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# Response of pigeonpea to boron nutrition

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## Abstract
Pigeonpea *(Cajanus cajan* L. Millspaugh) is an important pulse crop and a principal source of protein in the Indian of vegetarians diet. Studies on the mineral nutrition of pigeonpea especially micronutrients like boron are limited. The present study was undertaken to study the response to boron nutrition through soil application and foliar spray on growth and yield of pigeonpea. Two years pooled data revealed that, boron exerted positive and significant influence on the seed yield and yield attributes of pigeonpea. Soil application of granulated boron @2.5kg $ha^{-1}$ followed by (fb) foliar application of soluble boron @0.1 % at flowering and pod filling stage resulted in significantly higher seed yield (1501kg $ha^{-1}$) compared to RPP (1138kg $ha^{-1}$). However, it was on par with soil application of granulated boron @2.5kg $ha^{-1}$ along with foliar application of soluble boron @0.1 % at pod filling (1480kg $ha^{-1}$) or at flowering stage (1418kg $ha^{-1}$) and alone soil application of granulated boron @2.5kg/ha (1407kg $ha^{-1}$). Similar trend was also noticed for net returns and BC ratio. There was no marked change in soil nutrient status after harvest of pigeonpea compared to initial values. It is inferred that application of boron along with major nutrients is essential for sustainable yield of pigeonpea, as rainfed soils are highly vulnerable to nutrient deficiencies.

**Keywords:** Pigeonpea, boron, rainfed pigeonpea

## Introduction
Pigeonpea is one of the important pulse crops, which is so remunerative that it is being grown liberally by farmers in the prescribed agro climatic zones. It is one of the protein rich legumes of the semi-arid tropics grown predominantly under rainfed conditions. It is grown throughout the tropical and sub-tropical regions of the world. In India, 91 per cent of the world's pigeonpea is produced. It is grown in almost all the states and larger portion of the area is in Maharashtra, Uttar Pradesh, Madhya Pradesh, Andhra Pradesh, Tamil Nadu, Karnataka and Gujarat. Andhra Pradesh and Tamil Nadu together occupy 87.89 per cent of area and contribute 86.10 per cent to the total production. Soil application and foliar spray of micronutrients are the most important factors in determining the yield (Malla Reddy *et al.*, 2010) [4]. In almost all the pulses, flower drop determines the yield and yield attributing parameters. Retention of flowers produced by the plant gives potential yield more than expected. Retention of flowers is possible through foliar application of growth regulators as well as micronutrients during flower initiation and pod development stages along with soil application of micronutrients (Chaurasia *et al.*, 2005) [3]. Mineral nutrient deficiencies limit nitrogen fixation by the legume-*Rhizobium* symbiosis, resulting in lower legume yields. Nutrient limitations to legume production result from deficiencies of not only major nutrients but also micronutrients such as zinc (Zn), boron (B) and iron (Fe) (Bhuiyan *et al.*, 1999) [2]. Inadequate nodulation of pigeonpea can be associated with low plant available B. Increase in flower numbers, pod set improvement, and reduction in days to flowering are influenced by B. Boron plays a critical role in reducing the flower and pod drop presumably by preventing abscission layer formation. Increased pod number in response to boron application was also reported in soybean (Schon and Blevins, 1990) [7] and in *Phaseolus vulgaris* (Weaver *et al.*, 1985) [11]. Application of recommended dose of fertilizers (RDF), secondary and micronutrients to pigeonpea is essential for higher yield under rainfed conditions. Little information is available on the response of pigeonpea to boron under rainfed conditions in Vertisols. With these points in view, the investigation was carried out to find out the response of pigeonpea to boron nutrition in Vertisols under rainfed conditions.

## Material and Methods
A field experiment was conducted under rainfed conditions during *kharif*, 2014-2015 and 2015-2016 at the Krishi Vigyan Kendra, Vijayapura, it is situated on 16°83' North latitude, 77°71' East longitude and at an elevation of 592 meters above mean sea level and is located in

