phosphorus*

## INTRODUCTION

The important pulses grown in India are redgram, greengram, blackgram, cowpea, mothbean, horsegram, peas etc. Among arid legumes, cowpea (*Vignaunguiculata* (L.)Walp) is of immense importance, as it is a multipurpose grain legume extensively cultivated in arid and semiarid tropics. The cowpea is used as grain, green pods and fodder. Cowpea is grown as a catch crop, mulch crop, intercrop, mixed crop and green manure crop. Cowpea contributes to the improve- ment of soil fertility by the fixation of nitrogen (N) in the soil (60 -70 kg·N $ha^{-1}$ to the subsequent crop) in association with symbiotic bacteria under favorable conditions.

In Karnataka, the crop is grown in an area of 1.5 million hectares with a production of 0.49 million tonnes. The productivity of cowpea in Karnataka is low (420 kg $ha^{-1}$) as compared to the national productivity of 567 kg $ha^{-1}$. This clearly indicates there is necessity to identify the reasons for low productivity in India in general and Karnataka in particular. The studies show that high yielding varieties of crop can contribute to an extent towards the improvement of crop yield.

Phosphorus (P) is one of the most needed elements for pulse production. Phosphorus, although not required in large quantities, is critical to cowpea yield because of its multiple effects on nutrition.

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All growing plants require phosphorus for growth and development in significantly large quantity. Role of phosphorus is well documented that it increases root formation, number of nodules and in turn yield. Many workers have also reported that phosphorus application influences the content of other nutrients in leaves and seed. The deficiency can be so acute in some soils of the Northern dry zone of Karnataka that plant growth ceases as soon as the P stored in the seed is exhausted.

In Northern Dry zone under irrigation in summer season ground nut is one of the major crops. There is a need to identify the suitable alternative crop for groundnut during summer season in the areas where water is withdrawn early in the command areas. Hence this investigation was conducted to know the performance of new genotypes of cowpea *viz;* KBC-2, KM-5, IT-3895-1 in summer condition along with phosphorus fertilization.

## MATERIAL AND METHODS

A field experiment was conducted to study the "Performance of cowpea genotypes with different levels of phosphorus" under irrigated condition on vertisolsat farmers field (Mattihal Village of BasavanBagewadiTaluk) in Bijapur district during *summer*2012. The experiment was laid out in a factorial RCBD design with three replications. The treatments comprised of 12 treatment combinations of four genotypes (KBC-2, KM-5, IT-38956-1 and C-152) and three phosphorus levels (25, 50 and75 $P_20_5$ kg $ha^{-1}$). The soil of the experimental site was medium deep black soil. A composite soil sample was drawn from the experimental area before sowing to a depth of 30cm. The soil was analyzed for physical and chemical properties. The soil textural class of the experimental site was clayey in texture, low in organic carbon (0.49%), available nitrogen (111 kg $ha^{-1}$), available phosphorus (14.50 kg $ha^{-1}$) and medium in available potassium (255 kg $ha^{-1}$). At the time of sowing, entire dose of fertilizers with 25:25:25, 25:50:25 and 25:75:25 kg of nitrogen, phosphorus and potash in the form of urea, single super phosphate, and muriate of potash were applied as a basal dose as per the treatment. Five competitive plants selected were tagged at random from each plot for recording observations number of growth parametersand yield parameters at 30 DAS, 60 DAS and at harvest.

## RESULTS AND DISCUSSION

Genotypes play an important role in determining the yield of a crop. The potential yield of genotypes within the genetic limit is set by the prevailing environment. Genotypes differ in their yield potential depending on many physiological processes, which are controlled by both genetic makeup of the plant and the environment. During *summer* availability of photoperiod is more that is reflected yield of genotypes.

Among four genotypes, IT-38956-1 recorded significantly higher seed yield (1397 kg $ha^{-1}$) as compared to C-152 (1246 kg $ha^{-1}$), KBC-2 (835 kg $ha^{-1}$) and KM-5 (786 kg $ha^{-1}$). Earlier studies made by several workers also revealed the varietal differences in the seed yield of cowpea[2,3,6] .

