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**Bhagat SB**
Regional Agricultural Research Station, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, dist. Ratnagiri, Maharashtra, India

**Jadhao YS**
Regional Agricultural Research Station, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, dist. Ratnagiri, Maharashtra, India

**Dahiphale AV**
Regional Agricultural Research Station, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, dist. Ratnagiri, Maharashtra, India

**Correspondence**
**Bhagat SB**
Regional Agricultural Research Station, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, dist. Ratnagiri, Maharashtra, India

# Effect of different levels of phosphorus on nutrient uptake and quality parameter of fodder cowpea (*Vigna unguiculata* L. Walp) varieties under lateritic soil of Konkan region

**Bhagat SB, Jadhao YS and Dahiphale AV**

**Abstract**
The field trial entitled "Effect of different levels of phosphorus on performance of fodder cowpea (*Vigna unguiculata* L. Walp) varieties under lateritic soil of *Konkan* region" was carried out during *Rabi* season of 2016 at the Agronomy farm, College of Agriculture, Dapoli. The experiment was laid out in split plot design with three replications. The main plot treatment comprised of three cowpea varieties viz., EC-4216, DFC-1 and Shweta while in sub plot, four phosphorus levels *viz*., 20, 40, 60 and 80 kg $P_2O_5$ $ha^{-1}$ were accommodated. The result revealed that fodder cowpea variety EC-4216 showed better performance in respect of quality parameters viz crude protein content, crude fibre content, crude protein yield and crude fibre yield, Acid detergent fibre, Neutral detergent fibre content, Ash content whereas nitrogen and phosphorus uptake was on higher side compare to rest of varieties during *rabi* season in lateritic soil of Konkan region with application of 80 kg $P_2O_5$ $ha^{-1}$ to the fodder cowpea.

**Keywords:** Fodder cowpea, quality parameters and nutrient uptake

## Introduction
Cowpea is a broadly adopted and highly variable crop, cultivated around the world not only as a pulse, but also as a vegetable (both for the grains and green peas), a cover crop, a green manure crop, erosion resisting crop as well as fodder crop and having ability of drought tolerance. The average grain and fodder yield of cowpea in India is 3 q $ha^{-1}$ and 25-45 t $ha^{-1}$ (Ahmad *et al*. 2012) [1]. At present, the country faces a net deficit of 63 per cent green fodder, 24 per cent dry crop residues and 64 per cent feeds (Singh, 2009) [6]. Therefore, cultivation of quick growing good quality forage is an urgently need to cope up with the shortage of green forages.

There are ample evidences those indicate marked differences between cowpea genotypes and phosphorus uptake. Next to nitrogen, phosphorus is yield limiting nutrient. Cowpea, being the leguminous crop, responds more to phosphorus than nitrogen and potassium. These facts necessitate to determin the adequate supply of phosphorus to cowpea based on field experimentation for realizing the genetic yield potential of newly evolved varieties.

## Materials and Methods
The field experiment was carried out during *Rabi* season of 2016 to assess the effect of different levels of phosphorus on the productivity of fodder cowpea varieties. The experiment was laid out in split plot design comprising of twelve treatments replicated three times. The main plot treatment comprised of three cowpea varieties viz., EC-4216, DFC-1 and Shweta while in sub plot, four phosphorus levels *viz*., 20, 40, 60 and 80 kg $P_2O_5$ $ha^{-1}$ were accommodated.

## Results and Discussion
### A) Quality parameters studies
### Effect of quality parameters on varieties
The data presented in Table 1 revealed that, significant differences were found in crude protein content, crude fibre content, crude protein yield and crude fibre yield in respect with varieties. Variety EC-4216 was found significantly superior in crude protein content, crude protein yield and crude fibre yield followed by variety DFC-1 and Shweta, respectively. However, variety DFC-1 was at par with Shweta in respect to crude protein content and crude fibre yield.

