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# Effect of foliar application of calcium nitrate, boron and humic acid on nutrient content and uptake of transplanted Pigeonpea

**C Yathish, PS Fathima, K Pushpa, T Theerthana and R Krupashree**

## Abstract
Pulses are an important source of high quality protein complementing cereal proteins for pre-dominantly substantial vegetarian population of the country. Pigeonpea (*Cajanus cajan* (L.) Millsp.) is the second most important pulse crop of India after chickpea and is grown for it's grain as dhal and green seed as a vegetable. A field experiment was conducted at College of Agriculture, Vishweshwaraiah Canal Farm, Mandya during *kharif* 2017 to study the effect of foliar application of calcium nitrate, boron and humic acid on growth and yield of transplanted pigeonpea. The design followed is randomized complete block design with three replications. Higher nitrogen content in grain and stover (3.42% and 1.28%, respectively), phosphorous content in grain and stover (0.49% and 0.34%, respectively) and potassium content in grain and stover (0.9% and 1.1%) was recorded for the treatment with foliar spray of humic acid 6 ml $L^{-1}$ at flowering initiation and 15 days after flowering initiation along with RDF and FYM ($T_{13}$), protein per cent in grain also followed the similar trend. Higher concentration of calcium in grain and stover (0.37% and 1.2%) was recorded in treatment with foliar spray of 2.0% $Ca(NO_3)_2$ at flowering initiation and 15 days after flowering initiation along with RDF and FYM ($T_9$). Higher boron content in grain and stover (23.87 mg $kg^{-1}$ and 32.27 mg $kg^{-1}$) was recorded in treatment with foliar spray of 0.50% borax at and 15 days after flowering initiation along with RDF and FYM ($T_{11}$). Foliar spray of humic acid 6 ml $L^{-1}$ at flowering initiation and 15 days after flowering initiation along with RDF and FYM ($T_{13}$) recorded the higher uptake of nitrogen, phosphorous and potassium by grain (71.52, 10.27 and 18.84 kg $ha^{-1}$ respectively) and stover (95.08, 25.26 and 81.46 kg $ha^{-1}$ respectively). Higher uptake of boron by grain and stover (46.69 g $ha^{-1}$ and 230.81 g $ha^{-1}$ respectively) was recorded in foliar spray of 0.50% borax at flowering initiation and 15 days after flowering initiation along with RDF and FYM.

**Keywords:** Nutrient content and nutrient uptake

## Introduction
Pigeonpea (*Cajanus cajan* (L.) Millsp.) is the second most important pulse crop of India after chickpea. In India, pigeonpea is grown in an area of 3.85 m ha with a production and productivity of 2.81 m t and 729 kg $ha^{-1}$ respectively and in Karnataka, it is grown in an area of 0.73 m ha with a production and productivity of 0.47 m t and 651 kg $ha^{-1}$ respectively (Anon. 2015) [2]. Transplanted pigeonpea is the alternate option for optimum utilization of land and water resources. The transplanting of pigeonpea seedlings has been shown to increase grain yield by 69.5 per cent than direct sowing of pigeonpea.

One of the technologies that supported the increase in production of crops is foliar fertilization of macronutrients and micronutrients. It helps in rapid absorption of nutrients, serving as a complement to soil fertilization. Generally nutrients are quickly available to the plants by foliar application than the soil application (Phillips, 2004) [16].

Calcium has been reported to inhibit $Na^+$ uptake and thereby reduce its adverse effect on seed germination (Nayyar, 2003) [11] as well as increase plant growth (Munns, 2002) [10]. Calcium is an immobile element in plant and therefore application of calcium is more crucial for enhanced productivity. Foliar application of calcium is most effective when applied to buds and flowers as it can be readily absorbed and utilized by the plants.