Seed yield per plant is governed by number of factors which have direct or indirect impacts. Genotypes IT-38956-1 (12.74 g $plant^{-1}$) produced significantly higher seed yield per plant than C-152 (12.63 g $plant^{-1}$) KBC-2 (8.26 g $plant^{-1}$) and KM-5 (8.81 g $plant^{-1}$). Yield per plant is determined by other yield components namely number of pods per plant, number of seeds per pod, 100-seed weight. Number of pods per plant was significantly higher in IT-38956-1(16.78). This improvement was mainly due to significantly higher photosynthetic efficiency, which might have led to formation of more number of pods per plant and number of seeds per pod (Table1). Similar results were also reported by Birari *et al.*[1] and Jadhav *et al.*[2]. The genotypes IT-38956-1 (12.92g) and C-152 (12.87g) recorded significantly higher hundred seed weight than KBC-2 (10.82 g) and KM-5 (11.63g). Thus, owing to integration of all the favorable yield components and nutrient uptake also differed with among genotypes. The uptake of nitrogen, phosphorus and potassium at harvest was maximum with IT-38956-1(131.36 14.26 and 52.67 kg $ha^{-1}$).

Seed yield differed significantly due to different levels of phosphorus application. Maximum yield of 1087 kg $ha^{-1}$ was obtained with 50 kg $P_2O_5$ $ha^{-1}$ as compared to application of 75 kg $P_2O_5$ $ha^{-1}$ (1078 kg $ha^{-1}$) and 25 kg $P_2O_5$ $ha^{-1}$ (1033 kg $ha^{-1}$). These results are in conformity with the findings of Rajput[7], Okeleye and Okelana[4] may be due to higher magnitude of yield components like more number of pods per plant (13.17), number of seeds per pod (13.25), pod length (15.02 cm) seed weight per plant (10.82 g) and 100-seed weight (12.22 g). This indicates the positive correlation between seed yield and number of pods per plant, phosphorus is essential for photosynthesis, pod development and grain filling in leguminous crops. phosphorusis responsible for nodulation in cowpea. Thus higher nodulation resulted in higher nitrogen fixation and eventually the number of pods per plant. Osimane[5] opined that phosphorus plays an important role in translocation of assimilates to the pods being a constituent of protoplasm, which may be responsible for increased length of pods, pod weight, number of seeds per pod and in turn seed yield.

The higher number of seeds per pod could be due to increased pod length with phosphorus level (15.02cm) and it might have accommodated more number of seeds per pod (13.25). Higher numbers of seeds per pod and 100-seed weight have contributed to higher seed yield at application of 50 kg $P_2O_5$ $ha^{-1}$. The nutrients uptake was not significant. However higher uptake of nutrients (N,$P_20_5$ and K) was noticed with the application of 50 kg $P_2O_5$ $ha^{-1}$ (123.34, 13.53 and 51.92 kg $ha^{-1}$) followed by application of 75 kg $P_2O_5$ $ha^{-1}$ and 25 kg $P_2O_5$ $ha^{-1}$.

Higher grain yield (1423 kg $ha^{-1}$) of IT-38956-1 was obtained with application of 50 kg $P_20_5$ $ha^{-1}$ as compared to all the other treatment combinations this was due to the higher nutrient availability with the use of 50 kg $P_2O_5$ $ha^{-1}$ resulted in higher grain yield.

The maximum gross returns (42690 Rs$ha^{-1}$), net returns (28493Rs $ha^{-1}$) and BC ratio (3.01) was realized with genotype IT-38956-1 compared to other genotypes. The application of 50 kg $P_2O_5$ $ha^{-1}$ gave the higher gross returns, net returns and B:C ratio but differences as were non-significant.