Northern Dry Zone of Karnataka. The experiment was laid out in randomized complete block design with three replications which comprised of twelve treatments *viz.*, T1-RPP (FYM 6 t +25:50:0kg NPK+ Zn 15kg+ S 20kg ha$^{-1}$) T2: RPP + soil application of granulated Boron @2.5kg ha$^{-1}$, T3: RPP + soil application of granulated Boron @5kg ha$^{-1}$ T4: T1 plus 0.1 % foliar application (FA) of soluble boron at flowering stage T5: T1 plus 0.1% FA of soluble boron at pod filling stage T6: T1 plus 0.1% FA of soluble boron at flowering and pod filling stages T7: T2 plus 0.1 % FA of soluble boron at flowering stage T8: T2 plus 0.1% FA of soluble boron at pod filling stage T9: T2 plus 0.1% FA of soluble boron at flowering and pod filling stages T10: T3 plus 0.1 % FA of soluble boron at flowering stage T11: T3 plus 0.1 % FA of soluble boron at pod filling stage T12: T3 plus 0.1 % FA of soluble boron at flowering and pod filling stages. The variety TS 3R was used, which is a short duration, red and bold seeded variety, matures in 145 to 150 days. It is resistant to both wilt and sterility mosaic. It is high yielding and has wide adaptability. It was released by the University of Agricultural Sciences, Raichur for general cultivation in the central and southern zone of India for *kharif* season. The soil of the experimental site was medium black with sandy loam texture with 223.7, 12.5, 333.0kg NPK ha$^{-1}$ and sulphur (S) 8.2 mgkg$^{-1}$ with pH 8.01 (Table 1). The micronutrient contents were 0.26 mgkg$^{-1}$ B, and 0.27 mgkg$^{-1}$ Zn. Full dose of N and $P_2O_5$ (25:50:0kg N and P$_2$O5 ha$^{-1}$) were applied as basal dose at the time of sowing in the form of Urea and DAP and FYM @6 tonnes ha$^{-1}$ was applied two weeks prior to sowing for proper decomposition. Soil application of macro nutrients and micronutrients cured with vermicompost were applied as per treatments and foliar sprays were carried out taken at flowering and pod development stages, respectively. Soil applied granulated boron contains 15 % and foliar applied soluble boron contains 10 % boron. Post-harvest soil samples were drawn and analyzed for available N by alkaline permanganate method (Subbiah and Asija, 1956) [8], available phosphorus (P) by Olsen's method (Watanable and Olsen, 1965) [10] and available potassium (K) by neutral normal ammonium acetate method (Muhr *et al.*, 1965) [5]. Available B was analysed by hot water soluble B method (Berger and Truog, 1939) [1]. The crop was sown at inter row spacing of 0.9 m and intra row spacing of 0.2 m and was not subjected to moisture stress at critical stages, as rainfall was well distributed during the crop growth period. The average maximum temperature ranged from 28.4 °C to 38.4 °C and minimum temperature ranged from 17.7 °C to 27.1 °C.

## Results and Discussion

Boron recorded positive and significant influence on the seed yield and yield attributes of pigeonpea (Table 2).Soil application of granulated boron @2.5kg ha$^{-1}$fb foliar application of soluble boron @0.1% at flowering and at pod filling stages resulted in significantly higher seed yield (1501kg ha$^{-1}$) compared to RPP (1138kg ha$^{-1}$). However, it was on par with soil application of granulated boron @2.5kg ha$^{-1}$along with foliar application of soluble boron @0.1% at pod filling (1480kg ha$^{-1}$) or at flowering stages (1418kg ha$^{-1}$) and alone soil application of granulated boron @2.5kg/ha (1407kg ha$^{-1}$). Similar trend was observed for pods plant$^{-1}$ and seed yield plant$^{-1}$ (g) (Table 2).The per cent increases in seed yield due to soil application along with foliar application of boron over RPP range between 19 and 30 %. Yield increase in these treatments might be due to the inhibition in flower and pod abscission, improvement in morpho-physiological characters (stem girth, early vigor and crop establishment) and enhanced dry matter production and its partitioning in addition to higher pod number per plant. The plant height and 100 seed weight were not influenced significantly by micronutrients applied along with RPP either through soil or foliar application. Similar results have been observed by Velayutham *et al.* (2003) [9] in black gram (*Vigna mungo*) under rainfed conditions. Role of Boron in hormone synthesis and translocation, carbohydrate metabolism and DNA synthesis probably contributed to additional growth and yield (Ratna Kalyani *et al*., 1993) [6]. The non-significant increase in yield of pigeonpea due to higher level of B may be attributed to the increased accumulation of B in the root medium with its addition to soil beyond tolerance limit to the pigeonpea crop. Similar observations were also reported in lentil crop by Malla Reddy *et al.* (2010) [4]. Soil application of granulated boron @2.5kg ha$^{-1}$ fb foliar application of soluble boron @0.1 % at flowering and at pod filling recorded significantly higher net returns (Rs. 51,920 ha$^{-1}$) and it was on par with soil application of granulated boron @2.5kg ha$^{-1}$ along with foliar application of soluble boron @0.1% at pod filling (Rs.50,728 ha$^{-1}$), flowering (Rs.48,705 ha$^{-1}$) and alone soil application of granulated boron @2.5kg ha$^{-1}$ (Rs.47,923 ha$^{-1}$). Similar trend was also noticed with BC ratio. There was no marked change in soil nutrient status after harvest of pigeonpea compared to initial values (Table 3).


## Summary

It is inferred that regular application of micronutrients along with major nutrients is essential for sustainable yield in pigeonpea, as rainfed soils are highly vulnerable to nutrient deficiencies. Application of micronutrients like B along with N, $P_2O_5$, $K_2O$, S and Zn to soil before sowing enhances the productivity of pigeonpea in Vertisols.


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