Boron (B) is an essential trace element whose deficiency affects the yield and nutrient uptake of different crops, especially in legumes. Boron is needed by the crop plants for cell division, nucleic acid synthesis, uptake of calcium and transport of carbohydrates (Bose and Tripathi, 1996) [5]. Boron also plays an important role in flowering and fruit formation (Nonnecke, 1989). Its deficiency affects translocation of sugar, starch, nitrogen and phosphorus, synthesis of amino acids and proteins (Stanley *et al*., 1995) [18]. Factor that may cause shortfall in B supply for reproductive development are poor translocation of B from leaves and other mature tissues to the floral parts and poor access of the pollen grains and the embryo sacs to the vascular supply.

In such situation providing B by means of foliar application would be advantageous (Pandey and Gupta, 2013) [14].

Humic acid is the most complex form of organic material and it is a ready source of carbon and nitrogen and known as the black gold of agriculture and is increasingly becoming popular for use in agriculture. Foliar application of humic acid in leguminous plants has remarkable effects on growth of plant by increasing leaf area index which in turn increases photosynthetic activity (Ghorbani *et al*., 2010) [7]. Humic acid stimulates plant growth by the assimilation of major and minor elements, enzyme activation or inhibition, changes in membrane permeability and protein synthesis (Ulukan, 2008) [19]. Humic acid is also known to increase the plant growth through chelating different nutrients resulting in increase in production and quality of agricultural products through production of hormonal compounds (Albayrak and Camas, 2005) [1].

## Material and methods

Field experiment was conducted at College of Agriculture, Vishweshwaraiah Canal Farm, Mandya during *kharif* 2017. It falls under the region III and agro climatic zone VI (Southern dry zone) of Karnataka. Geographically the experimental site was located at 12º 34.31' North latitude and 76º 49.8' East longitude at 697 meter above mean sea level. The experiment was laid out in a Randomized Complete Block Design (RCBD) with 13 treatments replicated thrice. Treatments included are $T_1$ = Control (No spray), $T_2$ = Foliar spray of 1.0% Calcium nitrate at flower initiation, $T_3$ = Foliar spray of 2.0% Calcium nitrate at flower initiation, $T_4$ = Foliar spray of 0.25% borax at flower initiation, $T_5$ = Foliar spray of 0.50% borax at flower initiation, $T_6$ = Foliar spray of humic acid 4 ml $L^{-1}$ at flower initiation, $T_7$ = Foliar spray of humic acid 6 ml $L^{-1}$ at flower initiation, $T_8$ = Foliar sprays of 1.0% Calcium nitrate each at flower initiation and 15 days after flower initiation, $T_9$ = Foliar sprays of 2.0% Calcium nitrate each at flower initiation and 15 days after flower initiation, $T_{10}$ = Foliar sprays of 0.25% borax each at flower initiation and 15 days after flower initiation, $T_{11}$ = Foliar sprays of 0.50% borax each at flower initiation and 15 days after flower initiation, $T_{12}$ = Foliar sprays of humic acid 4 ml $L^{-1}$ each at flower initiation and 15 days after flower initiation and $T_{13}$ = Foliar sprays of humic acid 6 ml $L^{-1}$ each at flower initiation and 15 days after flower initiation [Note : Recommended dose of fertilizer and FYM (as per University of Agricultural Sciences, Bangalore, package of practice) are same to all the treatments. Commercial grade 12% Humic acid was used].

## Results and discussion

### Effect of foliar application of calcium nitrate, borax and humic acid on nutrient content in grain and stover of transplanted pigeonpea

### N, P, K, Ca and B content

The N, P, K, Ca and B content in grain and stover of transplanted pigeonpea as influenced by different treatments are presented in Table 1.

### Nitrogen

The foliar application of calcium nitrate, borax and humic acid showed the significant difference in nitrogen content of grain. Higher nitrogen content (3.42%) was recorded in the treatment $T_{13}$ (foliar spray of humic acid 6 ml $L^{-1}$ at flowering initiation and 15 days after flowering initiation along with RDF and FYM), which was on par with the treatment $T_9$ (3.41%) foliar spray of 2.0% $Ca(NO_3)_2$ at flowering initiation and 15 days after flowering initiation along with RDF and FYM. Significantly lower nitrogen content of grain (3.02%) was recorded in control ($T_1$) with RDF and FYM, followed by the treatment $T_4$ (3.12%) foliar spray of 0.25% borax at flowering initiation along with RDF and FYM.

