

Original Research Article

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Effect of Graded Doses of Sulphur and Boron on Yield Attributes and Nutrient Uptake by Chickpea

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ABSTRACT

Keywords

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A factorial experiment in randomized complete block design involving three Sulphur levels i.e. 0, 20 and 40 kg S ha⁻¹ and three levels of Boron viz. 0, 0.5 and 1 kg B ha⁻¹ with nine treatment combinations with four replications was carried out during rabi season, 2012-13 to evaluate the effect of graded doses of Sulphur and Boron on yield attributes and nutrient uptake by chickpea. Results revealed that increasing S levels up to 40 kg ha⁻¹ significantly increased yield attributes and seed yield of chickpea. Seed, stover and total uptake of N, P, K, S and B increased significantly up to 40 kg S ha⁻¹. Yield attributes increased with graded doses of B but seed yield increased significantly with increasing doses of Boron. Maximum N, P, K, S and B uptake by seed and stover and their total uptake was observed with application of 1.0 kg B ha⁻¹ which was significantly higher than its lower doses.

Introduction

Pulse production in India is about 19.27 million tonnes with area under cultivation of around 25.23 million hectare and an average productivity of nearly 0.76 tonnes ha⁻¹ (Anonymous, 2014). Pulse productivity of India is very much lesser than the other producing countries. In India, 48% of total pulse production is contributed by chickpea, signifying its importance in Indian agricultural production. Optimization of

macro- and micro- nutrient application will enhance the productivity of chickpea. Sulphur is considered as the fourth major nutrient after N, P and K. It is basically required for synthesis of proteins, especially S-containing amino acid i.e. methionine, cystine and cysteine and as a constituent of vitamins (thiamine and biotin) and other biologically active compounds like lipoic acid, acetyl coenzyme-A, ferredoxin and glutathione.

Moreover, sulphur deficiency adversely affects the chlorophyll synthesis. Beneficial effect of sulphur attributed to increase the number of nodules/plant resulting from improved root growth (Lange *et al.*, 1994). Boron (B) plays important role in cell-wall synthesis, sugar transport, cell division, differentiation, membrane functioning, root elongation, regulation of plant hormone level and generative growth in plants. Deficiency and toxicity of sulphur and boron may lead to affect the performance of chickpea. Taking this in view, the present investigation was undertaken to examine the appropriate doses of application for sulphur and boron in chickpea under central plains of Uttar Pradesh, India.

Materials and Methods

A field experiment was conducted during rabi season of 2012-13 at pot culture house of the Department of Soil Science and Agricultural Chemistry, C. S. Azad University of Agriculture and Technology, Kanpur with the coordinates 26.46° North and 80.35° East at the elevation of 125.9 meters above the mean sea level with mean annual rainfall of about 816.0 mm. Initial physio-chemical characteristics and fertility status of experimental field was observed by the soil samples collected randomly from the each micro plot to the depth of 0-15 cm with the help of soil auger prior to crop cultivation. Soil samples collected were analyzed for mechanical and chemical analysis, treatment wise. Soil pH (1:2.5) of experimental site was found to be vary from 8.10 to 8.25 while EC- 0.26 to 0.30 dS m⁻¹, organic carbon- 0.36 to 0.38%, available nitrogen (kg ha⁻¹)- 178 to 180, available phosphorus (kg ha⁻¹)- 10.32 to 10.90, available potassium (kg ha⁻¹)- 160 to 165, available sulphur (mg kg⁻¹)- 6.50 to 6.70 and available boron (mg kg⁻¹)- 0.450 to 0.480. Soil samples analyzed was found to be of loamy texture. Three levels of sulphur (0, 20