The variety Shweta recorded numerically higher crude fibre content than EC-4216, but both these varieties were at par with each other and were significantly superior to DFC-1. This might be due to treatment effects and particular characteristics of varieties. Increased primary nutrient uptake by plant also increased crude protein content and yield. However, variety EC-4216 was found to contain maximum nitrogen (2.87 per cent) and drew maximum amount of nitrogen (125.59 kg ha-1), thus having significantly higher crude protein content and crude protein yield than those found in other varieties. These results are in close vicinity with those reported by Magani and Kuchinda (2009) [4], Ayub *et al*. (2010) [2], Ahmad *et al*. (2012) [1], Krishna Lal *et al*. (2013) [3], Shekara *et al*. (2013) [5]. The ADF content and NDF content were not influenced significantly by different varieties. Variety EC-4216 recorded maximum ADF content followed by variety Shweta and DFC-1. However, variety Shweta noted higher NDF content followed by varieties EC-4216 and DFC-1. These results are in line with the findings of Tekleab and Agarwal (2000) [7] who recorded effect of varieties to be non-significant only for NDF and ADF. The ash content was influenced significantly by different varieties. The variety EC-4216 recorded significantly higher ash content than rest of the varieties. Tekleab and Agarwal (2000) [7] and Ayub *et al*. (2010) [2] have also reported significant differences among the varieties regarding the total ash content.

**Effect of phosphorus levels on quality parameters**

It was seen from the data presented in Table-1 that, the application of phosphorus produced beneficial effects on crude protein content and crude protein yield (q $ha^{-1}$). The crude protein content was significantly increased with increase in the level of phosphorus application. The phosphorus application at 80 kg $P_2O_5$ $ha^{-1}$ recorded higher crude protein content and crude protein yield (q $ha^{-1}$) which was significantly higher than all other levels of phosphorus. The lowest crude protein content was observed due to application of 20 kg $P_2O_5$ $ha^{-1}$. Whereas crude fibre yield, Acid detergent fibre, Neutral detergent fibre content did not cross the level of significance due to the application of levels of phosphorus. Whereas the application of phosphorus at 80 kg $P_2O_5$ $ha^{-1}$ was found to be significantly higher in respect with ash content (per cent), however, it was par with at 60 kg $P_2O_5$ $ha^{-1}$.

**B) Nutrient studies**

**Effect of Nutrient uptake on varieties**

It was clear from the results reported in Table 2 that, different cowpea varieties *viz*., EC-4216, DFC-1 and Shweta showed significant variation in nitrogen and phosphorus content and their uptake in plants. EC-4216 recorded significantly higher nitrogen and phosphorus content and uptake followed by varieties DFC-1 and Shweta. However, different cowpea varieties did not differ significantly in respect with potassium content, but showed significant variation in potassium uptake. Variety EC-4216 registered maximum potassium content in plants and significantly higher its uptake. This might be due to higher accumulation of dry matter and primary nutrient content, which led to higher nutrient removal by the crop. These results are in close vicinity with those reported by Magani and Kuchinda (2009) [4].

**Effect of phosphorus levels on nutrient content**

Nitrogen content, nitrogen uptake, phosphorus content, phosphorus uptake potassium content and potassium uptake in cowpea was significantly influenced due to different phosphorus levels under study. Application of phosphorus at 80 kg P2O5 $ha^{-1}$ significantly increased NPK content and uptake in the crop. The significantly lowest nitrogen content was observed due to application of 20 kg $P_2O_5$ $ha^{-1}$.