Significant difference in nitrogen content of stover was observed due to the influence of foliar application of calcium nitrate, borax and humic acid. Significantly higher nitrogen content in stover (1.28%) was recorded due to the foliar spray of humic acid 6 ml $L^{-1}$ at flowering initiation and 15 days after flowering initiation along with RDF and FYM ($T_{13}$) over all other treatments except treatment $T_9$ (1.27%) foliar spray of 2.0% $Ca(NO_3)_2$ at flowering initiation and 15 days after flowering initiation along with RDF and FYM which was on par.

### Protein percent

The data presented in the Table 1 indicates influence of foliar application of calcium nitrate, borax and humic acid on protein per cent.

Significantly higher protein per cent (21.35%) was recorded for the treatment with foliar spray of humic acid 6 ml $L^{-1}$ at flowering initiation and 15 days after flowering initiation along with RDF and FYM ($T_{13}$), which was on par with treatment $T_9$ (21.33%) foliar spray of 2.0% $Ca(NO_3)_2$ at flowering initiation and 15 days after flowering initiation along with RDF and FYM. Significantly lower protein per cent (18.89%) was recorded in control ($T_1$).

### Phosphorous

The data presented in the Table 1 indicates influence of foliar application of calcium nitrate, borax and humic acid on phosphorous content in grain and stover.

Foliar spray of humic acid 6 ml $L^{-1}$ at flowering initiation and 15 days after flowering initiation along with RDF and FYM (T13) recorded significantly higher phosphorous content in grain (0.49%) over all the treatments and control.

Significantly higher phosphorous content in stover (0.34%) was also recorded in the treatment receiving foliar spray of humic acid 6 ml $L^{-1}$ at flowering initiation and 15 days after flowering initiation along with RDF and FYM ($T_{13}$), followed by 0.32% in the treatment $T_9$ foliar spray of 2.0% $Ca(NO_3)_2$ at flowering initiation and 15 days after flowering initiation along with RDF and FYM. Significantly lower phosphorous content of stover (0.22%) was recorded in control ($T_1$) with RDF and FYM.

### Potassium

Potassium content in grains and stover showed a significant difference due to treatments. The potassium content in grain was highest (0.9%) in treatment with foliar spray of humic acid 6 ml $L^{-1}$ at flowering initiation and 15 days after flowering initiation along with RDF and FYM ($T_{13}$). The potassium content in grain was lowest (0.63%) in control ($T_1$ RDF and FYM).

The potassium content in stover varied from 1.10% to 0.8%. Significantly higher concentration of potassium (1.10%) was observed in $T_{13}$ with RDF + FYM, followed by $T_{11}$ (1.05%) with RDF + FYM and significantly lower concentration of potassium (0.8%) was observed in control ($T_1$).

### Calcium content

The grain calcium content varied significantly due to treatments. Significantly higher concentration of calcium (0.37%) was recorded in treatment with foliar spray of 2.0%

Ca $(NO_3)_2$ at flowering initiation and 15 days after flowering initiation along with RDF and FYM ($T_9$), followed by $T_8$ (0.35%) foliar spray of 1.0% $Ca(NO_3)_2$ at FI and 15 days after flowering initiation along with RDF and FYM and significantly lower concentration of calcium (0.21%) was observed in control ($T_1$).

Calcium content of stover in control was 0.8 per cent, which increased significantly to a highest of 1.20 per cent due to foliar spray of 2.0% $Ca(NO_3)_2$ at flowering initiation and 15 days after flowering initiation along with RDF and FYM ($T_9$).

**Boron content**

Foliar application of calcium nitrate, borax and humic acid significantly influenced the boron content of grain. Higher boron content (23.87 mg $kg^{-1}$) was recorded in treatment with foliar spray of 0.50% borax at flowering initiation and 15 days after flowering initiation along with RDF and FYM ($T_{11}$) and lower boron content (17.23 mg $kg^{-1}$) was observed in control ($T_1$).

