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# Effect of NPK levels on growth, yield and quality of cluster bean (*Cyamopsis tetragonoloba* (L.) Taub.) in lateritic soils of Konkan

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**Abstract**
An experiment was conducted to study the effect of different levels of NPK on growth, yield and quality of cluster bean (*Cyamopsis tetragonoloba* (L.) Taub.) in lateritic soils of Konkan during *Rabi* 2020-21 at the Research Farm of Department of Agronomy, Dr. BSKKV, Dapoli, Maharashtra. The treatments comprised of $T_1$: 00:00:00, $T_2$: 20:40:00, $T_3$: 20:40:40, $T_4$: 40:40:40, $T_5$: 40:40:60, $T_6$: 40:60:40, $T_7$: 40:60:60, $T_8$: 60:40:40 and $T_9$: 60:40:60 NPK kg ha$^{-1}$. The result emerged out that for getting higher green pod yield and stover yield, protein content in cluster bean, macro (P and K) and micro nutrients (Fe, Mn, Zn and Cu) content in green pod, the application of 40:60:60 N:$P_2O_5$:$K_2O$ kg ha$^{-1}$ was found to be beneficial in lateritic soils of Konkan.

**Keywords:** Effect of nitrogen, phosphorus, potassium levels, cluster bean, yield attributes, quality

## Introduction
Cluster bean (*Cyamopsis tetragonoloba* (L.) Taub.), commonly known as guar, has come to be recognized as one of the most important commercial crop of arid and semi-arid region. It is a drought hardy leguminous crop because of its deep tap rooting system and has high capacity to recover from water stress. Traditionally, pods of the cluster bean are used for vegetable purpose. Its plant, seed and straw are good source of nutritive fodder and feed for livestock. Cluster bean is also raised as a green manure and cover crop. Being a leguminous crop, it enriches the soil fertility by fixing the atmospheric nitrogen. The crop is mainly grown during rainy season, but it can also be grown successfully during summer season under irrigated condition.

In India, cluster bean is grown on an area of 23.30 lakh hectare with a productivity of 428.0 kg per hectare of pods. The maximum contribution in respect of area is shared by Rajasthan (18.18 lakh ha), followed by Gujarat (2.27 lakh ha), Haryana (1.27 lakh ha) and Punjab (0.14 lakh ha) with a production of 19.85 lakh tonnes, 2.27 lakh tonnes, 1.20 lakh tonnes and 0.14 lakh tonnes respectively (Anon., 2013) [1]. Rajasthan alone comprises about 78 per cent of area and contributes 80 per cent of production to the national basket of guar.

Poor soil fertility and lack of nutrients are considered to be major reasons of the dismally low productivity of the vegetable cluster bean. Therefore, augmenting of nutrient supply assumes prime significance to improve its productivity. The lateritic soils are extensively distributed in the Ratnagiri and Sindhudurg districts of the South Konkan. These soils are deficient in available phosphorus, low to medium in available nitrogen and low to medium in available potassium. The lateritic soils have high phosphorus fixing capacity (91%) (Kadrekar and Talashilkar, 1977) [3].

The area under cluster bean cultivation in Konkan region is increasing day by day. But, the RDF is being applied as per the recommendation of other Agril. Universities to cluster bean, which is actually recommended for that particular region with their soil types and agro-climatic conditions. Hence, there is need to trace the RDF for Cluster bean to be grown in lateritic soils of Konkan region. Keeping this in view, the present investigation was proposed.