**Table 1:** Effect of different levels of phosphorus on Quality parameter of fodder cowpea varieties at harvest as influenced by different treatments.

| Treatments | Crude protein content (per cent) | Crude protein yield (q ha-1) | Crude fibre content (per cent) | Crude fibre yield (q ha-1) | Acid detergent fibre content (per cent) | Neutral detergent fibre content (per cent) | Ash content (per cent) |
|---|---|---|---|---|---|---|---|
| **A. Varieties** | | | | | | | |
| V1: EC-4216 | 17.67 | 7.74 | 29.35 | 12.77 | 31.82 | 44.44 | 11.33 |
| V2: DFC-1 | 16.79 | 6.55 | 28.04 | 10.83 | 31.32 | 43.98 | 10.93 |
| V3: Shweta | 16.06 | 5.89 | 29.72 | 10.75 | 31.78 | 44.52 | 10.64 |
| S.E. m ± | 0.19 | 0.15 | 0.28 | 0.21 | 0.78 | 0.77 | 0.06 |
| C.D. at 5 % | 0.73 | 0.60 | 1.09 | 0.83 | N.S | N.S | 0.25 |
| **B. Phosphorus levels (kg $ha^{-1}$)** | | | | | | | |
| P1: 20 | 15.15 | 5.10 | 29.72 | 9.98 | 33.00 | 46.25 | 10.07 |
| P2: 40 | 16.31 | 6.13 | 29.37 | 11.02 | 32.31 | 44.79 | 10.69 |
| P3: 60 | 17.33 | 7.21 | 28.74 | 11.24 | 31.06 | 43.56 | 11.33 |
| P4: 80 | 18.58 | 8.46 | 28.32 | 12.86 | 30.19 | 42.65 | 11.77 |
| S.E. m ± | 0.27 | 0.27 | 0.47 | 0.50 | 1.59 | 1.62 | 0.18 |
| C.D. at 5 % | 0.81 | 0.82 | N.S | NS | N.S | N.S | 0.54 |
| Interaction | NS | NS | NS | NS | NS | NS | NS |

**Table 2:** Effect of different levels of phosphorus on Nitrogen, Phosphorus and Potassium content and uptake (kg ha-1) of fodder cowpea varieties as influenced by different treatments.

| Treatments | Nitrogen content (per cent) | Nitrogen uptake (kg $ha^{-1}$) | Phosphorus content (per cent) | Phosphorus uptake (kg $ha^{-1}$) | Potassium content (per cent) | Potassium uptake (kg $ha^{-1}$) |
|---|---|---|---|---|---|---|
| **A. Varieties** | | | | | | |
| V1: EC-4216 | 2.87 | 125.59 | 0.318 | 13.93 | 2.33 | 102.56 |
| V2: DFC-1 | 2.73 | 106.31 | 0.287 | 11.18 | 2.25 | 87.87 |
| V3: Shweta | 2.61 | 95.68 | 0.276 | 10.07 | 2.22 | 81.19 |
| S.E. m ± | 0.03 | 2.48 | 0.28 | 0.21 | 0.03 | 2.06 |
| C.D. at 5 % | 0.12 | 9.73 | 0.011 | 0.91 | N.S | 8.07 |
| **B. Phosphorus levels (kg $ha^{-1}$)** | | | | | | |
| P1: 20 | 2.46 | 83.01 | 0.264 | 8.90 | 1.99 | 66.67 |

| | | | | | | |
|---|---|---|---|---|---|---|
| P2: 40 | 2.65 | 99.56 | 0.283 | 10.63 | 2.22 | 83.54 |
| P3: 60 | 2.81 | 117.07 | 0.298 | 12.47 | 2.36 | 98.17 |
| P4: 80 | 3.01 | 137.12 | 0.328 | 14.91 | 2.50 | 113.79 |
| S.E. m ± | 0.04 | 4.44 | 0.004 | 0.48 | 0.03 | 3.44 |
| C.D. at 5 % | 0.13 | 13.19 | 0.013 | 1.41 | 0.10 | 10.22 |
| Interaction | NS | NS | NS | NS | NS | NS |

## Conclusion

On the basis of present investigation following broad conclusions can be drawn that fodder cowpea variety EC-4216 in combination with application of 80 kg $P_2O_5$ ha $^{-1}$ of showed better quality parameters (crude protein content, crude fibre content, crude protein yield and crude fiber yield) and higher uptake of nitrogen, phosphorus and potassium.

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