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# EFFECT OF FYM, POTASSIUM AND ZINC ON YIELD, QUALITY AND UPTAKE OF NUTRIENTS IN FORAGE CLUSTERBEAN IN ALLUVIAL SOIL

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## ABSTRACT

*A field experiment was carried out at the research farm, R.B.S. College, Bichpuri, Agra (U.P.) during kharif season to study the effect of FYM (0 and 5t ha$^{-1}$), potassium (0,30,60 and 90 kg $K_2O$ ha$^{-1}$) and zinc (0,1,2 and 4 kg ha$^{-1}$) levels on the yield, quality and uptake of nutrients in forage cluster bean (Cyamopsis tetragonoloba L.). The experiment was laid out in split plot design with three replications. Data revealed that the plant height, green foliage and dry matter yields and protein content and yield increased significantly with the application of 5t FYM, 90 kg $K_2O$ and 4 kg Zn ha$^{-1}$ over their respective controls. Application of 5t FYM ha$^{-1}$ gave 14.6 and 24.1 per cent higher green foliage and dry matter yield of fodder cluster bean over control respectively. It also increased the uptake of nutrients by the forage crop over control. Application of 90 kg $K_2O$ ha$^{-1}$ was more effective in increasing plant height green foliage and dry matter yields than those of 30 and 60 kg $K_2O$ ha$^{-1}$. The higher green foliage (304.2 t ha$^{-1}$) and dry matter yield (43.94 t ha$^{-1}$) were recorded with 90 kg $K_2O$ ha$^{-1}$, which was 14.8 and 23.6% higher than that of control. The uptake of nutrients by the crop increased significantly up to 90 kg $K_2O$ ha$^{-1}$ over control. Potassium application tended to increase the content and yield of protein in cluster bean. Application of zinc proved superior to control in terms of protein content and yield in cluster bean. The uptake of nutrients by the crop increased significantly with Zn addition up to 4 kg Zn ha$^{-1}$ over control. Green foliage (309.87 t ha$^{-1}$) and dry matter yield (43.64 t ha$^{-1}$) of cluster bean were the highest with 4 kg zinc ha$^{-1}$.*

**Keywords:** FYM, potassium, zinc, yield, uptake of nutrients, quality, cluster bean.

## INTRODUCTION

Cluster bean (Cyamopsis tetragonoloba L.) is an important legume crop mainly grown under rain fed condition during kharif season. It is hardy and drought tolerant crop. It is grown for different purposes viz. vegetable, green fodder, green manure and production of seeds. The ever-rising demand for fodder and feed for sustaining livestock production can be met through increasing productivity of fodder. The various factors are responsible for low productivity such as poor fertilization and improper soil management of which poor fertilization is main factor for poor productivity of cluster bean. Farmyard manure improves physical, chemical and biological properties of soil and sustains fertility and productivity of cultivated land. FYM has shown considerable increase in crop yield and helps in enhancing nutrient availability both from applied and native sources. Potassum is the most important essential nutrient after nitrogen and phosphorus and plays a vital role in plant cell sap, support enzymatic activity, photosynthesis and transportation of sugar, synthesis of protein and starch but does not bounds with carbon or oxygen. It also develops tolerance to drought condition and enhances plant ability to resist attacks of pest and diseases. Zinc plays an important role as a metal component of enzymes (alcohol dehydrogenase, super oxide dismutase, carbonic anhydrase and RNA polymerase) or as a functional, structural or regulator cofactor of a large number of enzymes (Marschner, 1986). It is considered to be the most yield limiting micronutrient in crop production in various parts of the world. Integration of K and Zn with FYM will not only sustain the crop production but also will be effective in improving soil fertility. As information is lacking on the effect of FYM, K and Zn on cluster bean production in Agra region of Uttar Pradesh, the present study was therefore, planned to assess the effect of FYM, potassium and zinc on productivity of cluster bean.

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## MATERIALS AND METHODS

The field experimental was conducted during kharif season at R.B.S.College Research farm Bichpuri, Agra (U.P.). The soil was sandy loam in texture having pH 7.8, EC 0.29 $dSm^{-1}$, organic carbon 3.6 g $kg^{-1}$, available N 165 kg $ha^{-1}$, P 8.5 kg $ha^{-1}$, K 110 kg $ha^{-1}$ and Zn 0.51 mg $kg^{-1}$. The experiment was laid out in split plot design with two levels of FYM (0 and 5t $ha^{-1}$), four levels each of K (0, 30, 60 and 90 kg $K_2O$ $ha^{-1}$) and Zn (0, 1, 2 and 4 kg Zn $ha^{-1}$) with three replications. A uniform dose of N and P @ 20 and 60 kg $P_2O_5$ $ha^{-1}$ was applied through diammonium phosphate at the time of sowing. Well decomposed FYM was applied before sowing of the crop. Potassium and Zn were applied through mutriate of potash and zinc sulphate, respectively at the time of sowing. Cluster bean (cv RGC-986) was sown as fodder crop in last week of June in both the years. Other agronomic management practices were followed as per standard recommendation. The crop was harvested after 90 days of sowing.The plant samples were digested with di acid mixture of $HNO_3$ and HCl $O_4$ in 9:1 ratio. Phosphorus was determined by vanadomolybdate yellow colour method (Jackson, 1973), S by turbidi metric method (Chesnin and Yien 1951), K by flame photometer, Zn by atomic absorption spectrophotometer. Nitrogen in plants was determined by modified micro Kjeldahl method. The nutrient uptake was calculated by multiplying the nutrient concentration values with the dry matter yield. The data were statistically analysed using standard procedures of ANOVA at 5% level of significance.