## Materials and Methods
An experiment was conducted to study the effect of different levels of NPK on growth, yield and quality of cluster bean (*Cyamopsis tetragonoloba* (L.) Taub.) in lateritic soils of Konkan during *Rabi* 2020-21 at the Research Farm of Department of Agronomy, Dr. BSKKV, Dapoli,

Maharashtra in Randomized Block Design comprising nine treatments *viz* $T_1$: 00:00:00, $T_2$: 20:40:00, $T_3$: 20:40:40, $T_4$: 40:40:40, $T_5$: 40:40:60, $T_6$: 40:60:40, $T_7$: 40:60:60, $T_8$: 60:40:40, $T_9$: 60:40:60 NPK kg ha$^{-1}$ with three replications, where the effect of different levels of NPK on growth, yield, quality of Cluster bean variety Pusa Navbahar at flowering stage and at harvest were studied. Seeds were sown by dibbling method with the spacing of 15 cm in between two hills and 45 cm distance in between two rows. The half dose of nitrogen and full dose of phosphorus and potassium was applied at the time of sowing and remaining dose of nitrogen was applied at flowering stage (30 DAS). The average plant height, number of branches per plant and number of pods per plant (from five randomly selected plants from each treatment) were measured at flowering or 30 DAS and at harvest stage of the crop. Green pod yield (q ha$^{-1}$), Stover yield (kg ha$^{-1}$) and protein content (%) was recorded after harvesting of the crop. NPK and micronutrients (Fe, Mn, Cu and Zn) content in green pod and plant were estimated by standard procedure suggested by Tondon (1993) and Mclaren and Crawford (1950) [5]

## Results and Discussion

### Growth and yield attributes

The data presented in Table 1 indicates that the height of the plant increased over the period of observations from 30 DAS to harvest of the crop. The maximum plant height (30.73 cm) was recorded with the application of 40:60:60 NPK kg ha$^{-1}$ at 30 DAS and 40:40:40 NPK kg ha$^{-1}$ (76.47 cm) at harvest of the crop. Application of 60:40:40 NPK kg ha$^{-1}$ ($T_8$) and 60:40:60 NPK kg ha$^{-1}$ ($T_9$) recorded the maximum number of branches (2.33), which found to be significantly superior over rest of the treatment. This might be due to the application of higher amount of nitrogen resulted in better growth, increase in number of branches per plant Nikam *et al.* (2018) [7]. The significantly higher number of pods plant$^{-1}$ (77.43) was observed in application of 40:60:60 NPK kg ha$^{-1}$. The increase in number of pods plant$^{-1}$ with the application of fertilizers may be due to adequate supply of nitrogen, phosphorus and potassium which are essential to provide the better nutritional environment in the root zone for proper crop growth and development (Anuradha *et al*. 2017) [2].

**Table 1:** Plant height, number of branches and number of pods of cluster bean as influenced by different doses of NPK

| Tr. Code | Treatment | Plant Height (cm) | | Number of branches plant$^{-1}$ at harvest | Number of Pods plant$^{-1}$ |
|---|---|---|---|---|---|
| | | 30 DAS | At Harvest | | |
| $T_1$ | 00:00:00 NPK kg ha$^{-1}$ | 13.87 | 42.80 | 1.27 | 31.37 |
| $T_2$ | 20:40:00 NPK kg ha$^{-1}$ | 23.20 | 69.40 | 1.40 | 62.43 |
| $T_3$ | 20:40:40 NPK kg ha$^{-1}$ | 25.40 | 76.20 | 1.67 | 63.83 |
| $T_4$ | 40:40:40 NPK kg ha$^{-1}$ | 29.47 | 76.47 | 1.60 | 66.77 |
| $T_5$ | 40:40:60 NPK kg ha$^{-1}$ | 27.27 | 71.00 | 1.53 | 68.37 |
| $T_6$ | 40:60:40 NPK kg ha$^{-1}$ | 30.53 | 74.07 | 1.73 | 68.47 |
| $T_7$ | 40:60:60 NPK kg ha$^{-1}$ | 30.73 | 76.33 | 1.60 | 77.43 |
| $T_8$ | 60:40:40 NPK kg ha$^{-1}$ | 27.93 | 73.93 | 2.33 | 70.13 |
| $T_9$ | 60:40:60 NPK kg ha$^{-1}$ | 27.80 | 72.33 | 2.33 | 71.93 |
| | SE (m) ± | 2.64 | 6.19 | 0.108 | 5.12 |
| | CD 5% | 7.92 | 18.55 | 0.325 | 15.36 |