and 40 kg S ha⁻¹) and three levels of Boron (0, 0.5 and 1 kg B ha⁻¹) with a total of nine treatment combinations viz. T1- (S0B0) 0 kg S ha⁻¹ + 0 kg B ha⁻¹, T2- (S1B0) 20 kg S ha⁻¹ + 0 kg B ha⁻¹, T3- (S2B0) 40 kg S ha⁻¹ + 0 kg B ha⁻¹, T4- (S0B1) 0 kg S ha⁻¹ + 0.5 kg B ha⁻¹, T5-(S1B1) 20 kg S ha⁻¹ + 0.5 kg B ha⁻¹, T6-(S2B1) 40 kg S ha⁻¹ + 0.5 kg B ha⁻¹, T7-(S0B2) 0 kg S ha⁻¹ + 1.0 kg B ha⁻¹, T8-(S1B2) 20 kg S ha⁻¹ + 1.0 kg B ha⁻¹ and T9 – (S2B2) 40 kg S ha⁻¹ + 1.0 kg B ha⁻¹ were laid out in factorial experiment in randomized complete block design with four replications. Chickpea variety Udai (K-75) was taken as the test crop. The size of each micro plots were 0.374 m² in the glasshouse. Nitrogen, phosphorus and potash were applied as basal dressing in all plots @ 20, 50 and 20 kg ha⁻¹, respectively. The sources of fertilizers used were DAP for nitrogen and phosphorous and muriate of potash for potassium, which were applied as basal. Besides these, application of sulphur and boron was also done basally as per the treatments through elemental sulphur and borax, respectively. Total numbers of pods were collected from the sample plant and their pods were weighed for pod weight plant⁻¹. After drying and cleaning, a composite sample of seeds were drawn for different treatments and one hundred (100) seeds were counted from each sample and weighed to get the 100 seed weight in gram and seed yield was recorded by standard procedure. Seed and stover samples were analysed for N content by Kjeldahl's method as described by Piper (1966). Phosphorus by colourimetric method as described by Jackson (1967), Potassium by flame photometer as described by Jackson (1967), Sulphur by turbidimetric method as described by Chesnin and Yien (1950) and Boron by Jackson (1965). Nutrient content (%) in seed and stover was multiplied with respective seed and stover yield to obtain uptake by seed and stover, respectively. Total nutrient uptake was calculated by adding uptake by seed and

stover. The data were statistically analyzed by standard method (Chandel, 1975).

Results and Discussion

Yield attributes and seed yield

Yield attributes viz., pod weight plant⁻¹, weight of 100 seeds and seed yield of chick pea was influenced significantly by different graded doses of Sulphur and Boron (Table 1). With the increments in the doses of sulphur, the value yield attributes and seed yield increased significantly up to the highest level of 40 Kg S ha⁻¹. Similar results about sulphur were also reported by Scherer and Lange (1996), Shivakumar (2001), Kumar *et al.*,

(2003), Vishram Ram *et al.*, (2007), Nawange *et al.*, (2011) and Islam (2012).

As regards to boron levels, highest 100 grain weight and pod weight/plant was observed with application of 1.0 kg B ha⁻¹ which was significantly higher than control treatment. However, seed yield increased significantly with successive increase in B levels. This is attributed to lesser flower drop and enhanced pollen growth under higher levels of Boron. Beneficial effect of Boron on flower drop and seed yield was noticed by Guhey *et al.*, (2008) and losses in seed yield under Boron deficiency was observed by Ceyhan *et al.*, (2007) in chickpea.

Table.1 Effect of graded doses of Sulphur and Boron on yield Attributes and seed yield of chickpea

| Treatments | 100 grain weight (g) | Pod weight plant ⁻¹ | Seed yield (kg/ha) |
|-------------------------|----------------------|--------------------------------|--------------------|
| S levels (kg/ha) | | | |
| 0 | 20.25 | 16.79 | 1403.00 |
| 20 | 21.69 | 18.95 | 1571.33 |
| 40 | 23.08 | 20.98 | 1760.00 |
| SEd | 0.32 | 0.37 | 36.35 |
| CD (<i>P</i> =0.05) | 0.66 | 0.77 | 75.05 |
| B levels (kg/ha) | | | |
| 0 | 21.18 | 17.99 | 1490.66 |
| 0.5 | 21.73 | 19.02 | 1583.33 |
| 1.0 | 22.18 | 19.69 | 1660.33 |
| SEd | 0.32 | 0.37 | 36.35 |
| CD (<i>P</i> =0.05) | 0.66 | 0.77 | 75.05 |
| Interaction | NS | NS | NS |

Table.2 Effect of graded doses of Sulphur and Boron on N, P, K, S and B uptake by seed and stover and their total uptake by chickpea