Significant difference in boron content of stover was observed due to influence of foliar application of calcium nitrate, borax and humic acid. Higher boron content in stover (32.27 mg $kg^{-1}$) was recorded for the treatment with foliar spray of 0.50% borax at flowering initiation and 15 days after flowering initiation along with RDF and FYM ($T_{11}$), followed by the treatment foliar spray of humic acid 6 ml $L^{-1}$ at flowering initiation and 15 days after flowering initiation along with RDF and FYM ($T_{13}$). Significantly lower boron content of stover (24.93 mg $kg^{-1}$) was recorded in control ($T_1$) with RDF and FYM.

Significant difference in content of N, P, K, Ca and B was observed due to foliar application of calcium nitrate, borax and humic acid. The highest nitrogen content in grain and stover (3.42% and 1.28% respectively) was recorded due to the foliar spray of humic acid 6 ml $L^{-1}$ at flowering initiation and 15 days after flowering initiation along with RDF and FYM ($T_{13}$), which was on par with treatment $T_9$ (3.41% and 1.27% respectively) foliar spray of 2.0% $Ca(NO_3)_2$ at flowering initiation and 15 days after flowering initiation along with RDF and FYM. The increased nitrogen content with foliar application of calcium nitrate may be due to higher $Ca^{2+}$ cations which plays important role in more rational utilization of soil nitrogen and active assimilation of $NO_3$ in roots and leaves as observed in the present study and also reported by Chaity and Sarkar (2009) [6].

While higher phosphorous and potasssium content in grain and stover was recorded in the treatment with foliar spray of humic acid 6 ml $L^{-1}$ at FI and 15 days after FI along with RDF and FYM ($T_{13}$). The higher content of N, P and K due foliar application of humic acid fastens the absorption of nutrients, induces nodule formation and increases rhizobial activity (Metre *et al*., 2013) [9], there by increased the N, P and K content in $T_{13.}$

Higher concentration of calcium in grain and stover (0.37% and 1.2%) was recorded in treatment with foliar spray of 2.0% $Ca(NO_3)_2$ at flowering initiation and 15 days after flowering initiation along with RDF and FYM ($T_9$), the similar findings were also reported by Peyvast *et al*. (2009) [15] in tomato and Schon (1993) [17] in pepper.

Higher boron content in grain and stover (23.86 mg $kg^{-1}$ and 32.26 mg $kg^{-1}$) was recorded in treatment with foliar spray of 0.50% borax at flowering initiation and 15 days after flowering initiation along with RDF and FYM ($T_{11}$) compared to the treatment $T_{4,}$ $T_5$ and $T_{10}$. Two foliar applications borax resulted in higher B concentrations in seed than single time application, indicating that B concentration in seed may increase with more than one application as long as foliar borax rate does not reach a toxic level (Bellaloui *et al*., 2010) [3].

**Effect of foliar application of calcium nitrate, borax and humic acid on nutrient uptake by grain and stover of transplanted pigeonpea**

**N, P, K, Ca and B uptake**

The N, P, K, Ca and B uptake in grain and stover of transplanted pigeonpea as influenced by different treatments are presented in Table 2.

**Nitrogen uptake**

The nitrogen uptake by grain and stover were significant due to treatments. Significantly higher nitrogen uptake by grain was observed in $T_{13}$ (71.52 kg $ha^{-1}$), followed by $T_{11}$ (64.44 kg $ha^{-1}$) and significantly lower nitrogen uptake (46.62 kg $ha^{-1}$) by grain was observed in control.

Treatment $T_{13}$ recorded significantly higher nitrogen uptake (95.08 kg $ha^{-1}$) by stover, which was on par with $T_9$ (93.35 kg $ha^{-1}$). Control ($T_1$) with RDF and FYM recorded significantly lower uptake of nitrogen by stover (62.11 kg $ha^{-1}$).

**Phosphorous uptake**

The Phosphorous uptake by grain was highest (10.27 kg $ha^{-1}$) in treatment with foliar spray of humic acid 6 ml $L^{-1}$ at flowering initiation and 15 days after flowering initiation along with RDF and FYM ($T_{13}$). The phosphorous uptake in grain was lowest (5.80 kg $ha^{-1}$) in control ($T_1$) with RDF and FYM.