## RESULTS AND DISCUSSION

### *Effect of FYM*

The plant height, green foliage and dry matter yields and protein content in cluster bean fodder increased significantly with FYM application over control (no FYM). The mean maximum plant height (144.1 cm) green foliage (312.29 t $ha^{-1}$), dry matter (45.41 t $ha^{-1}$) yields, protein content (15.2 %) were obtained at 5 t FYM $ha^{-1}$. The mean increases in green foliage and dry matter yield due to 5 t FYM $ha^{-1}$ over control were 14.6 and 24.1 per cent, respectively. The increase in yield might be due to steady decomposition of FYM and release of nutrients throughout the crop growth period coupled with better assimilation of nutrients (Saket *et al.* 2014). The beneficial effect of FYM on yield was also reported by Singh *et al.* (2013a). The protein yield also significantly increased with FYM application from 51.6 q $ha^{-1}$at control to 69.0 q $ha^{-1}$ at 5 t FYM $ha^{-1}$. Saket *et al.* (2014) also reported similar results.

Application of 5 t FYM $ha^{-1}$ significantly increased the uptake of N (111.0 kg $ha^{-1}$), P (17.2 kg $ha^{-1}$), K (146.9 kg $ha^{-1}$), S (7.7 kg $ha^{-1}$) and Zn (84.0 g $ha^{-1}$) by cluster bean crop over control. The increase in nutrient uptake may be due to increase in nutrient content and dry matter yield. Higher uptake of N with FYM may be due to mineralization of N from FYM which sufficiently meet the nutritional requirement of the crop (Singh *et al.,* 2013b). The effect of FYM in increasing P uptake may be associated with improvement of the soil environment which encouraged proliferation of roots resulting in more absorption of water and nutrients from larger area and depth, The higher nutrient uptake with FYM might be attributed to solubilization of nutrients, chelation of complex intermediate organic molecules, produced during the decomposition of added FYM, their mobilization and accumulation of different nutrients in different plant parts. Similar results were reported by Saket *et al.* (2014).

### *Effect of potassium*

Data (Table 1) show that application of potassium significantly increased the plant height in cluster bean up to 90 kg $K_2O$ $ha^{-1}$. This may be due to function of K in most of the physiological and metabolic processes resulting in increased growth and development of plants. Similar results were reported by Singh and Singh (1994).Application of 30, 60 and 90 kg $K_2O$ $ha^{-1}$ increased the green foliage yield by 3.0, 8.1 and 14.8 per cent over contro l, respectively. As potassium is essential for growth, the favorable effect of high doses of K on growth and yields of cluster bean was mainly responsible for green foliage and dry matter yields. The results are in close conformity with those of Tomar *et al.* (2002).

Table 1: Effect of FYM, potassium and zinc on growth, yield and quality of fodder clusterbean

| Treatment | Plant height (cm) | Yield ($t\ ha^{-1}$) | | Protein content (%) | Protein yield ($q\ ha^{-1}$) |
|---|---|---|---|---|---|
| | | Green foliage | Dry matter | | |
| FYM ($t\ ha^{-1}$) | | | | | |
| 0 | 127.0 | 272.50 | 36.60 | 14.1 | 51.6 |
| 5 | 144.1 | 312.29 | 45.41 | 15.2 | 69.0 |
| SEm± | 1.35 | 2.47 | 2.17 | 0.31 | 3.04 |
| CD (P=0.5) | 3.87 | 7.06 | 6.21 | 1.00 | 8.69 |
| Potassium ($kg\ ha^{-1}$) | | | | | |
| 0 | 128.0 | 265.02 | 35.54 | 14.1 | 50.1 |
| 30 | 131.4 | 273.02 | 38.41 | 14.4 | 55.3 |
| 60 | 133.2 | 286.60 | 41.40 | 14.6 | 60.4 |
| 90 | 135.5 | 304.20 | 43.94 | 14.8 | 65.0 |
| SEm± | 0.34 | 1.26 | 0.70 | 0.11 | 0.98 |
| CD (P=0.5) | 0.98 | 3.61 | 2.00 | 0.31 | 2.80 |
| Zinc ($kg\ ha^{-1}$) | | | | | |
| 0 | 126.0 | 268.30 | 34.29 | 14.0 | 48.0 |
| 1 | 128.5 | 273.53 | 36.25 | 14.2 | 51.5 |
| 2 | 130.0 | 206.51 | 39.40 | 14.5 | 57.1 |
| 4 | 132.8 | 309.87 | 43.64 | 14.8 | 64.6 |
| SEm± | 0.36 | 0.99 | 0.54 | 0.04 | 0.76 |
| CD (P=0.5) | 1.04 | 2.85 | 1.55 | 0.11 | 2.17 |