Observation pertaining to the effect of different levels of NPK on yield and stover yield of cluster bean is given in Table 2. The treatment which received 40:60:60 NPK kg ha$^{-1}$ recorded the significantly highest green pod yield i.e. 52.01 q ha$^{-1}$. This may be due to adequate supply of nitrogen, phosphorus and potassium which are essential to provide the better nutritional environment in the root zone for proper crop growth and development (Anuradha *et al.* 2017) [2]. The highest stover yield to the tune of 913.06 kg ha$^{-1}$ was recorded in treatment $T_9$ with the application of 60:40:60 NPK kg ha$^{-1}$.

The results of present investigation are in line with those of Reddy and Reddy (2011) [9], Rathor *et al*. (2007) [8] and Singh and Kumar (2016) [10] who obtained increased yield attributes, straw and biological yields with the combined application of fertilizers (N and P) up to optimum level.

**Table 2:** Green pod yield and straw yield of cluster bean as influenced by different doses of NPK

| Tr. Code | Treatment | Green Pod Yield (q ha$^{-1}$) | Stover Yield (kg ha$^{-1}$) |
|---|---|---|---|
| $T_1$ | 00:00:00 NPK kg ha$^{-1}$ | 18.97 | 599.44 |
| $T_2$ | 20:40:00 NPK kg ha$^{-1}$ | 37.06 | 763.89 |
| $T_3$ | 20:40:40 NPK kg ha$^{-1}$ | 44.81 | 788.06 |
| $T_4$ | 40:40:40 NPK kg ha$^{-1}$ | 46.49 | 843.89 |
| $T_5$ | 40:40:60 NPK kg ha$^{-1}$ | 46.97 | 856.11 |
| $T_6$ | 40:60:40 NPK kg ha$^{-1}$ | 46.38 | 812.78 |
| $T_7$ | 40:60:60 NPK kg ha$^{-1}$ | 52.01 | 903.33 |
| $T_8$ | 60:40:40 NPK kg ha$^{-1}$ | 47.34 | 899.72 |
| $T_9$ | 60:40:60 NPK kg ha$^{-1}$ | 48.19 | 913.06 |
| | SE (m) ± | 5.57 | 39.23 |
| | CD 5% | 16.71 | 117.62 |

### Protein content

The protein content in green cluster bean pods varied from 2.12 to 4.15% (Table 3). The range value of protein of cluster bean variety Pusa Navbahar reported here are in agreement with Thorat (2005) [12]. The data revealed that the protein content was significantly highest in treatment $T_8$ with application of 60:40:40 NPK kg ha$^{-1}$, which was at par with the treatment $T_4$ (40:40:40 NPK kg ha$^{-1}$), $T_5$ (40:40:60 NPK

kg ha$^{-1}$), $T_6$ (40:60:40 NPK kg ha$^{-1}$), $T_7$ (40:60:60 NPK kg ha$^{-1}$) and $T_9$ (60:40:60 NPK kg ha$^{-1}$). The reason for higher nitrogen content might be due to increased activity of nitrate reductase enzyme. Manohar *et al*. (2018) [4] reported graded increase in protein content in Pusa Navbahar variety of cluster bean with the application of graded application of RDF i.e. 75, 100 and 150% RDF.

The application of 40:60:60 NPK kg ha$^{-1}$ (treatment $T_7$) recorded the highest phosphorus and potassium content (0.237 and 0.343%) in green cluster bean pods. The application of 40:60:60 NPK kg ha$^{-1}$ ($T_7$) and 60:40:60 NPK kg ha$^{-1}$ ($T_9$) recorded the highest iron content (88.11%) and manganese content (21.06%), respectively. Application of 60:40:40 NPK kg ha$^{-1}$ ($T_8$) recorded the highest zinc and copper content (13.23 and 7.48%). The increase in micro-nutrients (i.e. Fe, Mn, Zn and Cu) content in pod with the application of different levels of NPK (from treatment $T_2$ to $T_9$) could be attributed to increasing availability of nutrients from organic matter that after decomposition release macro and micro-nutrients to soil solution, which becomes available to the plants, resulting in higher uptake. Similar values of Mn, Zn and Cu content in green pod of cluster bean were reported by Mevlut Akcura *et al*. (2020)