**Table 1: Yield parameters and economics as influenced by different cowpeagenotypes and phosphorus levels**

| Treatments | Number of pods per plant | Number of seeds per pod | Pod length (cm) | Gross income (Rs. $ha^{-1}$) | Net income (Rs. $ha^{-1}$) | B:C ratio |
|---|---|---|---|---|---|---|
| $V_1$-KBC-2 | 9.33 | 10.78 | 14.09 | 25053 | 10856 | 1.76 |
| $V_2$-KM-5 | 9.44 | 11.22 | 13.27 | 23580 | 9383 | 1.66 |
| $V_3$-IT- 38956-1 | 16.78 | 13.89 | 15.67 | 44586 | 27723 | 2.95 |
| $V_4$-C- 152 | 16.44 | 13.78 | 15.88 | 38063 | 23199 | 2.63 |
| SEm± | **0.30** | **0.30** | **0.30** | **734** | **734** | **0.05** |
| CD (P=0.05) | **0.88** | **0.88** | **0.89** | **2153** | **2153** | **0.15** |
| $P_1$-25 | 12.83 | 11.92 | 14.45 | 31007 | 16910 | 2.20 |
| $P_2$-50 | 13.17 | 13.25 | 15.02 | 33865 | 18418 | 2.30 |
| $P_3$-75 | 13.00 | 12.08 | 14.71 | 32340 | 18043 | 2.26 |
| SEm± | **0.26** | **0.25** | **0.26** | **636** | **635** | **0.04** |
| CD (P=0.05) | **NS** | **0.76** | **NS** | **NS** | **NS** | **NS** |
| $V_1P_1$ | 8.00 | 10.00 | 14.25 | 24410 | 10313 | 1.73 |
| $V_1P_2$ | 11.33 | 12.00 | 14.08 | 26190 | 11993 | 1.84 |
| $V_1P_3$ | 8.67 | 10.33 | 13.92 | 24560 | 10263 | 1.72 |
| $V_2P_1$ | 9.00 | 10.00 | 13.03 | 22700 | 8603 | 1.61 |
| $V_2P_2$ | 11.00 | 12.00 | 13.85 | 24640 | 10443 | 1.74 |
| $V_2P_3$ | 8.33 | 11.67 | 12.94 | 23400 | 9103 | 1.64 |
| $V_3P_1$ | 15.00 | 13.33 | 14.52 | 40740 | 26643 | 2.89 |
| $V_3P_2$ | 17.33 | 15.00 | 15.99 | 42690 | 28493 | 3.01 |
| $V_3P_3$ | 17.05 | 13.33 | 16.51 | 42330 | 28033 | 2.96 |
| $V_4P_1$ | 17.00 | 14.33 | 16.01 | 36180 | 22083 | 2.57 |
| $V_4P_2$ | 15.33 | 14.00 | 16.17 | 36940 | 22743 | 2.60 |
| $V_4P_3$ | 17.00 | 13.00 | 15.47 | 39070 | 24773 | 2.73 |
| SEm± | **0.52** | **0.52** | **0.53** | **1271** | **1271** | **0.09** |
| CD (P=0.05) | **1.54** | **NS** | **NS** | **NS** | **NS** | **NS** |

V= variety, P= phosphorus levels

**Table 2: Seed yield per plant (g), 100 seed weight (g ) and seed yield(( kg ha$^{-1}$) asinfluenced by different cowpeagenotypes and phosphorus levels**