The phosphorous uptake in stover varied from 14.03 kg $ha^{-1}$ to 25.25 kg $ha^{-1}$. Significantly higher uptake of phosphorous (25.26 kg $ha^{-1}$) was observed in $T_{13}$ with RDF + FYM, followed by $T_9$ (23.77 kg $ha^{-1}$) with RDF + FYM and significantly lower uptake of phosphorous (14.04 kg $ha^{-1}$) was observed in control ($T_1$).

**Potassium uptake**

Data presented in Table 2 showed that, significantly higher potassium uptake by grain was noticed in $T_{13}$ (18.84 kg $ha^{-1}$) over control and all other treatments and potassium uptake by stover was also higher in $T_{13}$ (81.46 kg $ha^{-1}$) and lower uptake was noticed in control (50.84 kg $ha^{-1}$).

**Calcium uptake**

Calcium uptake by the grains varied from 3.17 to 7.29 kg $ha^{-1}$. Higher calcium uptake of 7.29 kg $ha^{-1}$ was observed in $T_{13}$, followed by treatment $T_{11}$ (6.85 kg $ha^{-1}$). The lowest uptake was noticed in control (3.17 kg $ha^{-1}$).

Uptake of calcium by stover was also significant. 88.20 kg $ha^{-1}$ of calcium uptake by stover was observed in $T_9$ which is significantly higher than other treatments. Whereas, 51.05 kg $ha^{-1}$ of calcium uptake was observed in control.

**Borax uptake**

The data in Table 2 indicates the uptake of boron by grain and stover which differed significantly due to treatments. Higher uptake of boron by grain was recorded in $T_{11}$ with 46.70 g $ha^{-1}$, which was on par with 46.54 g $ha^{-1}$ in $T_{13}$ and significant over control $T_1$ (26.56 g $ha^{-1}$) and rest of the treatments.

Boron uptake by stover was significantly higher in $T_{11}$ (230.81 g $ha^{-1}$), which was on par with $T_{13}$ and $T_9$ (229.53 and 220.99 g $ha^{-1}$, respectively) and significantly lower (159.1 g $ha^{-1}$) borax uptake was noticed in control.

Foliar application of calcium nitrate, borax and humic acid significantly increased the uptake of N, P and K by grain and stover of transplanted pigeonpea. The higher uptake of nitrogen, phosphorous and potassium by grain (71.52, 10.27 and 18.84 kg $ha^{-1}$ respectively) and stover (95.08, 25.26 and 81.46 kg $ha^{-1}$ respectively) was recorded in foliar spray of humic acid 6 ml $L^{-1}$ at flowering initiation and 15 days after flowering initiation along with RDF and FYM ($T_{13}$) treatment. The higher calcium uptake by grain was recorded in $T_{13}$ while, higher calcium uptake in stover was recorded in $T_9$. The foliar application of humic acid significantly enhances the presence of various antioxidants in the leaves and stimulates root initiation thus resulting in higher uptake of nitrogen, phosphorous, potassium and calcium (Schmidt and Zhang, 1998). The observations are in accordance with the findings of Lingaraju *et al*. (2016) who reported that significantly higher uptake of nitrogen, phosphorus and potassium at harvest 223.65, 35.55 and 240 kg $ha^{-1}$ respectively by soybean due to foliar application of 0.1% humic acid at flower initiation as compared to other sprays and control.

Higher uptake of boron by grain and stover was recorded in $T_{11}$ foliar spray of 0.50% borax at flowering initiation and 15 days after flowering initiation along with RDF and FYM (46.7 g $ha^{-1}$ and 230.81 g $ha^{-1}$ respectively) which was on par with $T_{13}$ (46.54 g $ha^{-1}$ and 229.53 g $ha^{-1}$ respectively). Similar findings of increased boron uptake due to foliar application of borax were reported by Bhattacharyya *et al*. (2015) [4] in sunflower, Padbhushan and Kumar (2015) [13] in greengram.