| Treatments | N uptake (kg ha ⁻¹) | | | P uptake (kg ha ⁻¹) | | | K uptake (kg ha ⁻¹) | | | S uptake (kg ha ⁻¹) | | | B uptake (kg ha ⁻¹) | | |
|-------------------------|---------------------------------|--------|--------|---------------------------------|--------|-------|---------------------------------|--------|-------|---------------------------------|--------|-------|---------------------------------|--------|--------|
| | Seed | Stover | Total | Seed | Stover | Total | Seed | Stover | Total | Seed | Stover | Total | Seed | Stover | Total |
| S levels (kg/ha) | | | | | | | | | | | | | | | |
| 0 | 44.21 | 31.41 | 75.62 | 17.48 | 6.91 | 24.38 | 7.367 | 25.77 | 33.14 | 9.69 | 3.28 | 12.97 | 72.52 | 60.76 | 133.29 |
| 20 | 50.13 | 38.68 | 88.81 | 21.55 | 9.16 | 30.71 | 9.76 | 31.54 | 41.29 | 11.32 | 4.27 | 15.58 | 87.33 | 73.31 | 160.65 |
| 40 | 56.68 | 47.18 | 103.86 | 26.36 | 10.74 | 37.09 | 12.69 | 35.79 | 48.48 | 13.21 | 5.28 | 18.52 | 101.89 | 86.81 | 188.45 |
| SEd | 0.93 | 0.81 | 1.95 | 0.48 | 0.31 | 0.61 | 0.28 | 0.67 | 0.99 | 0.35 | 0.16 | 0.36 | 0.94 | 0.79 | 2.62 |
| CD (<i>P</i> =0.05) | 1.92 | 1.66 | 4.03 | 0.99 | 0.63 | 1.26 | 0.57 | 1.39 | 2.04 | 0.72 | 0.33 | 0.75 | 1.94 | 1.62 | 5.42 |
| B levels (kg/ha) | | | | | | | | | | | | | | | |
| 0 | 47.35 | 35.67 | 83.02 | 19.85 | 8.18 | 28.03 | 8.82 | 28.74 | 37.56 | 10.62 | 3.88 | 14.50 | 80.61 | 67.51 | 148.12 |
| 0.5 | 50.49 | 39.13 | 89.62 | 21.89 | 8.94 | 30.83 | 9.98 | 31.02 | 41.01 | 11.43 | 4.28 | 15.74 | 87.90 | 73.93 | 161.59 |
| 1.0 | 53.17 | 42.48 | 95.65 | 23.65 | 9.68 | 33.33 | 11.01 | 33.34 | 44.35 | 12.16 | 4.67 | 16.83 | 93.32 | 79.44 | 172.68 |
| SEd | 0.93 | 0.81 | 1.95 | 0.48 | 0.31 | 0.61 | 0.28 | 0.67 | 0.99 | 0.35 | 0.16 | 0.36 | 0.94 | 0.79 | 2.62 |
| CD (<i>P</i> =0.05) | 1.92 | 1.66 | 4.03 | 0.99 | 0.63 | 1.26 | 0.57 | 1.39 | 2.04 | 0.72 | 0.33 | 0.75 | 1.94 | 1.62 | 5.42 |
| Interaction | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |

Nutrient uptake

N, P, K, S and B uptake by seed and stover and their total uptake by chickpea is presented in table 2 shows that the graded doses of Sulphur and Boron caused significant variation in nutrient uptake. Uptake by seed and stover and total nutrient uptake increased with higher doses of nutrient applied. Nutrient uptake viz. N, P, K, S, B by seed and stover and their total uptake increased significantly up to the level of 40 kg S ha⁻¹. Kumar *et al.*, (2003) and Chiaiese *et al.*, (2004) reported about the increment sulphur content in grain and stover of chickpea with the application of sulphur. Application of sulphur results in increased N fixation (Lange *et al.*, 1994; Scherer and Lange, 1996; Zhao *et al.*, 1999) which might have promoted production of higher amounts of above ground dry matter that could have led to higher acquisition of nutrients ultimately resulted in higher nutrient content in grain and stover. Higher nutrient content coupled with higher seed and stover yield led to higher nutrient uptake.

Boron application up to the level 1.0 kg ha⁻¹ was found to increase nutrient uptake by seed and stover and their total uptake in chickpea over control. The highest dose of boron applied in the experiment was found to increase the nutrient uptake by seed and stover and their total uptake significantly. Guhey *et al.*, (2008) reported positive effect of Boron on chlorophyll content which may be responsible for the increase in the nutrient content and uptake by plant with the higher growth characters. Yakubu *et al.*, (2010) also reported about the beneficial effect of boron in nitrogen uptake in legumes. So, increased chlorophyll content could have resulted in higher photosynthates and biomass production which would have been efficiently distributed to the roots for its development and for supplying energy for nutrient uptake.

S and B fertilization have a pivotal role in enhancing yield attributing characters and nutrient uptake performance in chickpea. Application of 40 kg ha⁻¹ of S and 1.0 kg B ha⁻¹ proved to increase yield attributes and nutrient uptake by chickpea under central plains of Uttar Pradesh, India.

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