Each successive increase in K levels from 0 to 90 kg $K_2O\ ha^{-1}$ increased the protein content and yield. The maximum value of protein yield (65.0 q $ha^{-1}$) was obtained with 90 kg $K_2O\ ha^{-1}$. Since, protein yield is the resultant of dry matter yield and protein content, it also increased due to potassium application because of an increase in dry matter yield. Similar results were reported by Tomar *et al.* (2002).A marked increase in N uptake (104.8 kg $ha^{-1}$), P (15.6 kg $ha^{-1}$), K (142.0 kg $ha^{-1}$), S (8.1 kg $ha^{-1}$) and Zn (78.1g $ha^{-1}$) was recorded with the application of 90 kg $K_2O\ ha^{-1}$ (Table 2). Since, the nutrient uptake is a function of their content in crop plant and yield of plant, increases in nutrients uptake by the crop are expected. These results are in conformity with those of Tomar *et al.* (2002) and Brar *et al.* (2004) who reported increased uptake of N, P, K, S and Zn by Chickpea and Pea, respectively.

Table 2: Effect of FYM, potassium and zinc on uptake of N, P, K, S ($kg\ ha^{-1}$) and Zn ($g\ ha^{-1}$) by cluster bean crop

| Treatment | Nitrogen | Phosphorus | Potassium | Sulphur | Zinc |
|---|---|---|---|---|---|
| FYM ($t\ ha^{-1}$) | | | | | |
| 0 | 82.7 | 9.7 | 114.6 | 3.8 | 58.0 |
| 5 | 111.0 | 17.2 | 146.9 | 7.7 | 81.0 |
| SEm± | 1.26 | 1.71 | 2.22 | 0.63 | 7.7 |
| CD (P=0.5) | 3.62 | 4.88 | 6.35 | 1.82 | 22.0 |
| Potassium ($kg\ ha^{-1}$) | | | | | |
| 0 | 80.5 | 9.1 | 111.6 | 4.4 | 51.0 |
| 30 | 88.7 | 11.0 | 121.8 | 5.6 | 60.0 |
| 60 | 97.1 | 13.5 | 132.5 | 6.6 | 69.0 |
| 90 | 104.8 | 15.6 | 142.0 | 8.1 | 78.1 |
| SEm± | 0.74 | 0.99 | 1.29 | 0.37 | 2.4 |
| CD (P=0.5) | 2.11 | 2.83 | 3.69 | 1.05 | 6.9 |
| Zinc ($kg\ ha^{-1}$) | | | | | |
| 0 | 77.2 | 9.1 | 106.6 | 4.2 | 49.0 |
| 1 | 82.8 | 10.7 | 114.0 | 5.1 | 57.0 |
| 2 | 91.6 | 13.0 | 125.3 | 6.8 | 66.2 |
| 4 | 103.6 | 15.9 | 140.3 | 8.9 | 78.1 |
| SEm± | 0.63 | 0.54 | 1.18 | 0.21 | 2.2 |
| CD (P=0.5) | 1.80 | 1.54 | 3.38 | 0.61 | 6.2 |