**Table 1:** Effect of foliar application of calcium nitrate, borax and humic acid on N, P and K content in transplanted pigeonpea grain and stover

| Treatments | | N (%) | | Protien (%) | P (%) | | K (%) | | Ca (%) | | B (mg $kg^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Grain | stover | | grain | stover | grain | stover | grain | stover | grain | stover |
| $T_1$ | Control (No spray) | 3.02 | 0.97 | 18.89 | 0.38 | 0.22 | 0.63 | 0.80 | 0.21 | 0.80 | 17.23 | 24.93 |
| $T_2$ | FS of 1.0% $Ca(NO_3)_2$ at FI | 3.13 | 1.09 | 19.58 | 0.42 | 0.25 | 0.67 | 0.85 | 0.31 | 0.91 | 19.33 | 26.60 |
| $T_3$ | FS of 2.0% $Ca(NO_3)_2$ at FI | 3.22 | 1.18 | 20.14 | 0.43 | 0.27 | 0.71 | 0.89 | 0.31 | 0.96 | 20.77 | 28.17 |
| $T_4$ | FS of 0.25% borax at FI | 3.12 | 1.02 | 19.47 | 0.40 | 0.24 | 0.73 | 0.92 | 0.24 | 0.86 | 20.87 | 28.53 |
| $T_5$ | FS of 0.50% borax at FI | 3.17 | 1.12 | 19.79 | 0.42 | 0.25 | 0.75 | 0.96 | 0.28 | 0.91 | 21.63 | 29.77 |
| $T_6$ | FS of HA 4 ml $L^{-1}$ at FI | 3.13 | 1.03 | 19.56 | 0.42 | 0.26 | 0.75 | 0.95 | 0.24 | 0.85 | 20.63 | 27.40 |
| $T_7$ | FS of HA 6 ml $L^{-1}$ at FI | 3.21 | 1.18 | 20.08 | 0.44 | 0.28 | 0.80 | 1.02 | 0.26 | 0.90 | 21.00 | 28.83 |
| $T_8$ | FS of 1.0% $Ca(NO_3)_2$ at FI and 15 days after FI | 3.33 | 1.23 | 20.83 | 0.45 | 0.27 | 0.76 | 0.97 | 0.35 | 1.16 | 21.50 | 29.00 |
| $T_9$ | FS of 2.0% $Ca(NO_3)_2$ at FI and 15 days after FI | 3.41 | 1.27 | 21.33 | 0.47 | 0.32 | 0.80 | 1.01 | 0.37 | 1.20 | 22.03 | 30.07 |
| $T_{10}$ | FS of 0.25% borax at FI and 15 days after FI | 3.21 | 1.14 | 20.08 | 0.430 | 0.267 | 0.79 | 0.98 | 0.34 | 1.02 | 22.07 | 30.40 |
| $T_{11}$ | FS of 0.50% borax at FI and 15 days after FI | 3.29 | 1.19 | 20.58 | 0.457 | 0.290 | 0.83 | 1.05 | 0.35 | 1.11 | 23.87 | 32.27 |
| $T_{12}$ | FS of HA 4 ml $L^{-1}$ at FI and 15 days after FI | 3.32 | 1.22 | 20.72 | 0.459 | 0.303 | 0.81 | 1.03 | 0.32 | 0.99 | 21.17 | 29.00 |
| $T_{13}$ | FS of HA 6 ml $L^{-1}$ at FI and 15 days after FI | 3.42 | 1.28 | 21.35 | 0.491 | 0.340 | 0.90 | 1.10 | 0.34 | 1.07 | 22.23 | 30.90 |
| S.Em ± | | 0.02 | 0.01 | 0.169 | 0.005 | 0.004 | 0.01 | 0.013 | 0.004 | 0.012 | 0.28 | 0.48 |
| CD @ 5% | | 0.07 | 0.033 | 0.493 | 0.013 | 0.01 | 0.032 | 0.039 | 0.013 | 0.031 | 0.82 | 1.41 |