**Table 3:** Protein and macro-nutrient (NPK) content in green pod of cluster bean as influenced by different doses of NPK

| Tr. Code | Treatment | Protein (%) | Macro-nutrient content (%) | |
|---|---|---|---|---|
| | | | P | K |
| $T_1$ | 00:00:00 NPK kg ha$^{-1}$ | 2.12 | 0.154 | 0.217 |
| $T_2$ | 20:40:00 NPK kg ha$^{-1}$ | 2.56 | 0.162 | 0.247 |
| $T_3$ | 20:40:40 NPK kg ha$^{-1}$ | 2.81 | 0.181 | 0.290 |
| $T_4$ | 40:40:40 NPK kg ha$^{-1}$ | 3.28 | 0.194 | 0.297 |
| $T_5$ | 40:40:60 NPK kg ha$^{-1}$ | 3.58 | 0.178 | 0.333 |
| $T_6$ | 40:60:40 NPK kg ha$^{-1}$ | 3.71 | 0.232 | 0.283 |
| $T_7$ | 40:60:60 NPK kg ha$^{-1}$ | 4.11 | 0.237 | 0.343 |
| $T_8$ | 60:40:40 NPK kg ha$^{-1}$ | 4.15 | 0.230 | 0.280 |
| $T_9$ | 60:40:60 NPK kg ha$^{-1}$ | 4.09 | 0.207 | 0.340 |
| | SE (m) ± | 0.338 | 0.006 | 0.021 |
| | CD 5% | 1.014 | 0.019 | 0.063 |

**Table 4:** Micronutrient (Fe, Mn, Zn and Cu) content in green pod of cluster bean as influenced by different doses of NPK

| Tr. Code | Treatment | Micro-nutrient content in green pod (mg kg$^{-1}$) | | | |
|---|---|---|---|---|---|
| | | Fe | Mn | Zn | Cu |
| $T_1$ | 00:00:00 NPK kg ha$^{-1}$ | 70.12 | 15.26 | 8.12 | 6.34 |
| $T_2$ | 20:40:00 NPK kg ha$^{-1}$ | 76.48 | 17.24 | 10.69 | 6.34 |
| $T_3$ | 20:40:40 NPK kg ha$^{-1}$ | 80.12 | 18.02 | 11.23 | 6.72 |
| $T_4$ | 40:40:40 NPK kg ha$^{-1}$ | 82.16 | 18.78 | 11.98 | 6.89 |
| $T_5$ | 40:40:60 NPK kg ha$^{-1}$ | 83.14 | 19.57 | 12.03 | 7.12 |
| $T_6$ | 40:60:40 NPK kg ha$^{-1}$ | 87.23 | 19.96 | 12.68 | 7.14 |
| $T_7$ | 40:60:60 NPK kg ha$^{-1}$ | 88.11 | 20.23 | 13.08 | 7.28 |
| $T_8$ | 60:40:40 NPK kg ha$^{-1}$ | 87.62 | 20.84 | 13.23 | 7.48 |
| $T_9$ | 60:40:60 NPK kg ha$^{-1}$ | 86.69 | 21.06 | 12.98 | 7.34 |
| | SE (m) ± | 1.173 | 0.419 | 0.66 | 0.162 |
| | CD 5% | 3.516 | 1.257 | 1.965 | 0.484 |

## Conclusion

On the basis of data obtained from the present investigation, it can be concluded that for getting higher green pod yield and stover yield, protein content in cluster bean, macro (P and K) and micro nutrients (Fe, Mn, Zn and Cu) content in green pod, the application of 40:60:60 N:$P_2O_5$:$K_2O$ kg ha$^{-1}$ was found to be beneficial in lateritic soils of Konkan.

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