*Effect of zinc*

Application of zinc increased the plant height over control. The maximum value of this character was noted at 4 kg Zn $ha^{-1}$ followed 2, 1 kg Zn $ha^{-1}$ and control. Similar findings were reported by Meena *et al.* (2006) and Ali *et al.* (20013). Application of Zn also increased the green foliage and dry matter yield significantly up to 4 kg Zn $ha^{-1}$ (Table 1). The magnitude of increase was 15.5 and 27.3 per cent in green foliage and dry matter yield, respectively over control. The increase in plant height and yields might be due to role of Zn in biosynthesis of indole acetic acid (IAA) and especially due to its role in initiation of primordial for partitioning of photosynthates towards them which resulted in better yield (Ali *et al.* 2013). Increasing levels of Zn from 0 to4 Zn $ha^{-1}$ increased the content and yield of protein from 14.0 to 14.8 % and from 48.0 to 64.6 q kg $ha^{-1}$, respectively in cluster bean crop. This was mainly owing to higher dry matter yield and protein per centage in ciuster bean plants. The results corroborate with the findings of Meena *et al.* (2006) and Ali *et al.* (2013). A perusal of data (Table 2) revealed that N, P, K, S, and Zn uptake increased significantly with Zn application over control. The highest uptake of N (103.6kg $ha^{-1}$) was associated with 4 kg Zn $ha^{-1}$. Significant increase in P uptake by plants (15.9kg $ha^{-1}$) was also found with 4 kg Zn $ha^{-1}$ as observed by Singh and Singh (2012). The maximum uptake of K by the crop (140.3 kg $ha^{-1}$) was recorded with 4 kg Zn $ha^{-1}$. Plant uptake of S and increased along with rise in levels of Zn up to 4 kg $ha^{-1}$. The increase in nutrient uptake may be due to increase in nutrient content and dry matter yield. Zinc plays structural and regulatory roles in large numbers of enzymes and protein synthesis, which directly affects the nutrients absorption from the soil (Behera *et al.* 2009 and Sharma *et al.* 2014). Zinc uptake by cluster bean crop increased significantly with increasing levels of applied Zn. Highest Zn uptake was found with 4 kg Zn $ha^{-1}$ and lowest in control. The higher Zn uptake due to its application could be attributed to the priming effect caused by higher crop growth and consequently higher removal of zinc due to its application. Ali *et al.* (2013) reported similar results.

From the present investigation, it may be concluded that the application of FYM, K and Zn increased the green foliage and dry matter yields and protein content in fodder cluster bean, Application of 5 t FYM, 90 kg $K_2O$ and 4 kg Zn $ha^{-1}$ gave the maximum values of yields and protein content in cluster bean under agroclimate condition of Agra region.

**REFERENCES**

Ali, J., Singh, S. P and Singh, S. (2013) Response of fababean to boron, zinc and sulphur application in alluvial soil. *Journal of the Indian Society of Soil Science* **61** (3): 202-206.

Behera, S. K., Singh, M. V. and Lakaria B. L. (2009) Micronutrient deficiency in India and their amelio-ration through fertilizers. *Indian Farming* **59**: 28-31.

Brar, M. S., Kaur, N., Rachna and Sharma, A. (2004) Effect of graded doses of potassium on pea (Pisum sativum L).Journal of Potassium Research **20**: 100-108

Chesnin, L. and Yien, C. H. (1951) Turbidimetric determination of available sulphate. Soil Science Society of America Proceedings **15:** 149-151**.**

Jackson, M. L. (1973) *Soil Chemical Analysis.* Prentice Hall of India Private Limited, New Delhi.

Marschner, H. (1986) *Mineral nutrition* of higher plants. Academic Press Inc. USA, pp. 269-369.

Meena, R. K., Dahama, A. K. and Reager, M. L. (2006) Effect of phosphorus and zinc fertilization on growth and quality of cluster bean (*Cymopsis tetragonoloba* (L) Taub) *Annals of Agricultural Research* **27**: 224-226.

Saket, S., Singh, S. B., Namdeo, K. N. and Parihar, S. S. (2014) Effect of organic and inorganic fertilizers on yield, quality and nutrients uptake of lentil. *Annals of Plant and Soil Research* **16** (3): 268-241.

Sharma, A. K., Raghubanshi, B. P. S. and Sirothia, P. (2014) Response of chickpea to levels of zinc and phosphorus. *Annals of Plant and Soil Research* **16** (2): 172-173.

Singh, D. and Singh, H. (2012) Effect of phosphorus and zinc nutrition on yield, nutrient uptake and quality of chickpea. *Annals of Plant and Soil Research* **14**: 71-74.

Singh, V. and Singh, G.P. (1994) Effect of applied potassium and molybdenum on yield and composition of chickpea. Journal of Potassium Research **10** (4): 411-414.

Singh, Y. Singh, P. Sharma, R. D. Marko, G. S. Namdeo, K. N. (2013b) Effect of organics on content and uptake of nutrients by lentil genotypes. *Annals of Plant and Soil Research* **15** (2); 122-127.

Singh, Y., Singh, P., Sharma, R. D., Marko, G. S. and Namdeo, K. N. (2013a) Effect of organic sources of nutrients on growth, yield and quality of lentil genotypes. *Annals of Plant and Soil Research* **15** (2): 134-137.

Singh, Y., Singh, P., Sharma, R. D., Marko, G. S. and Namdeo, K. N. (2013a) Effect of organic source of nutrients on growth, yield and quality of lentil genotypes- Annals of Plant and Soil Research **15** (2): 134-137.

Tomar, R. S., Kanzaria, M. V. and Jain, V. K. (2001) Response of Chickpea to potassium in a calcareous soil. Journal of Potassium Research **18**: 105-108