FS : Foliar spray FI : Flower initiation HA : Humic acid

**Table 2:** Effect of foliar application of calcium nitrate, borax and humic acid on uptake of N, P, K, calcium and boron by transplanted pigeonpea grain and stover

| Treatments | | N (kg $ha^{-1}$) | | P (kg $ha^{-1}$) | | K (kg $ha^{-1}$) | | Ca (kg $ha^{-1}$) | | B (g $ha^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Grain | Stover | Grain | Stover | Grain | Stover | Grain | Stover | Grain | Stover |
| $T_1$ | Control (No spray) | 46.62 | 62.11 | 5.80 | 14.04 | 9.71 | 50.84 | 3.17 | 51.05 | 26.56 | 159.10 |
| $T_2$ | FS of 1.0% $Ca(NO_3)_2$ at FI | 52.33 | 73.34 | 7.01 | 16.87 | 11.13 | 57.59 | 5.07 | 61.42 | 32.29 | 179.53 |
| $T_3$ | FS of 2.0% $Ca(NO_3)_2$ at FI | 54.90 | 81.97 | 7.41 | 19.04 | 12.15 | 62.24 | 5.39 | 66.65 | 35.37 | 196.23 |
| $T_4$ | FS of 0.25% borax at FI | 52.15 | 68.19 | 6.69 | 15.77 | 12.16 | 61.08 | 4.13 | 57.30 | 34.92 | 190.13 |
| $T_5$ | FS of 0.50% borax at FI | 53.83 | 76.40 | 7.08 | 16.99 | 12.81 | 65.72 | 4.82 | 61.85 | 36.78 | 203.06 |
| $T_6$ | FS of HA 4 ml $L^{-1}$ at FI | 53.00 | 69.29 | 7.11 | 17.21 | 12.70 | 63.70 | 4.12 | 57.22 | 34.94 | 183.73 |
| $T_7$ | FS of HA 6 ml $L^{-1}$ at FI | 55.91 | 81.42 | 7.66 | 19.09 | 13.92 | 70.61 | 4.58 | 62.33 | 36.54 | 198.95 |
| $T_8$ | FS of 1.0% $Ca(NO_3)_2$ at FI and 15 days after FI | 58.89 | 86.92 | 8.01 | 19.43 | 13.43 | 68.55 | 6.30 | 81.74 | 37.98 | 204.93 |
| $T_9$ | FS of 2.0% $Ca(NO_3)_2$ at FI and 15 days after FI | 62.35 | 93.35 | 8.65 | 23.77 | 14.61 | 73.99 | 6.82 | 88.20 | 40.25 | 220.99 |
| $T_{10}$ | FS of 0.25% borax at FI and 15 days after FI | 55.16 | 78.70 | 7.38 | 18.36 | 13.62 | 67.69 | 5.84 | 69.98 | 37.88 | 209.25 |
| $T_{11}$ | FS of 0.50% borax at FI and 15 days after FI | 64.44 | 85.12 | 8.94 | 20.74 | 16.24 | 75.35 | 6.85 | 79.40 | 46.70 | 230.81 |
| $T_{12}$ | FS of HA 4 ml $L^{-1}$ at FI and 15 days after FI | 59.70 | 86.70 | 8.27 | 21.62 | 14.52 | 73.16 | 5.76 | 70.31 | 38.10 | 206.65 |
| $T_{13}$ | FS of HA 6 ml $L^{-1}$ at FI and 15 days after FI | 71.52 | 95.08 | 10.27 | 25.26 | 18.84 | 81.46 | 7.29 | 79.48 | 46.54 | 229.53 |
| S.Em ± | | 1.5 | 1.79 | 0.22 | 0.39 | 0.54 | 1.48 | 0.13 | 1.86 | 0.77 | 4.44 |
| CD @ 5% | | 4.37 | 5.27 | 0.63 | 1.15 | 1.57 | 4.32 | 0.4 | 5.45 | 2.25 | 12.96 |

FS : Foliar spray FI : Flower initiation HA : Humic acid

## Conclusion

Based on the results obtained by the field experiment, it can be concluded that two sprays of humic acid 6 ml $L^{-1}$ at flower initiation and 15 days after flower initiation increases the nutrient content of transplanted pigeonpea.

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