| Treatments | Seed yield per plant (g) | 100 seed weight (g) | seed yield( kg ha$^{-1}$) |
|---|---|---|---|
| **Genotypes (V)** | | | |
| $V_1$ -KBC-2 | 8.26 | 10.82 | 835 |
| $V_2$-KM-5 | 8.81 | 11.63 | 786 |
| $V_3$ -IT- 38956-1 | 12.74 | 12.92 | 1397 |
| $V_4$ -C- 152 | 12.63 | 12.87 | 1246 |
| SEm± | **0.09** | **0.22** | **24** |
| CD (P=0.05) | **0.26** | **0.65** | **71** |
| **Phosphorus levels ( $P_2 0_5$ kg ha$^{-1}$)** | | | |
| $P_1$-25 | 10.47 | 11.63 | 1033 |
| $P_2$-50 | 10.82 | 12.33 | 1087 |
| $P_3$-75 | 10.54 | 12.22 | 1078 |
| SEm± | **0.07** | **0.19** | **21** |
| CD (P=0.05) | **0.23** | **0.56** | **62** |
| **Genotypes X Phosphorus levels** | | | |
| $V_1P_1$ | 8.36 | 10.85 | 813 |
| $V_1P_2$ | 8.37 | 10.91 | 873 |
| $V_1P_3$ | 8.05 | 10.71 | 818 |
| $V_2P_1$ | 8.39 | 11.21 | 756 |
| $V_2P_2$ | 8.86 | 12.06 | 821 |
| $V_2P_3$ | 9.18 | 11.60 | 780 |
| $V_3P_1$ | 12.29 | 11.88 | 1358 |
| $V_3P_2$ | 13.05 | 13.44 | 1423 |
| $V_3P_3$ | 12.88 | 13.43 | 1411 |
| $V_4P_1$ | 12.84 | 12.56 | 1206 |
| $V_4P_2$ | 13.00 | 12.90 | 1231 |
| $V_4P_3$ | 12.04 | 13.14 | 1302 |
| SEm± | **0.16** | **0.39** | **42** |
| CD (P=0.05) | **0.46** | **NS** | **128** |

V= variety, P= phosphorus levels

**Table 3: Uptake of total N, Pand K in soil after harvest of cowpea as influenced by Different genotypes and phosphorus levels**

| | Major nutrients uptake( kg ha$^{-1}$ ) | | |
|---|---|---|---|
| **Treatments** | **N** | **$P_2 0_5$** | **$K_2O$** |
| **Genotypes(V)** | | | |
| $V_1$ -KBC-2 | 114.06 | 12.87 | 50.00 |
| $V_2$-KM-5 | 115.18 | 12.53 | 48.44 |
| $V_3$ -IT- 38956-1 | 131.36 | 14.26 | 52.67 |
| $V_4$ -C- 152 | 134.32 | 13.96 | 54.67 |
| SEm± | **1.75** | **0.16** | **0.86** |
| CD (P=0.05) | **NS** | **0.47** | **2.53** |
| **Phosphorus levels($P_2 0_5$ kg ha$^{-1}$)** | | | |
| $P_1$-25 | 122.43 | 13.31 | 51.00 |
| $P_2$-50 | 123.34 | 13.53 | 51.92 |
| $P_3$-75 | 125.42 | 13.40 | 51.33 |
| SEm± | **1.51** | **0.14** | **0.75** |
| CD (P=0.05) | **NS** | **NS** | **NS** |
| **Genotypes X Phosphorus levels** | | | |
| $V_1P_1$ | 111.17 | 12.18 | 48.67 |
| $V_1P_2$ | 116.95 | 13.18 | 50.33 |
| $V_1P_3$ | 114.06 | 13.26 | 51.00 |
| $V_2P_1$ | 116.95 | 12.62 | 50.00 |
| $V_2P_2$ | 112.28 | 12.52 | 45.33 |
| $V_2P_3$ | 116.32 | 12.47 | 50.00 |
| $V_3P_1$ | 133.32 | 14.32 | 53.33 |
| $V_3P_2$ | 126.75 | 14.42 | 56.00 |
| $V_3P_3$ | 134.02 | 14.05 | 53.67 |
| $V_4P_1$ | 128.28 | 14.10 | 52.00 |
| $V_4P_2$ | 137.39 | 13.99 | 56.00 |
| $V_4P_3$ | 137.28 | 13.80 | 50.67 |
| SEm± | **3.04** | **0.28** | **1.50** |
| CD (P=0.05) | **NS** | **NS** | **4.40** |

V= variety, P= phosphorus levels

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